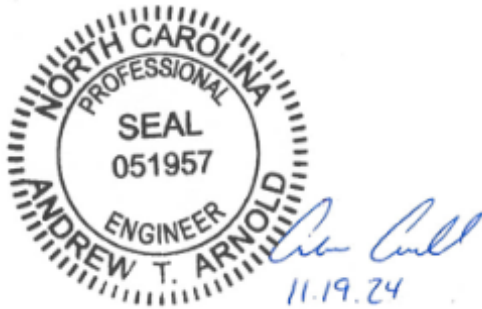


CONTRACT SPECIFICATIONS

CITY OF EDEN, NC

North Aeration Basin Replacement (NCDEQ Project No. SRP-W-ARP-0244 / SRP-W-0017 / EDA Award No. 04-01-07832)

NOVEMBER 2024



SUBMITTED BY
Dewberry Engineers Inc.
551 Piney Forest Road
Danville, VA 24540
434.797.4497

SUBMITTED TO
City of Eden
308 E. Stadium Drive
Eden, NC 27289

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**City of Eden
Rockingham County, North Carolina**

ADVERTISEMENT FOR BIDS

Sealed Bids for the **Eden WWTP North Aeration Basin Replacement** project will be received by the City of Eden, at the office of the Administrative Assistant of the City Manager, 308 E. Stadium Drive, Eden, NC 27288 (physical), or PO Box 70, Eden, NC 27289 (mailing) until **11:00 am** local time on **December 17, 2024**, at which time the Bids received will be publicly opened and read aloud. North Carolina Department of Environmental Quality Division of Water Infrastructure is funding this project through American Rescue Plan Act from the State Fiscal Recovery Fund (Project No. SRP-W-ARP-0244) and the Clean Water Revolving Loan Fund (SRP-W-0017). This project will also be partially funded with Federal funds from the United States Department of Commerce, Economic Development Administration (EDA Award # 04-01-07832) and therefore is subject to the Federal laws and regulations associated with that program. Work consists of the following:

1. Demolition of existing in ground concrete basin structure.
2. Construction of concrete reactor tanks in the North Aeration Basin
3. Dewatering
4. New pre-engineered metal blower building
5. Installation of High-Speed Turbo Blowers.
6. Installation of fine bubble membrane diffusers.
7. Installation of large bubble mixing system.
8. Integration of new equipment into existing SCADA.
9. Construction of a mixing chamber to receive influent, RAS, and filter backwash with baffling
10. Installation of 48" pipe from the headworks to the mixing chamber
11. Construction of a new splitter box
12. Installation of 42" pipe from the mixing chamber to the new splitter box
13. Site grading and access road improvements

All work on this project is subject to American Iron and Steel (AIS), Davis-Bacon Act and MBE/WBE requirements.

A pre-bid meeting will be held at 11:00 AM local time on December 4, 2024, at 308 E. Stadium Drive, Eden, NC 27288. Attendance at the pre-bid meeting is encouraged but not mandatory. A Pre-Bid site visit is not mandatory but may be arranged by contacting Melinda Ward, Utility Manager (336) 623-9921 at the Wastewater Treatment Plant. Direct Inquiries to: Drew Arnold, Dewberry, aarnold@dewberry.com; (434) 549-8499. Copies of the Contract Documents may be obtained at Dewberry, 551 Piney Forest Road, Danville, VA 24540.

Each Bid must be accompanied by a BID BOND payable to the Owner for five (5) percent of the total bid amount. A CERTIFIED CHECK in the amount of not less than five (5) percent of the bid amount may be submitted in lieu of a BID BOND. A PERFORMANCE BOND and PAYMENT BOND, each in the amount of one hundred (100) percent of the Contract Price, with a corporate surety approved by the OWNER, will be required for the faithful performance of the contract.

The OWNER reserves the right to waive irregularities and informalities in bids received and to reject any and all bids and to award the contract where it appears to be in the best interest of the Owner. The Owner also reserves the right to break apart the overall bid price of the project into two separate agreements due to project funding sources requiring separation.

Bidders must be a properly licensed Contractor in the State of North Carolina. Contractor's NC license number must be on the outside of the bid package in order to be considered a Responsive Bid.

Bid Documents may be downloaded electronically at the following website. Please notify the Engineer of intent to bid the project to be placed on the plan holders list.

<https://www.edennc.us/518/Construction-Projects>

The BID DOCUMENTS may be examined at the following locations:

Dewberry	Dodge Data and Analytics
551 Piney Forest Road, Danville, VA 24540	Online Plan Room

City of Eden, City Hall
308 E. Stadium Drive, Eden, NC 27288

+ + END OF ADVERTISEMENT FOR BIDS + +

INSTRUCTIONS TO BIDDERS

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ARTICLE 1 – DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office* – The office from which the Bidding Documents are to be issued.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and format stated in the advertisement or invitation to bid.

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

3.01 This project will be partially funded with Federal funds from the United States Department of Commerce, Economic Development Administration and therefore is subject to the Federal laws and regulations associated with that program.

3.02 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with this bid (a) written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and (b) the following additional information:

- A. Bidders Qualification Statement.
- B. Evidence of Bidder's authority to do business in the state where the Project is located.
- C. Bidder's state of other contractor license number, if applicable.
- D. Bidder's compliance statement.

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

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

3.05 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

4.01 *Site and Other Areas*

- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or

storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

4.02 *Existing Site Conditions*

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify:
 - a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
 - b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
 - c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

B. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 *Site Visit and Testing by Bidders*

- A. Bidder shall conduct the required Site visit during normal working hours, and shall not disturb any ongoing operations at the Site.
- B. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- C. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations,

investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.

- D. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- E. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.05 *Other Work at the Site*

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

ARTICLE 5 – BIDDER'S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;
- B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;
- D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;
- E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such

information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs;

- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
- J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

6.01 A pre-Bid conference will be held at the time and location stated in the invitation or advertisement to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

ARTICLE 8 – BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of five (5) percent of Bidder's Bid price and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.

8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the

required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.

- 8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be substantially completed and ready for final payment are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

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

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

- 11.01 The Contract for the Work, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those "or-equal" or substitute or materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an "or-equal" or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids in case of proposed substitute and five (5) days prior in the case of proposal "or-equal". Each such request shall comply with the requirements of Paragraphs 7.04 and 7.05 of the General Conditions. The burden of proof of the merit of the proposed item is upon Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner. Substitutes and "or-equal" materials and equipment may be proposed by Contractor in accordance with Paragraphs 7.04 and 7.05 of the General Conditions after the effective date of the Contract.
- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.
- 11.03 **If an award is made, Contractor shall be allowed to submit proposed substitutes and "or-equals", in accordance with the General Conditions.**

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- ~~12.01 A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.~~
- ~~12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.~~
- 12.03 **If required by the bid documents**, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work:
- A. **Systems Integrator**
 - B. **Electrical Contractor**
 - C. **Cast-in-Place Subcontractor or Pre-Cast Concrete Tank Manufacturer**
- If requested by Owner, such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, or other individual or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.
- 12.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.06 of the General Conditions.
- 12.05 **Contractor shall not be required to employ any subcontractor, supplier, individual, or entity against whom Contractor has reasonable objection.**
- 12.06 **The Contractor shall not award work to subcontractor(s) in excess of the limits stated in SC7.06.**

ARTICLE 13 – PREPARATION OF BID

- 13.01 This project will be partially funded with Federal funds from the United States Department of Commerce, Economic Development Administration and therefore is subject to the Federal laws and regulations associated with that program.
- 13.02 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid

price shall be indicated for each section, Bid item, alternate, unit price item, and/or lump sum listed therein.

- 13.03 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation shall be shown.
- 13.04 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.
- 13.05 A Bid by an individual shall show the Bidder's name and official address.
- 13.06 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.
- 13.07 All names shall be printed in ink below the signatures.
- 13.08 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.09 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
- 13.10 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID

14.01 Lump Sum

- A. Bidders must submit a Bid on a lump sum basis as set forth in the Bid Form. Failure to fill out all required information on the bid form is grounds for determining the bid as unresponsive.

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 7 of the Bid Form.
- 15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in a plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed to Owner at address in Article 1.01 of Bid Form.
- 15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 16.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

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

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.
- 19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.
- 19.03 Evaluation of Bids
- A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- 19.04 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

- 19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.
- 19.06 Owner reserves the right to award the project to the lowest responsive bidder in up to (2) separate construction contracts.

ARTICLE 20 – BONDS AND INSURANCE

- 20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner’s requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

ARTICLE 21 – SIGNING OF AGREEMENT

- 21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement(s) along with the other Contract Documents as identified in the Agreement(s). Within 15 days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner. Within ten days thereafter, Owner shall deliver one fully executed counterpart of the Agreement(s) to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 22 – SALES AND USE TAXES

- 22.01 Owner is exempt from North Carolina state sales and use taxes on materials and equipment to be incorporated in the Work. Said taxes shall not be included in the Bid. Refer to Paragraph SC-7.09 of the Supplementary Conditions for additional information.

ARTICLE 23 – FUNDING REQUIREMENTS

- 23.01 Federal Participation Disclosure – This project will be partially funded with Federal funds from the United States Department of Commerce, Economic Development Administration and therefore is subject to the Federal laws and regulations associated with that program.
- 23.02 Consistent with Executive Order 13858, Strengthening Buy-American Preferences for Infrastructure Projects,” as modified by Executive Order 14005, Ensuring the Future Is Made in All of America by All of America’s Workers, the Recipient is encouraged to use, to the greatest extent practicable, iron and aluminum as well as steel, cement, and other manufactured products produced in the United States in every contract, subcontract, purchase order, or sub-award that is chargeable under this Award.
- 23.03 American Iron and Steel requirements apply to this project.
- 23.04 Davis Bacon Act requirements apply to this project.

ARTICLE 24 – CONTRACTS TO BE ASSIGNED: N/A

Davis-Bacon Instructions for SRF Projects

To be included in the Contract Documents:

- The entire contents of 29 CFR 5.5
- The appropriate wage determination (usually Heavy). This determination must be the most current and have been in effect at least 10 days prior to bid opening. If a wage determination for the project location is not available, then the Statewide wage determination may be used. If it takes longer than 90 days to execute contracts and the wage determination changes, then the new wage rates must be incorporated into the contract. Wage Determinations can be found at:
https://beta.sam.gov/search?index=wd&is_active=true&date_filter_index=0&date_rad_selection=date&wdType=dba&page=1

During Construction:

- Post the Davis-Bacon Poster
<https://www.dol.gov/sites/dolgov/files/WHD/legacy/files/fedprojc.pdf>
- Post the appropriate wage rates. These should be the ones included in the specifications and any new classifications approved by the Department of Labor.
- Weekly payrolls are to be maintained onsite for all subject contractors and subcontractors. Number them for each week of the construction period including weeks that do not have payroll. Form WH 347 is suggested. Do not submit these to the State SRF office, submit them to the municipality for review. Link to Form WH 347 -
<https://www.dol.gov/sites/dolgov/files/WHD/legacy/files/wh347.pdf>
- The municipality will conduct interviews with employees when there are irregularities concerning wages being paid. Use Standard Form 1445.
- For additional wage classification approvals, complete form SF 1444 found at this link:
https://www.nps.gov/dscw/upload/sf1444-classificationrateauthorizationrequest_7-14-06.pdf
Email this form to: whd-cbaconformance_incoming@dol.gov

The entire contents of this package is:

- 1) These Instructions
- 2) 29 CFR 5.5
- 3) Davis-Bacon Poster
- 4) Payroll form WH 347

29 CFR §5.5 Contract provisions and related matters.

(a) The Agency head shall cause or require the contracting officer to insert in full in any contract in excess of \$2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a public building or public work, or building or work financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in §5.1, the following clauses (or any modifications thereof to meet the particular needs of the agency, *Provided*, That such modifications are first approved by the Department of Labor):

(1) *Minimum wages.* (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

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

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

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

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

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

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by

the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

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

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

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

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

(2) *Withholding.* The (write in name of Federal Agency or the loan or grant recipient) shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) *Payrolls and basic records.* (i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show

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

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the (write in name of appropriate federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency). The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/esa/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the (write in name of appropriate federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit them to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency), the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, sponsor, or owner).

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

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

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

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

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

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

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

(4) *Apprentices and trainees*—(i) *Apprentices*. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) *Trainees*. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In

addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

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

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

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

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

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

(9) *Disputes concerning labor standards.* Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

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

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

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

(b) *Contract Work Hours and Safety Standards Act.* The Agency Head shall cause or require the contracting officer to insert the following clauses set forth in paragraphs (b)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by §5.5(a) or §4.6 of part 4 of this title. As used in this paragraph, the terms *laborers* and *mechanics* include watchmen and guards.

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

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

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

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

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

EMPLOYEE RIGHTS UNDER THE DAVIS-BACON ACT

FOR LABORERS AND MECHANICS EMPLOYED ON FEDERAL OR FEDERALLY ASSISTED CONSTRUCTION PROJECTS

THE UNITED STATES DEPARTMENT OF LABOR WAGE AND HOUR DIVISION

PREVAILING WAGES

You must be paid not less than the wage rate listed in the Davis-Bacon Wage Decision posted with this Notice for the work you perform.

OVERTIME

You must be paid not less than one and one-half times your basic rate of pay for all hours worked over 40 in a work week. There are few exceptions.

ENFORCEMENT

Contract payments can be withheld to ensure workers receive wages and overtime pay due, and liquidated damages may apply if overtime pay requirements are not met. Davis-Bacon contract clauses allow contract termination and debarment of contractors from future federal contracts for up to three years. A contractor who falsifies certified payroll records or induces wage kickbacks may be subject to civil or criminal prosecution, fines and/or imprisonment.

APPRENTICES

Apprentice rates apply only to apprentices properly registered under approved Federal or State apprenticeship programs.

PROPER PAY

If you do not receive proper pay, or require further information on the applicable wages, contact the Contracting Officer listed below:

or contact the U.S. Department of Labor's Wage and Hour Division.



For additional information:

1-866-4-USWAGE

(1-866-487-9243) TTY: 1-877-889-5627



WWW.WAGEHOUR.DOL.GOV

U.S. Department of Labor
Wage and Hour Division

PAYROLL

(For Contractor's Optional Use; See Instructions at www.dol.gov/whd/forms/wh347instr.htm)



Rev. Dec. 2008

Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number.

OMB No.: 1235-0008
Expires: 01/31/2015

NAME OF CONTRACTOR <input type="checkbox"/> OR SUBCONTRACTOR <input type="checkbox"/>				ADDRESS					OMB No.: 1235-0008 Expires: 01/31/2015										
PAYROLL NO.		FOR WEEK ENDING			PROJECT AND LOCATION				PROJECT OR CONTRACT NO.										
(1) NAME AND INDIVIDUAL IDENTIFYING NUMBER (e.g., LAST FOUR DIGITS OF SOCIAL SECURITY NUMBER) OF WORKER	(2) NO. OF WITHHOLDING EXEMPTIONS	(3) WORK CLASSIFICATION	OT OR ST	(4) DAY AND DATE							(5) TOTAL HOURS	(6) RATE OF PAY	(7) GROSS AMOUNT EARNED	(8) DEDUCTIONS					(9) NET WAGES PAID FOR WEEK
				HOURS WORKED EACH DAY										FICA	WITH- HOLDING TAX		OTHER	TOTAL DEDUCTIONS	
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While completion of Form WH-347 is optional, it is mandatory for covered contractors and subcontractors performing work on Federally financed or assisted construction contracts to respond to the information collection contained in 29 C.F.R. §§ 3.3, 5.5(a). The Copeland Act (40 U.S.C. § 3145) contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) regulations at 29 C.F.R. § 5.5(a)(3)(ii) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

Public Burden Statement

We estimate that it will take an average of 55 minutes to complete this collection, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, U.S. Department of Labor, Room S3502, 200 Constitution Avenue, N.W. Washington, D.C. 20210

Date _____

I, _____
 (Name of Signatory Party) (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

_____ on the
 (Contractor or Subcontractor)

_____ ; that during the payroll period commencing on the
 (Building or Work)

_____ day of _____, _____, and ending the _____ day of _____, _____,
 all persons employed on said project have been paid the full weekly wages earned, that no rebates have
 been or will be made either directly or indirectly to or on behalf of said

_____ from the full
 (Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly
 from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part
 3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948,
 63 Stat. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. § 3145), and described below:

(2) That any payrolls otherwise under this contract required to be submitted for the above period are
 correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the
 applicable wage rates contained in any wage determination incorporated into the contract; that the classifications
 set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship
 program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and
 Training, United States Department of Labor, or if no such recognized agency exists in a State, are registered
 with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

– in addition to the basic hourly wage rates paid to each laborer or mechanic listed in
 the above referenced payroll, payments of fringe benefits as listed in the contract
 have been or will be made to appropriate programs for the benefit of such employees,
 except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

– Each laborer or mechanic listed in the above referenced payroll has been paid,
 as indicated on the payroll, an amount not less than the sum of the applicable
 basic hourly wage rate plus the amount of the required fringe benefits as listed
 in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS:

NAME AND TITLE	SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR
 SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE
 31 OF THE UNITED STATES CODE.

"General Decision Number: NC20230085 01/06/2023

Superseded General Decision Number: NC20220085

State: North Carolina

Construction Type: Heavy

Counties: Guilford, Randolph and Rockingham Counties in North Carolina.

HEAVY CONSTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

<p>If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:</p>	<ul style="list-style-type: none"> . Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
<p>If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:</p>	<ul style="list-style-type: none"> . Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

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

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

Modification Number Publication Date
 0 01/06/2023

SUNC2011-066 08/26/2011

	Rates	Fringes
CARPENTER, Includes Form Work....	\$ 13.98 **	0.69
ELECTRICIAN.....	\$ 15.41 **	3.13
LABORER: Common or General.....	\$ 10.00 **	0.00
LABORER: Pipelayer.....	\$ 12.87 **	2.21
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 16.16 **	3.18
OPERATOR: Bulldozer.....	\$ 14.63 **	0.00
OPERATOR: Loader.....	\$ 15.13 **	2.79
TRUCK DRIVER.....	\$ 13.12 **	1.89

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

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$16.20) or 13658 (\$12.15). Please see the Note at the top of the wage determination for more information.

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

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

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical

order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

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

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

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

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

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

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

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

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

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISIO"

"General Decision Number: NC20230019 10/06/2023

Superseded General Decision Number: NC20220019

State: North Carolina

Construction Type: Heavy Dredging

Counties: North Carolina Statewide.

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

<p>If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:</p>	<ul style="list-style-type: none"> . Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
<p>If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:</p>	<ul style="list-style-type: none"> . Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

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

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

Modification Number	Publication Date
0	01/06/2023
1	10/06/2023

* ENGI0025-002 10/01/2023

	Rates	Fringes
Dredging : (Hydraulic Dredges Over 20'")		
CLASS A1.....	\$ 45.26	15.17+a
CLASS A2.....	\$ 40.33	14.82+a
CLASS B1.....	\$ 39.14	14.74+a
CLASS B2.....	\$ 36.84	14.58+a
CLASS C1.....	\$ 35.83	14.26+a
CLASS C2.....	\$ 34.68	14.18+a
CLASS D.....	\$ 28.81	13.77+a
Hydraulic Dredges Under 20'")		
Cook.....	\$ 8.11 **	1.73+b
Deckhand.....	\$ 7.77 **	1.73+b
Engineer.....	\$ 9.59 **	1.73+b
Launchman.....	\$ 8.19 **	1.73+b
Leverman.....	\$ 10.03 **	1.73+b
Mate.....	\$ 8.82 **	1.73+b
Mess Cook.....	\$ 7.71 **	1.73+b
Messman & Janitor.....	\$ 7.53 **	1.73+b
Oiler & Fireman.....	\$ 8.11 **	1.73+b
Shoreman.....	\$ 7.82 **	1.73+b
Spider Barge Operator.....	\$ 8.68 **	1.73+b
Spill Barge Operator.....	\$ 8.68 **	1.73+b
Welder.....	\$ 9.79 **	1.73+b

CLASSIFICATIONS:

- CLASS A1: Deck Captain, Leverman, Mechanical Dredge Operator. Licensed Tug Operator over 1000 HP
- CLASS A2: Crane Operator (360 swing)
- CLASS B1: Derrick Operator (180 swing), Spider/Spill Barge Operator, Timber Fork Operator, Dozer Operator, Engineer, Blaster/Driller, Fill Placer, Electrician, Licensed Boat Operator, Licensed Crew Boat Operator.
- CLASS B2: Certified Welder.
- CLASS C1: Mate, Drag Barge Operator, Welder, Assistant Fill Placer, Steward.
- CLASS C2: Boat Operator.
- CLASS D: Shoreman, Deckhand, Rodman, Scowman, Cook, Messman, Oiler, Janitor, Drill Oiler

PREMIUMS: Additional 20% for hazardous material work

FOOTNOTE APPLICABLE TO ABOVE CRAFTS:

- a. New Year's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. Vacation Contribution of 8% of straight time rate multiplied by the total hours worked.
 - b. New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas Day. Plus Vacation contribution of 8% of straight time pay for all hours worked.
- INCENTIVE PAY : (Add to Hourly Rate)

Operator (NCCCO License/Certification) \$1.80; Licensed Tug Operator over 1000 HP (Assigned as Master) USCG licensed Master of Towing Vessels (MOTV) \$1.80; Licensed Boat Operator (assigned as lead boat captain) USCG licensed boat operator \$1.30; Engineer (QMED and Tankerman endorsement or licensed engineer (USCG) \$1.80; Oiler QMED and Tankerman endorsement (USCG) \$1.80; All classifications Tankerman endorsement only (USCG) \$1.55; Deckhand or Mater AB w/Lifeboatman only (USCG) \$1.80; Welder (ABS certification)

\$1.55

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

=====
** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$16.20) or 13658 (\$12.15). Please see the Note at the top of the wage determination for more information.

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

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

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U.S. Department of Labor
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END OF GENERAL DECISIO"

BID FORM

Eden WWTP North Aeration Basin Replacement
50159317

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ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

City of Eden, NC

204 Mebane Bridge Rd

Eden, NC 27288

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

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

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

<u>Addendum No.</u>	<u>Addendum, Date</u>

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

C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related

reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.

- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
 - 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Contract 1

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

PART A: GENERAL STRUCTURAL, ELECTRICAL, MECHANICAL, AND SITE WORK: Lump sum price to furnish and install all new products and equipment or refurbishing as per contract documents completed and ready for operation including, but not limited to, furnishing all necessary labor, machinery, apparatus, tools, materials, piping, concrete, electrical, HVAC, controls, E&S controls, excavation, dewatering, site restoration, mobilization, and other associated work to install and erect those products for the recondition or replacement at the WWTP, in accordance with the drawings and specifications. **Price in this Part is for all work *not* included in subsequent Parts B, C, and Contract B below:**

PART A BASE BID: _____ Dollars (in words) (\$ _____)

PART B: MAJOR PROCESS EQUIPMENT: For furnishing major plant equipment but *excluding* costs in Part A and C. Price indicated shall include direct purchase of equipment and exclude mark-up and any associated installation costs. The bid price will be based on furnishing equipment and materials in compliance with the Specifications. Should the Contractor fail to list a Manufacturer of equipment which complies with the specifications, the Owner reserves the right to select approved specified equipment of his choice without an increase in the Contract price. Only one approved Manufacturer may be entered on the blank for each equipment item. Failure to provide an approved Manufacturer’s name for each item may result in rejection of the bid. The applicable Section of the specifications is listed beside each equipment item.

<u>Equipment and Manufacturer</u>	<u>Bid Price</u>
1. High Speed Turbo Blowers and Controls (Section 431100) Manufacturer: _____	\$ _____
<i>Note: Per Section 431100, the Contractor is to submit proposals from all three specified high-speed turbo blower (HSTB) manufacturers for review by Engineer and selection by the Owner based on the information provided in 431100. Each prospective bidder shall write in the manufacturer with the highest equipment cost for a basis of determining the low bidder. Contract price for this bid item at the time of award will be based on the capital cost (no markup or installation) for the final selected HSTB using selection criteria of Section 431100. <u>Important-information requested in Section 431100 for all three named equipment manufacturers shall be submitted with bid.</u></i>	
2. Fine Bubble Membrane Diffusers (Section 465133) Manufacturer: _____	\$ _____
3. Large Bubble Mixing System and Controls (Section 464125) Manufacturer: _____	\$ _____
4. Two (2) North Basin Sump Pumps (Section 221329.01)	\$ _____

Manufacturer: _____

5. One (1) South Basin Transfer Pump (Section 221329.01) \$ _____
Manufacturer: _____

6. Three (3) Rectangular Weir Gates (Section 462030) \$ _____
Manufacturer: _____

7. Three (3) Sluice Gates (Section 462030) \$ _____
Manufacturer: _____

8. Six (6) Air Flow Meters (Section 400212) \$ _____
Manufacturer: _____

9. Six (6) Electrically Actuated Butterfly Control Valves (Section 331200) \$ _____
Manufacturer: _____

10. Pre-Engineered Metal Blower/Electrical Building (Section 133419) \$ _____
Manufacturer: _____

PART B BASE BID (sum of items 1-10 above) _____
_____ Dollars (in words) (\$ _____)

PART C: CONTROL SYSTEM AND SYSTEM PROGRAMMING: Bidder agrees to provide all additional general and specialty services, labor, materials, software and equipment, including but not limited to PLCs, RTUs, OIC, OITs, networking devices and additional measurement gauges, sensors and transmitters, as necessary to provide a complete, fully tested and operational controls system as reflected in the Contract Documents meeting all functionality of the system. **Price shall include all costs associated with the provision of the controls system, which is not already reflected in Parts A and B, above.** Work shall be performed for the following Lump Sum:

Integrator: _____

PART C BASE BID: _____
_____ Dollars (in words) (\$ _____)

PART D: PREFERRED CONTROL SYSTEMS INTEGRATOR – ADDITIVE PRICE: The preferred system integrator for the City of Eden is MG Newell Corporation, 301 Citation Ct, Greensboro, NC. Contact person is Richard Poff, Richard.poff@mgnewell.com, 336-393-0100. If the contractor writes in another system’s integrator under Part C above due to MG Newell being higher cost, Part D below shall include the ADDITIVE COST to hire MG Newell for this project. The Contractor shall also submit formalized quotes from MG Newell and the Contractor’s preferred systems integrator for justification of the cost additive for review by the Engineer. If there is a net additive, the Owner reserves the right to pay the additive amount without funding assistance from NCDEQ-DWI funding. If the Owner elects to pay the additive amount, the Contractor will contract with the preferred systems integrator to perform all related work. If the Contractor does write in MG Newell Corporation under Part C, please write “\$0” below.

PART D: NET DIFFERENCE FOR PREFERRED CONTROL SYSTEMS INTEGRATOR:

_____ Dollars (in words) (\$ _____)

CONTRACT 1 BID SUBTOTAL (Parts A, B, C, and D Combined):

_____ Dollars (in words) (\$ _____)

5.02 Contract 2

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

CONCRETE WORK ASSOCIATED WITH THE NEW NORTH AERATION BASIN: This dollar amount shall include the scope of work associated with installing a new concrete reactor basin as shown in the contract drawings. This scope of work shall include the concrete work (either cast in place or pre-cast post tensioned), reinforcing steel, and the aluminum handrails and toe plate as shown in the contract drawings and as described in the contract specifications.

Cast in Place Concrete Contractor/Subcontractor or Precast Post-Tensioned Concrete Tank Manufacturer: _____

CONTRACT 2 BID SUBTOTAL:

_____ Dollars (in words) (\$ _____)

5.03 Base Bid (Sum of Contracts 1 and 2)

The base bid will be used for the basis of determining the lowest responsive bidder. If an award is issued for the project, the Owner will issue a single notice of award and two (2) agreements to the same general contractor. Base bid shall include all work associated with Contracts 1 and 2 above.

TOTAL BASE BID (SUM OF CONTRACTS 1 AND 2 ABOVE):

_____ Dollars (in words) (\$ _____)

ARTICLE 6 – TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are submitted with and made a condition of this Bid:
- A. Required Bid security;
 - B. List of Proposed Subcontractors;
 - C. List of Proposed Suppliers;
 - D. List of Project References;
 - E. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
 - F. Contractor's License No.: _____ ;
 - G. Required Bidder Qualification Statement with supporting data;
 - H. High Speed Turbo Blower submittals from each manufacturer per specification 431100.

ARTICLE 8 – DEFINED TERMS

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

ARTICLE 9 – BID SUBMITTAL

BIDDER: *[Indicate correct name of bidding entity]*

By:

[Signature] _____

[Printed name] _____

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

Attest:

[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

Bidder's License No.: _____

(where applicable)



BID BOND

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

BIDDER (*Name and Address*):

SURETY (*Name, and Address of Principal Place of Business*):

OWNER (*Name and Address*):

BID

Bid Due Date:

Description (*Project Name— Include Location*):

BOND

Bond Number:

Date:

Penal sum _____ \$ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER

SURETY

Bidder's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

*Note: Addresses are to be used for giving any required notice.
Provide execution by any additional parties, such as joint venturers, if necessary.*

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

QUALIFICATIONS STATEMENT

THE INFORMATION SUPPLIED IN THIS DOCUMENT IS CONFIDENTIAL TO THE EXTENT PERMITTED BY LAWS AND REGULATIONS

1. SUBMITTED BY:

Official Name of Firm: _____

Address: _____

2. SUBMITTED TO: _____

3. SUBMITTED FOR: _____

Owner: _____

Project Name: _____

TYPE OF WORK: _____

4. CONTRACTOR'S CONTACT INFORMATION

Contact Person: _____

Title: _____

Phone: _____

Email: _____

5. AFFILIATED COMPANIES:

Name: _____

Address: _____

6. TYPE OF ORGANIZATION:

SOLE PROPRIETORSHIP

Name of Owner: _____

Doing Business As: _____

Date of Organization: _____

PARTNERSHIP

Date of Organization: _____

Type of Partnership: _____

Name of General Partner(s): _____

CORPORATION

State of Organization: _____

Date of Organization: _____

Executive Officers:

- President: _____

- Vice President(s): _____

- Treasurer: _____

- Secretary: _____

LIMITED LIABILITY COMPANY

State of Organization: _____

Date of Organization: _____

Members: _____

JOINT VENTURE

Sate of Organization: _____

Date of Organization: _____

Form of Organization: _____

Joint Venture Managing Partner

- Name: _____

- Address: _____

Joint Venture Managing Partner

- Name: _____

- Address: _____

Joint Venture Managing Partner

- Name: _____

- Address: _____

7. LICENSING

Jurisdiction: _____

Type of License: _____

License Number: _____

Jurisdiction: _____

Type of License: _____

License Number: _____

8. CERTIFICATIONS

CERTIFIED BY:

Disadvantage Business Enterprise: _____

Minority Business Enterprise: _____

Woman Owned Enterprise: _____

Small Business Enterprise: _____

Other (_____): _____

9. BONDING INFORMATION

Bonding Company: _____

Address: _____

Bonding Agent: _____

Address: _____

Contact Name: _____

Phone: _____

Aggregate Bonding Capacity: _____

Available Bonding Capacity as of date of this submittal: _____

10. FINANCIAL INFORMATION

Financial Institution: _____

Address: _____

Account Manager: _____

Phone: _____

INCLUDE AS AN ATTACHMENT AN AUDITED BALANCE SHEET FOR EACH OF THE
LAST 3 YEARS

11. CONSTRUCTION EXPERIENCE:

Current Experience:

List on **Schedule A** all uncompleted projects currently under contract (If Joint Venture list each participant's projects separately).

Previous Experience:

List on **Schedule B** all projects completed within the last 5 Years (If Joint Venture list each participant's projects separately).

Has firm listed in Section 1 ever failed to complete a construction contract awarded to it?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

Has any Corporate Officer, Partner, Joint Venture participant or Proprietor ever failed to complete a construction contract awarded to them in their name or when acting as a principal of another entity?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

Are there any judgments, claims, disputes or litigation pending or outstanding involving the firm listed in Section 1 or any of its officers (or any of its partners if a partnership or any of the individual entities if a joint venture)?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

12. SAFETY PROGRAM:

Name of Contractor's Safety Officer: _____

Include the following as attachments:

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) OSHA No. 500- Log & Summary of Occupational Injuries & Illnesses for the past 5 years.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all OSHA Citations & Notifications of Penalty (monetary or other) received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all safety citations or violations under any state all received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide the following for the firm listed in Section V (and for each proposed Subcontractor furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) the following (attach additional sheets as necessary):

Workers' compensation Experience Modification Rate (EMR) for the last 5 years:

YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____

Total Recordable Frequency Rate (TRFR) for the last 5 years:

YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____

Total number of man-hours worked for the last 5 Years:

YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____

Provide Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) Days Away From Work, Days of Restricted Work Activity or Job Transfer (DART) incidence rate for the particular industry or type of Work to be performed by Contractor and each of Contractor's proposed Subcontractors and Suppliers) for the last 5 years:

YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____

13. EQUIPMENT:

MAJOR EQUIPMENT:

List on **Schedule C** all pieces of major equipment available for use on Owner's Project.

I HEREBY CERTIFY THAT THE INFORMATION SUBMITTED HEREWITH, INCLUDING ANY ATTACHMENTS, IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME OF ORGANIZATION: _____

BY: _____

TITLE: _____

DATED: _____

NOTARY ATTEST:

SUBSCRIBED AND SWORN TO BEFORE ME

THIS _____ DAY OF _____, 20__

NOTARY PUBLIC - STATE OF _____

MY COMMISSION EXPIRES: _____

REQUIRED ATTACHMENTS

1. Schedule A (Current Experience).
2. Schedule B (Previous Experience).
3. Schedule C (Major Equipment).
4. Audited balance sheet for each of the last 3 years for firm named in Section 1.
5. Evidence of authority for individuals listed in Section 7 to bind organization to an agreement.
6. Resumes of officers and key individuals (including Safety Officer) of firm named in Section 1.
7. Required safety program submittals listed in Section 13.
8. Additional items as pertinent.

SCHEDULE A

CURRENT EXPERIENCE

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE C - LIST OF MAJOR EQUIPMENT AVAILABLE

ITEM	PURCHASE DATE	CONDITION	ACQUIRED VALUE

**BIDDER COMPLIANCE STATEMENT/CERTIFICATION
REGARDING EQUAL EMPLOYMENT OPPORTUNITY**

Applicability: Bid exceeding ten thousand dollars for construction contract/ subcontract of unlimited amount and non-construction contract/subcontract of less than one million dollars.

This statement relates to a proposed (Contract between _____ (contractor) and Public Body) or (subcontract between _____(subcontractor) and _____) to be funded under a federally assisted project. (contractor)

Pursuant to Executive Order 11246 and its implementing regulations at 41 CFT 60-1.7(b)(1), as the undersigned bidder, I certify that:

1.) Bidder has participated in a previous contract or subcontract subject to the equal opportunity clause.

_____ Yes _____ No

2.) Bidder has developed and has on file at each establishment affirmative action programs pursuant to 41 CFR 60-2 (applies only to non-construction contractors)

_____ Yes _____ No

3.) Bidder has filed with the Joint Reporting Committee, the Director (Office of Federal Contract Compliance Programs, U.S. Department of Labor), an agency, or the Equal Employment Opportunity Commission, all reports due under the applicable filing requirements.

_____ Yes _____ No

I understand that if I have failed to file any compliance reports which have been required of me, or have failed to develop and have on file at each establishment affirmative action programs pursuant to 41 CFR 60-2, when required, I am not eligible to have my bid or proposal considered, or to enter into the proposed contract.

I further understand that if awarded the proposed contract, and the contract for the FIRST time brings me under the filing requirements or the written affirmative action programs that I will, as applicable: (a) within 30 days file with the Public Body Standard Form 100 (EEO-1); and (b) within 120 days from the commencement of the contract develop and submit to the Director of OFCCP for approval a Written Affirmative Action Plan.

NAME AND ADDRESS OF BIDDER (Include Zip Code):

NAME AND TITLE OF SIGNER (Please Type):

SIGNATURE:

1. What contracts or subcontracts are subject to the Equal Opportunity Clause?

- "Federal government contracts or subcontracts" exceeding \$10,000, or contracts or subcontracts with the Federal government which, in any 12 month period, total or can reasonably be expected to have an aggregate total value exceeding \$10,000.

- "Federally assisted construction contracts/subcontracts and non-construction contracts/subcontracts" exceeding \$10,000.

2. When is a bidder required to have on file at each establishment affirmative action programs?

- For NON-CONSTRUCTION CONTRACTS (service and supply), DOL regulations (41 cfr 60-2) call for a Written Affirmative Action Plan from each prime contractor or subcontractor with 50 or more employees and (1) a contract of \$50,000 or more; or (2) Government bills of lading which, in any 12 month period, total or can be reasonably be expected to total \$50,000 or more.

- For CONSTRUCTION CONTRACTS, DOL regulations do not require a Written Affirmative Action Program. However, contractors must take specified Affirmative Action Steps and to demonstrate with evidence that the Specifications (41 CFR 60-4.3) in the Equal Opportunity Clause have been implemented.

3. What reports are due under the applicable filing requirements?

- Standard Form 100

Each person (contractor and subcontractor) shall file annually with the Joint Reporting Committee, on or before March 31, reports on Standard Form 100 (EEO-1), if such person (1) is not exempt as provided for by 41 CFT 60-1.5, (2) has 50 or more employees, and (1) a contract of \$50,000 or more; or (b) government bills of lading which, in any 12 month period, total or can reasonable be expected to total \$50,000 or more.

Each person required to submit reports shall file such report with the PUBLIC BODY within 30 days after the award to him or a contract or subcontract, UNLESS such person has

submitted such a report within 12 months preceding the date of the award. Subsequent reports shall be submitted annually, on or before March 31, to the Joint Reporting Committee, P. O. Box 1480, Arlington, Virginia 22210.

- Monthly Employment Utilization Report (Form CC-257)

This report is required for construction contracts/ subcontractors.

- Other Reports

Any other reports that have been required pursuant to E.O. 11246 by a contracting agency, the Equal Opportunity Commission or the Director, Office of Federal Contract Compliance Programs, U.S. Department of Labor.



NOTICE OF AWARD

Date of Issuance:

Owner: City of Eden

NCDEQ Project No.: SRP-W-ARP-0244

Engineer: Dewberry

Engineer's Project No.: 50159317

Project: Eden WWTP North Aeration Basin Replacement

Contract Name:

Bidder:

Bidder's Address:

TO BIDDER:

You are notified that Owner has accepted your Bid dated _____ for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

The Contract Price of the awarded Contract is: \$ _____ [subject to unit prices]

[5] unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award or has been transmitted or made available to Bidder electronically.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner [5] counterparts of the Agreement, fully executed by Bidder.
2. Deliver with the executed Agreement(s) the Contract security [e.g., performance and payment bonds] and insurance documentation as specified in the Instructions to Bidders and General Conditions, Articles 2 and 6.

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner: _____
Authorized Signature

By:

Title:

cc: Engineer

**AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)**

THIS AGREEMENT is by and between the City of Eden (“Owner”) and _____ (“Contractor”).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

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

ARTICLE 2 – THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows:

Eden WWTP North Aeration Basin Replacement
City of Eden, NC

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by Dewberry Engineers Inc., 551 Piney Forest Road, Danville, VA 24540.

3.02 The Owner has retained Dewberry Engineers Inc. (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

A. Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Contract Times: Days*

A. The Work will be substantially completed within 510 days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 540 days after the date when the Contract Times commence to run.

4.03 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the

delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion: Contractor shall pay Owner \$500 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$300 for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

ARTICLE 5 – CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:

~~A. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item):~~

~~The extended prices for Unit Price Work set forth as of the Effective Date of the Contract are based on estimated quantities. As provided in Paragraph 13.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer.~~

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

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

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

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 25th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments

previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract

- a. 95 percent of Work completed (with the balance being retainage); and
 - b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion **of the entire construction to be provided under the Contract Documents**, Owner shall pay an amount sufficient to increase total payments to Contractor to 95 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions.

6.03 *Final Payment*

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

ARTICLE 7 – INTEREST

7.01 All amounts not paid when due shall bear interest at the maximum legal rate.

ARTICLE 8 – CONTRACTOR’S REPRESENTATIONS

- 8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:
- A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
 - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
 - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

- A. The Contract Documents consist of the following:
1. This Agreement (pages 1 to 6 inclusive).
 2. Performance bond (pages 1 to 3 inclusive).
 3. Payment bond (pages 1 to 3 inclusive).

4. General Conditions (pages 1 to 65 inclusive).
5. Supplementary Conditions (pages 1 to 18 inclusive).
6. EDA Contracting Provisions for Construction Projects (pages 1 to 23 inclusive).
7. EDA Construction Site Sign Specifications (pages 1 to 5 inclusive).
8. Davis-Bacon Wage Rates (pages 1 to 28 inclusive).
9. Requirements for Affirmative Action (EEO) (pages 1 to 1).
10. Qualification Statement (pages 1 to 12 inclusive).
11. Compliance Statement (pages 1 to 2 inclusive).
12. Lobbying Certification and Restriction Forms (pages 1 to 1).
13. Specifications as listed in the Table of Contents of the Project Manual.
14. Drawings (not attached but incorporated by reference) consisting of 66 sheets with each sheet bearing the following general title: Eden WWTP North Aeration Basin Replacement.
15. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (pages 1 to 7 inclusive).
16. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice of Award.
 - b. Notice to Proceed.
 - c. Application for Payment.
 - d. Work Change Directives.
 - e. Change Orders.
 - f. Certificate of Substantial Completion.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 Terms

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

10.02 Assignment of Contract

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto 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 Documents.

10.03 *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.

10.04 *Severability*

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

10.05 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

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

OWNER:

CONTRACTOR:

By: _____

By: _____

Title: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

License No.: _____
(where applicable)

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

NOTE TO USER: Use in those states or other jurisdictions where applicable or required.



NOTICE TO PROCEED

Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:
	Effective Date of Contract:

TO CONTRACTOR:

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on [REDACTED], 20[REDACTED]. *[see Paragraph 4.01 of the General Conditions]*

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work shall be done at the Site prior to such date. In accordance with the Agreement, the number of days to achieve Substantial Completion is 120 days from the notice to proceed date, and the number of days to achieve readiness for final payment is 150 days from the notice to proceed date.

Before starting any Work at the Site, Contractor must comply with the following:
[Note any access limitations, security procedures, or other restrictions]

Owner: _____

 Authorized Signature

By: _____
 Title: _____
 Date Issued: _____

Copy: Engineer



PERFORMANCE BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):*

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: None See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal *(seal)*

Surety's Name and Corporate Seal *(seal)*

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

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 shall 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 shall 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 shall 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 shall 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 shall 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 shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall 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 shall not be reduced or set off on account of any such unrelated obligations. No right of action shall 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 may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall 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 shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall 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 shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall 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 shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:



PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location)*:

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:

Amount:

Modifications to this Bond Form: None See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

_____ *(seal)*

Contractor's Name and Corporate Seal

_____ *(seal)*

Surety's Name and Corporate Seal

By: _____

Signature

By: _____

Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____

Signature

Attest: _____

Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

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 shall 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 shall 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 shall 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 shall 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 shall 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 shall 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 satisfy 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 shall 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 shall be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall 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 shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall 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:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
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;
4. A brief description of the labor, materials, or equipment furnished;
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;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and

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 shall be 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 shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:



Contractor's Application for Payment No.

	Application Period:	Application Date:
To (Owner):	From (Contractor):	Via (Engineer):
Project:	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.:

**Application For Payment
Change Order Summary**

Approved Change Orders	Number	Additions	Deductions			
				1. ORIGINAL CONTRACT PRICE	\$	_____
				2. Net change by Change Orders	\$	_____
				3. Current Contract Price (Line 1 ± 2)	\$	_____
				4. TOTAL COMPLETED AND STORED TO DATE (Column F total on Progress Estimates).....	\$	#REF!
				5. RETAINAGE:		
				a. X <u> #REF! </u> Work Completed.....	\$	#REF!
				b. X <u> #REF! </u> Stored Material.....	\$	#REF!
				c. Total Retainage (Line 5.a + Line 5.b).....	\$	#REF!
				6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c)	\$	#REF!
				7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)	\$	_____
				8. AMOUNT DUE THIS APPLICATION	\$	#REF!
				9. BALANCE TO FINISH, PLUS RETAINAGE (Column G total on Progress Estimates + Line 5.c above).....	\$	#REF!
TOTALS						
NET CHANGE BY CHANGE ORDERS						

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:

(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;

(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and

(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor Signature

By: _____	Date: _____
-----------	-------------

Payment of: \$ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____
(Engineer) (Date)

Payment of: \$ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____
(Owner) (Date)

Approved by: _____
Funding or Financing Entity (if applicable) (Date)

Progress Estimate - Unit Price Work

Contractor's Application

For (Contract):						Application Number:					
Application Period:						Application Date:					
A						B	C	D	E	F	
Item		Contract Information				Estimated Quantity Installed	Value of Work Installed to Date	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (F / B)	Balance to Finish (B - F)
Bid Item No.	Description	Item Quantity	Units	Unit Price	Total Value of Item (\$)						
Totals											



CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer:	Engineer's Project No.:
Project:	Contract Name:

This [preliminary] [final] Certificate of Substantial Completion applies to:

All Work The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]*

Amendments to Owner's responsibilities: None
 As follows

Amendments to Contractor's responsibilities: None
 As follows:

The following documents are attached to and made a part of this Certificate: *[punch list; others]*

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:		RECEIVED:		RECEIVED:	
By: _____	By: _____	By: _____	By: _____	By: _____	By: _____
(Authorized signature)		Owner (Authorized Signature)		Contractor (Authorized Signature)	
Title: _____	Title: _____	Title: _____	Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____	Date: _____	Date: _____	Date: _____

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, 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 form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *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, or both; 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, or both; 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; or (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. 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), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree 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 the 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. *Engineer*—The individual or entity named as such in the Agreement.
21. *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.
22. *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. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *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.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner’s acceptance of the Bid.
27. *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.
28. *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.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor’s plan to accomplish the Work within the Contract Times.
30. *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.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or “RPR” includes any assistants or field staff of Resident Project Representative.
33. *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.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals and the performance of related construction activities.
35. *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.
36. *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.

37. *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 furnished by Owner which are designated for the use of Contractor.
38. *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.
39. *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.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *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.

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

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. 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. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. *Evidence of Owner’s Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), 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 executed 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 specifically 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 *Initial Acceptance of Schedules*

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

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items 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 items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall 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.

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, shall mean 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, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the 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 Documents 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 Documents 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 shall 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 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 thereunder.
- 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 give written notice to Owner and Contractor 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 editions, 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 shall preclude 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 thirtieth 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 sixtieth day after the day of Bid opening or the thirtieth 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 shall 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 shall 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 shall 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 the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- 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. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall 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 utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 4. acts of war or terrorism.
- D. 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.
- E. Paragraph 8.03 governs 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.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times 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.

- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- 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; 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 7.12, 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 at law; 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 shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site 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 known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); 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 upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. 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; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

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 either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 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 the necessity of Owner's obtaining 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 above; 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. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, 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 conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
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; or
 - 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 as 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, or both, then any such adjustment shall 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, or both, 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.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. 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 in the Contract Documents, or was not shown or indicated 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), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; 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 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. *Possible Price and Times Adjustments:*
 - 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, 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. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - 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;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. 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, or both, then any such adjustment shall 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, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings*: The Supplementary Conditions identify:
1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 2. 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 Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. 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; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for 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, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, 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.
- 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 or 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.H shall obligate 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 shall obligate 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 all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, 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 shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. 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.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

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. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

maintaining the policies, coverages, and endorsements 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 and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements 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 and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. 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, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of 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.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect 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 shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

- A. *Workers' Compensation:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).
- 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.
- C. *Commercial General Liability—Form and Content:* 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:
1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. 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.
 8. 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.
- D. *Automobile liability:* Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result

of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

- G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
 - 1. include at least the specific coverages provided in this Article.
 - 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 - 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 - 4. remain in effect at least until final payment (and longer if expressly required in this Article) 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 Documents.
 - 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. 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.

6.05 *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 full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 - 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 - 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
 - 3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 - 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed 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.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- 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 notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. *Additional Insurance:* 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 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. 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 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 Subcontractors, all individuals or entities identified in the Supplementary Conditions as 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. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial 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.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work 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 any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 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 6.05 shall 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, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

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

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, 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.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and

guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 *“Or Equals”*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the 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 material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an “or equal” item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- 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 shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 *Substitutes*

- A. Unless the specification or description of an item of material or equipment 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 material or equipment under the circumstances described below. To the extent possible such requests shall 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 material or equipment from anyone other than Contractor.
 - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.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 material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall 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 that specified, and
 - 3) be suited to the same use as that 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 that specified, and

- 2) available engineering, sales, maintenance, repair, and replacement services.
- d. shall 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 shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities 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, Supplier, or other individual or entity 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 five days.

- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. 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, Suppliers, or other individuals or entities 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, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, 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, Supplier, or other individual or entity, whether initially or as a replacement, shall 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 fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

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

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. 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

7.09 *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.

7.10 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work 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 shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give 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 notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *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.

7.12 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when 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.
 - C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
 - D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
 - E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor 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).
 - F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
 - G. Contractor's duties and responsibilities for safety and protection shall 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.

7.13 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or

exchanged between or among employers at the Site in accordance with Laws or Regulations.

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 threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements:*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
- 2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
- 3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Contractor shall submit the number of copies required in the Specifications.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to

provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

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.D.
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. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.
- D. *Engineer's Review:*
 1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction 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 shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 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.
 5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 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, shall 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, Sample, or other submittal shall 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.D.4.

E. *Resubmittal Procedures:*

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

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 and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.

- D. 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 shall 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 and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop

Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

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 utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. 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.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, 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.

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 at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner 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, or both. 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 shall 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. When applicable, any such equitable adjustment in Contract Price shall 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 is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- 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. 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 to 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.
- C. 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 to Contractor.

- D. 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 shall 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 Documents (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 10.08. 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 *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 Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *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.

10.07 *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.

10.08 *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, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 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 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *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 (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not 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, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 - 2. *Work Change Directives:* 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 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: 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. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *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. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes 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 shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate 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.

11.03 *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.

11.04 *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 shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall 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); or
 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 11.04.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 11.04.C).

- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and 11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.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 five 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 shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
 - d. no fee shall 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 will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *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 shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under

the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. 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. The supporting data shall 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. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall 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.
 3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *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 that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 Execution of Change Orders

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 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 11.02, (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 in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *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 shall be submitted 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; and
 - 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.
- 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 shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall 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 shall 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 shall 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 shall 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 shall 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 shall 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 shall be incorporated in a Change Order 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. 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 shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable

thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes

other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- 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 shall not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety 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. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. 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.
- 5. 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:* When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

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 on account of any of the foregoing will be valid.
- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

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, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 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 will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

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 shall 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 shall 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 shall 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 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 shall 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 special 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, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, 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 shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

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 rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 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 on account of 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. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- 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, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 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 on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of 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 that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated 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;
 - l. there are other items entitling 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 shall 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 shall be treated as an amount due as determined by Paragraph 15.01.C.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 seven 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 shall 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 seven 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 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 6.05 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 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall 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 disputes that Contractor believes are unsettled; 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 Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall 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. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. 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. *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.

D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation,

including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- 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 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 terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then 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 other adjacent areas;
 - 2. correct such defective Work;
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not 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, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall 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) ten 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) 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 seven 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 shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; 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 on account of loss of anticipated overhead, profits, or revenue, 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 seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 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, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph 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; and
 - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising 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; or
 - 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 Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

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 shall not constitute a waiver of that provision, nor shall 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 or completion of the Contract or termination 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 *Headings*

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

I. SUPPLEMENTARY CONDITIONS

A. *Caption and Introductory Statements*

Supplementary Conditions

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2013 Edition). All provisions that are not so amended or supplemented remain in full force and effect.

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

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

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC-1.01 Defined Terms

- SC 1.01.A.8** Add the following language at the end of last sentence of Paragraph 1.01.A.8:
- The Change Order form to be used on this Project is EJCDC C-941. Agency approval is required before Change Orders are effective.
- SC 1.01.A.48** Add the following language at the end of the last sentence of Paragraph 1.01.A.48:
- A Work Change Directive cannot change Contract Price or Contract Times without a subsequent Change Order.
- SC 1.01.A.49** Add the following new Paragraph after Paragraph 1.01.A.48:
- Abnormal Weather Conditions – Conditions of extreme or unusual weather for a given region, elevation, or season as determined by Engineer. Extreme or unusual weather that is typical for a given region, elevation, or season should not be considered Abnormal Weather Conditions.**

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.01 Delivery of Bonds and Evidence of Insurance

- SC-2.01** Delete Paragraphs 2.01 B. and C. in their entirety and insert the following in their place:
- B. Evidence of Contractor's Insurance: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies of insurance (including all endorsements, and identification**

of applicable self-insured retentions and deductibles) required to be provided by Contractor in Article 6. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

SC 2.02 **Copies of Documents**

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

Owner shall furnish to Contractor five copies of the Contract Documents (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF).

ARTICLE 3 – DOCUMENTS: INTENT, AMENDING, RESUSE

All documents listed herein are a part of this contract and the requirements of each part shall apply to the entire project as may be applicable. Contract documents covering the work under this contract consist of the specifications and contract drawings.

SC-3.02 Reference Standards

SC-3.02.A Add a new paragraph immediately after paragraph 3.02A.2.

Whenever reference is made to the furnishing of materials or testing thereof to conform to the standards of any technical organization or body, it shall be construed to mean the latest standard, code, specification, or tentative specification adopted and published at the date of advertisement for bids, even though reference has been made to an earlier standard; and such standards are made a part of hereof to the extent which is indicated or intended.

When no reference is made to a code, standard, or specification, the standard specifications of the ASTM, the ASA, the AIEE, or the NEMA shall govern.

The following is a partial list of typical abbreviations which may be used in the specifications and the organizations to which they refer:

AASHA	AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS
ACI	AMERICAN CONCRETE INSTITUTE
ACIFS	AMERICAN CAST IRON FLANGE STANDARDS
AGMA	AMERICAN GEAR MANUFACTURERS ASSOCIATION
AIA	AMERICAN INSTITUTE OF ARCHITECTS
AIEE	AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	AMERICAN IRON AND STEEL INSTITUTE
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
API	AMERICAN PETROLEUM INSTITUTE
ASHRAE	AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR CONDITIONING ENGINEERS
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AREA	AMERICAN RAILWAY ENGINEERING ASSOCIATION
AWS	AMERICAN WELDING SOCIETY
AWWA	AMERICAN WATER WORKS ASSOCIATION
CPSC	CONSUMER PRODUCTS SAFETY COMMISSION
CRSI	CONCRETE REINFORCING STEEL INSTITUTE
EI	EDISON ELECTRICAL INSTITUTE
FS	FEDERAL SPECIFICATIONS
IEEE	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS
IPCEA	INSULATED POWER CABLE ENGINEERS ASSOCIATION
NBFU	NATIONAL BOARD OF FIRE UNDERWRITERS
NBS	NATIONAL BUREAU OF STANDARDS
NCMA	NATIONAL CONCRETE MASONRY ASSOCIATION
NEC	NATIONAL ELECTRIC CODE OF NBFU
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NFSHSA	NATIONAL FEDERATION OF STATE HIGH SCHOOL ASSOCIATIONS
NS	NORFOLK SOUTHERN CORPORATION
N&W	NORFOLK & WESTERN RAILWAY COMPANY
PCA	PORTLAND CEMENT ASSOCIATION
SSPC	STEEL STRUCTURES PAINTING COUNCIL
SCPI	STRUCTURAL CLAY PRODUCTS INSTITUTE
UL	UNDERWRITERS LABORATORIES, INC.
DEQ	DEPARTMENT OF ENVIRONMENTAL QUALITY
DOT	DEPARTMENT OF TRANSPORTATION

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

SC-4.01 Commencement of Contract Times; Notice to Proceed

SC 4.01.A Amend the last sentence of paragraph 4.01.A by striking out the following words:

In no event will the contract times commence to run later than the sixtieth day after the day of bid opening or the thirtieth day after the effective date of the contract, whichever date is earlier.

SC-4.05 Delays in Contractor’s Progress

SC-4.05.C.2 Amend paragraph 4.05.C.2 by striking out the following text: “abnormal weather conditions,” and inserting the following text:

Abnormal Weather Conditions

SC-4.05 Add the following new paragraph immediately after Paragraph 4.05.C.4:

When establishing the contract time, an allowance will be made for four (4) calendar days of work lost per month due to inclement weather conditions. The Contractor, at the time of each periodic pay request, shall submit to the Engineer and Owner for approval a list of all working days lost due to either inclement weather or site conditions caused by inclement weather for the period. Accompanying his list should be a summary of the specific conditions which caused the loss. This request will be reviewed by the Engineer in light of observations made by the Engineer and resident inspector. Approval of the periodic payment estimate by the Engineer, Owner, and Agency will also include approval of the weather delay request. After substantial completion, and not until then, a change order must be executed if a time extension for weather related delays is requested by the Contractor. The time extension must be based solely on the time requested within the periodic payment estimates. Subtracted from this time will be the four (4) days per month allowance assumed in the contract. There cannot be a decrease in contract length if the allowance for inclement weather exceeds the actual number of days lost due to inclement weather. To convert working days into calendar days, multiply the working days by seven (7) and divide by the number of working days in a typical work week.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.03 Subsurface and Physical Conditions

SC 5.03 Delete Paragraphs 5.03.A and 5.03.B in their entirety and insert the following:

- A. No reports of explorations or tests of subsurface conditions at or adjacent to the Site, or drawings of physical conditions relating to existing surface or subsurface structures at the Site, are known to Owner.**

SC-5.06 Hazardous Environmental Conditions

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

- A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.**
- B. Not Used.**

ARTICLE 6 – BONDS AND INSURANCE

SC-6.02 Insurance—General Provisions

SC-6.02 Add the following paragraph immediately after Paragraph 6.02.B:

- 1. Contractor may obtain worker’s compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the project is located, (b) is certified or authorized as a worker’s compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker’s compensation insurance for similar projects by the state within the last 12 months.**

SC-6.03 Contractor’s Liability Insurance

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03.J:

K. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

- 1. Workers’ Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:**

State:	<u>Statutory</u>
Federal, if applicable (e.g., Longshoreman’s):	<u>Statutory</u>
Jones Act coverage, if applicable:	
Bodily injury by accident, each accident	\$ <u>N/A</u>
Bodily injury by disease, aggregate	\$ <u>N/A</u>
Employer’s Liability:	
Bodily injury, each accident	\$ <u>500,000</u>

Bodily injury by disease, each employee	\$ 500,000
Bodily injury/disease aggregate	\$ 500,000

For work performed in monopolistic states, stop-gap liability coverage shall be endorsed to either the worker's compensation or commercial general liability policy with a minimum limit of: **\$ 1,000,000**

Foreign voluntary worker compensation **Statutory**

2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:

General Aggregate	\$ 2,000,000
Products - Completed Operations Aggregate	\$ 1,000,000
Personal and Advertising Injury	\$ 1,000,000
Each Occurrence (Bodily Injury and Property Damage)	\$ 1,000,000

3. Automobile Liability under Paragraph 6.03.D. of the General Conditions:

Bodily Injury:	
Each person	\$ 1,000,000
Each accident	\$ 1,000,000
Property Damage:	
Each accident	\$ 1,000,000
<i>[or]</i>	
Combined Single Limit of	\$ 1,000,000

4. Excess or Umbrella Liability:

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

SC-6.05 *Property Insurance*

SC-6.05.A.1 Add the following new subparagraph after subparagraph 6.05.A.1:

- a. **In addition to Owner, Contractor, and all Subcontractors, include as insureds the following:**
 - 1. *Engineer*
 - 2. *Inspector*

ARTICLE 7 – CONTRACTOR’S RESPONSIBILITIES

SC-7.02.C. Add the following new paragraph immediately after Paragraph 7.02.B:

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

SC-7.04 “Or Equals”

SC-7.04.A Amend the third sentence of Paragraph 7.04.A by striking out the following words:

Unless the specification or description contains or is followed by words reading that no like, equivalent, or ‘or-equal’ item is permitted.

SC-7.04.A.1 Amend the last sentence of Paragraph a.3 by striking out “and;” and adding a period at the end of Paragraph a.3.

**SC-7.04.A.1 Delete paragraph 7.04.A.1.a.4 in its entirety and insert the following in its place:
[Deleted]**

SC-7.06.A Amend Paragraph 7.06.A by adding the following text to the end of the Paragraph:

The Contractor shall not award work valued at more than fifty percent of the Contract Price to Subcontractor(s), without prior written approval of the Owner.

**SC-7.06.B Delete paragraph 7.06.B in its entirety and insert the following in its place:
[Deleted]**

SC-7.06.E Amend the second sentence of Paragraph 7.06.E by striking out “Owner may also require Contractor to retain specific replacements; provided, however, that”.

ARTICLE 10 – ENGINEER’S STATUS DURING CONSTRUCTION

SC-10.03 *Project Representative*

A. SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.A:

- B. The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.**
- 1. General:** RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.
 - 2. Schedules:** Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.
 - 3. Conferences and Meetings:** Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.
 - 4. Liaison:**
 - a.** Serve as Engineer’s liaison with Contractor. Working principally through Contractor’s authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b.** Assist Engineer in serving as Owner’s liaison with Contractor when Contractor’s operations affect Owner’s on-Site operations.
 - c.** Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
 - 5. Interpretation of Contract Documents:** Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
 - 6. Shop Drawings and Samples:**
 - a.** Record date of receipt of Samples and Contractor-approved Shop Drawings.
 - b.** Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
 - c.** Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.
 - 7. Modifications:** Consider and evaluate Contractor’s suggestions for modifications in Drawings or Specifications and report such suggestions,

together with RPR's recommendations, if any, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.

8. Review of Work and Rejection of Defective Work:

- a. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
- b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

9. Inspections, Tests, and System Start-ups:

- a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.
- b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.

10. Records:

- a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.
- b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.
- c. Maintain records for use in preparing Project documentation.

11. Reports:

- a. Furnish to Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.
- b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.

- c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.
 12. **Payment Requests:** Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.
 13. **Certificates, Operation and Maintenance Manuals:** During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.
 14. **Completion:**
 - a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
 - b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.
 - c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.
- C. The RPR shall not:**
1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
 2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
 3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
 4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's work.
 5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS, CHANGES IN THE WORK

SC-11.07 Execution of Change Orders

SC-11.07.B. Add the following new paragraph 11.07.B.:

All contract change orders must be concurred in by Agency before they are effective.

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

SC-13.02 Allowances

SC 13.02.C Delete paragraph 13.02.C in its entirety and insert the following in its place: [deleted]

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

SC-15.01 Progress Payments

SC 15.01.B Amend the second sentence of Paragraph 15.01.B.1 by striking out the following text: “a bill of sale, invoice, or other.”

SC 15.01.B.3 Add the following language at the end of paragraph 15.01.B.3:

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for the benefit of the Contractor.

SC 15.01.B.4 Add the following new Paragraph after Paragraph 15.01.B.3:

The Application for Payment form to be used on this Project is EJCDC C-620. The Agency must approve all Applications for Payment before payment is made.

SC 15.01.D.1 Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:

The Application for Payment with Engineer’s recommendations will be presented to the Owner and Agency for consideration. If both the Owner and Agency find the Application for Payment acceptable, the recommended amount less any reduction under the provisions of Paragraph 15.01.E will become due thirty (30) days after the Application for Payment is presented to the Owner, and the Owner will make payment to the Contractor.

SC 15.02 Contractor's warranty of title.

SC 15.02.A Amend Paragraph 15.02.A by striking out the following text: "no later than seven days after the time of payment by Owner" and insert "no later than the time of payment by Owner."

SC-15.03 Substantial Completion

SC 15.03.B Add the following new subparagraph to Paragraph 15.03.B:

- 1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.**

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

SC-17.02 Attorneys' Fees

SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.

SC-17.02 Attorneys' Fees: For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result.

ARTICLE 18 – MISCELLANEOUS

SC-18.07 Add the following paragraph at the end of Paragraph 18.07.A

The Code of North Carolina (North Carolina Public Procurement Act) required all public bodies to include in every contract of more than \$10,000 the following two provisions: Section 2.2-4311, Employment discrimination by Contractor prohibited; required contract provisions, and Section 2.2-4312, Drug-free workplace to be maintained by Contractor; required contract provisions.

2.2-4311. Employment discrimination by contractor prohibited; required contract provision

All public bodies shall include in every contract of more than \$10,000 the following provisions:

- 1. During the performance of this contract, the contractor agrees as follows:**
 - a. The contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the contractor. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.**

- b. The contractor, in all solicitations or advertisements for employees placed by or on behalf of the contractor, will state that such contractor is an equal opportunity employer.
 - c. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.
2. The contractor will include the provisions of the foregoing paragraphs a, b and c in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.

2.2-4312. Drug-free workplace to be maintained by contractor; required contract provisions

All public bodies shall include in every contract over \$10,000 the following provisions:

During the performance of this contract, the contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.

For the purposes of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to a contractor in accordance with this chapter, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.



Work Change Directive No.

Date of Issuance: _____ Effective Date: _____
 Owner: _____ Owner's Contract No.: _____
 Contractor: _____ Contractor's Project No.: _____
 Engineer: _____ Engineer's Project No.: _____
 Project: _____ Contract Name: _____

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments: *[List documents supporting change]*

Purpose for Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to changes on Contract Price and Contract Time, is issued due to: *[check one or both of the following]*

- Non-agreement on pricing of proposed change.
- Necessity to proceed for schedule or other Project reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price \$ _____ [increase] [decrease].
 Contract Time _____ days [increase] [decrease].

Basis of estimated change in Contract Price:

- Lump Sum Unit Price
- Cost of the Work Other

RECOMMENDED:

AUTHORIZED BY:

RECEIVED:

By: _____	By: _____	By: _____
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: _____ Date: _____
 Title: _____



Change Order No. _____

Date of Issuance:

Effective Date:

Owner:

Owner's Contract No.:

Contractor:

Contractor's Project No.:

Engineer:

Engineer's Project No.:

Project:

Contract Name:

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments: *[List documents supporting change]*

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES <i>[note changes in Milestones if applicable]</i>
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] from previously approved Change Orders No. ___ to No. ___: \$ _____	[Increase] [Decrease] from previously approved Change Orders No. ___ to No. ___: Substantial Completion: _____ Ready for Final Payment: _____ days
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] of this Change Order: \$ _____	[Increase] [Decrease] of this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for Final Payment: _____ days or dates

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____ Engineer (if required)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: _____ Date: _____
Title: _____

American Iron and Steel (AIS)

Guidance for Clean Water and Drinking Water State Revolving Fund (SRF) Projects in North Carolina

This State guidance summarizes the requirements under Subsection 436(a)(2) of the Consolidated Appropriations Act of 2014 P.L. 113-76 that SRF recipients only use iron and steel products produced in the United States. The Environmental Protection Agency (EPA) has provided full guidance on the requirements at the following website:

http://water.epa.gov/grants_funding/aisrequirement.cfm.

Recipients of SRF awards must submit the executed *Certification for SRF Projects* and a list of any products that may potentially require a waiver from EPA, with their Bid Information Package. The recipient will not receive any funds if the State has not received these items.

Manufacturers can use the template “*Compliance Certification*” to document that materials are “produced in the United States.”

Outline of American Iron and Steel Section

1. Certification Statement for SRF Projects.
2. Waiver Instructions.
 - a. National Waiver.
 - b. Project Specific Waiver.
3. Materials covered by AIS.
4. Template *Compliance Certification* for Materials Covered by AIS:
 - a. Step Certification Products Letter Template: Step Certification creates a paper trail which documents the location of the manufacturing process involved with the production of steel and iron materials. A Step Certification is a process by which each handler (supplier, fabricator, manufacturer, processor, etc.) of the iron and steel products certifies that their step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers its work along with a certification of its origin.
 - b. Non-Step Certification Product Letter Template
5. Template for *De Minimis National Waiver List* to be used by Contractor.

American Iron and Steel (AIS)

Certification Statement for State Revolving Fund (SRF) Projects

Funding recipients of SRF awards must submit this executed form signed by both authorized representatives of the contractor and funding recipient. Provide a list of any products that may potentially require a waiver from EPA with the Bid Information package to the State SRF Program to receive funding.

The _____ certifies that their contractors performing
(Funding Recipient)
construction, alteration, maintenance and repair of the public treatment works under project
number _____ will comply with subsection 436 (a)(2) of the Consolidated
Appropriations Act of 2014 P.L. 113-76 and only use iron and steel products produced in the
United States.

<u>Contractor</u>	<u>Owner</u>
(print) _____	(print) _____
(sign and date) _____	(sign and date) _____

American Iron and Steel (AIS)

National Waivers and Project Specific Waiver Instructions

A. National Waivers:

- 1) Approved EPA national waivers can be found at this website:
<https://www.epa.gov/cwsrf/american-iron-and-steel-requirement-approved-national-waivers-0>.
- i. The De Minimis National Waiver Pursuant to Section 436 of P.L. 113-76, Consolidated Appropriations Act (CAA) (April 15, 2014) for iron and steel components is approved. An example table is included in this document for use in documenting materials utilized for the project on de minimis list.
 - a. De Minimis National Waiver applies to incidental components. Visit EPA National Waiver website for de minimis Waiver for description of incidental components within a water infrastructure project.
 - b. Note that no single de minimis item can be more than 1% of the total material cost of the project and the total of all de minimis items must not exceed 5% of the **total material cost of the project**.

B. Project Specific Waiver Instructions:

- 1) Project specific waiver requests are provided for in subsection 436(b) of the Act. It states they will be granted if the Administrator of the EPA finds that:
 - i. Applying subsection 436(a)(2) would be inconsistent with the public interest;
 - ii. Iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
 - iii. Inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.
- 2) If a project-specific waiver is required during the construction phase, submit waiver requests to the Division of Water Infrastructure (DWI) designated inspector identified in the Plans and Specifications Funding Approval Letter issued for the funded SRF project. The DWI inspector will forward the waiver to the designated EPA representative at the following email addresses for a final determination:

- i. For Clean Water SRF (CWSRF) funded projects cwsrfwaiver@epa.gov
- ii. For Drinking Water SRF (DWSRF) funded projects dwsrfwaiver@epa.gov
- iii. NOTE: SRF project numbers to be issued by the Division of Water Infrastructure starting with Fall 2023-approved projects are:
 1. SRF-W-XX-#### for CWSRF
 2. SRF-D-XX-#### for DWSRF

The current format CS#####-## for CWSRF and WIF-#### for DWSRF will eventually phase out for projects approved in Spring 2023 and before.

- 3) A checklist of items for a complete waiver application package can be found in the EPA guidance document for AIS at:

<https://www.epa.gov/cwsrf/ais-waiver-request-checklist-assistance-recipients>

- 4) Once DWI Inspector submits the waiver to EPA on behalf of the funding recipient, EPA will perform the following actions with the waiver:
 - i. Conduct product research to determine availability in the United States.
 - ii. Conduct a mandatory 15-day public comment period.
 - iii. After public comment, the waiver is sent to the Office of General Council (OGC) for review and concurrence.
 - iv. After OGC review, the waiver is approved by EPA leadership and posted to the EPA waiver website.
- 5) Once the waiver is received from EPA, the funding recipient will need to maintain the waiver for three years after project closeout.

American Iron and Steel (AIS)

Materials Covered by AIS

1. Lined and unlined pipes and fittings, manhole covers, municipal castings (detailed below).
2. Hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel (detailed below).
3. Reinforced precast concrete and construction materials (detailed below).
4. Products must be composed of greater than 50% iron and steel measured by cost and permanently incorporated into the project to be subject to the provision.
5. NOTE: Mechanical and electrical components, equipment and systems are not subject to AIS.

<u>Municipal Castings</u>	<u>Structural Steel</u>	<u>Construction Material</u>
Access Hatches Ballast Screen Benches Bollards Cast Bases Cast Iron Hinged Hatches Cast Iron Riser Rings Catch Basin Inlet Cleanout/Monument Boxes Construction Covers and Frames Curb and Corner Guards Curb Openings Detectable Warning Plates Downspout Shoes Drainage Grates, Frames and Inlets Inlets Junction Boxes Lampposts Manhole Covers, Rings, Frames and Risers Meter Boxes Service Boxes Steel Hinged Hatches Steel Riser Rings Trash Receptacles Tree Grates Tree Guards Trench Grates Valve Boxes, Covers and Risers	Wide Flange shapes I-beams Channels Angles Tees Zees H-piles Sheet piling Tie Plates Cross Ties (note: at least one dimension must be 3 inches or greater to be subject)	Wire Rod Bar Angles Concrete Reinforcing Bar Wire Wire Cloth Wire Rope and Cables Tubing Framing Joists Trusses Fasteners Welding Rods Decking Grating Railings Stairs Access Ramps Fire Escapes Ladders Wall Panels Dome Structures Roofing Ductwork Surface Drains Cable Hanging Systems Manhole Steps Fencing and Fence Tubing Guardrails Doors Stationary Screens

American Iron and Steel (AIS)
Template Compliance Certification for Materials Covered By AIS
(Step Certification Template Letter)

Company Name:

Company Address:

SUBJECT: American Iron and Steel Certification for Project: (include name and/or NC Division of Water Infrastructure SRF project number here)

I _____, certify that the following products were produced at the following location or steps in the production of the listed products, occurred at the following location:

Location:

Product

Step in production (Final production, melting, bending, etc.)

1)

2)

3)

Continue with list of products)

Therefore, these materials for the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

(signature and title of company representative)

(date)

American Iron and Steel (AIS)
Template Compliance Certification for Materials Covered By AIS
(Non-Step Certification Template Letter)

Company Name:

Company Address:

SUBJECT: American Iron and Steel Certification for Project: (include name and/or NC Division of Water Infrastructure SRF project number here)

I _____, certify that the following products were produced at the following location or steps in the production of the listed products, occurred at the following location:

Location:

Product

- 1)
- 2)
- 3)

Continue with list of products)

Therefore, these materials for the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

(signature and title of company representative)

(date)

American Iron and Steel (AIS)
Template *De Minimis* National Waiver* List
(to be used by Contractor)

<u>Item</u>	<u>Cost</u>

Total De Minimis Cost: _____

Total Material Cost for Project: _____

De Minimis Cost Is _____% of total material costs.

*NOTE: The De Minimis National Waiver Pursuant to Section 436 of P.L. 113-76, Consolidated Appropriations Act (CAA) (April 15, 2014) requires the following limits for ***incidental material components***:

1. All products included in the project under the de minimis waiver must total less than 5% of the total materials cost of the project.
2. Any single product cannot be more than 1% of the total materials cost of the project.

**NOTICE OF REQUIREMENTS FOR AFFIRMATIVE ACTION
TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY
(EXECUTIVE ORDER 11246 AND 41 CFR PART 60-4)**

The following Notice shall be included in, and shall be a part of all solicitations for offers and bids on all Federal and federally assisted construction contracts or subcontracts in excess of \$10,000.

The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Timetables	Goals for minority participation for each trade	Goals for female participation for each trade
	19.3 %	6.9%

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

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

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

State of _____

County of _____

City of _____

*the appropriate County
and insert the "Goal" (percent) in the Affirmative Action document*

ECONOMIC AREAS

STATE _____ **GOAL (percent)**

Maine:

001 Bangor, ME:	
Non-SMSA Counties _____	0.8
ME Aroostook; ME Hancock; ME Penobscot; ME Piscataquis; ME Waldo; ME Washington.	
002 Portland-Lewiston, ME:	
SMSA Counties:	
4243 Lewiston-Auburn, ME _____	0.5
ME Androscoggin.	
6403 Portland, ME _____	0.6
ME Cumberland; ME Sagadahoc.	
Non-SMSA Counties _____	0.5
ME Franklin; ME. Kennebec; ME Knox. ME; Lincoln; ME Oxford; ME Somerset; ME York.	

Vermont:

003 Burlington, VT:	
Non-SMSA Counties _____	0.8
NH Coos; NH Grafton; NH Sullivan; VT Addison; VT Caledonia; VT Chittenden; VT Essex; VT Franklin; VT Grand Isle; VT Lamoille; VT Orange; VT Orleans; VT Rutland; VT Washington; VT Windsor.	

Massachusetts:

004 Boston, MA:	
SMSA Counties:	
1123 Boston - Lowell - Brockton - Lawrence - Haverhill. MA-NH _____	4.0
MA Essex; MA Middlesex; MA Norfolk; MA Plymouth; MA Suffolk; NH Rockingham.	
4763 Manchester-Nashua, NH _____	0.7
NH Hillsborough.	
5403 Fall River-New Bedford, MA _____	1.6
MA Bristol	
9243 Worcester - Fitchburg – Leominster, MA _____	1.6
MA Worcester.	
Non-SMSA Counties _____	3.6
MA Barnstable; MA Dukes-, MA Nantucket, NH Belknap; NH Carroll; NH Merrimack; NH Strafford.	

Rhode Island:

005 Providence - Warwick - Pawtucket, RI:	
SMSA Counties:	
6483 Providence - Warwick - Pawtucket RI _____	3.0
RI Bristol; RI Kent; RI Providence; RI Washington	
Non-SMSA Counties _____	3.1
RI Newport.	

Connecticut (Massachusetts):

006 Hartford - New Haven - Springfield, CT-MA:

SMSA Counties:

3283 Hartford - New Britain – Bristol, CT	6.9
CT Hartford; CT Middlesex; CT Tolland	
5483 New Haven - Waterbury – Meriden, CT	9.0
CT New Haven.	
5523 New London - Norwich, CT	4.5
CT New London.	
6323 Pittsfield, MA	1.6
MA Berkshire.	
8003 Springfield - Chicopee - Holyoke. MA-CT	4.8
MA Hampden; MA Hampshire.	
Non-SMSA Counties	5.9
CT Litchfield; CT Windham; MA Franklin; NH Cheshire; VT Windham.	

New York:

007 Albany - Schenectady - Troy, NY:

SMSA Counties:

0160 Albany - Schenectady – Troy, NY	3.2
NY Albany; NY Montgommy, NY Rensselaer, NY Saratoga; NY Schenectady.	
Non-SMSA Counties	2.6
NY Clinton; NY Columbia; NY Essex; NY Fulton; NY Greene; NY Hamilton, NY Schoharie NY Warren; NY Washington; VT Bennington.	

008 Syracuse - Utica, NY:

SMSA Counties:

8160 Syracuse	3.8
NY Madison; NY Onondaga; NY Oswego.	
8680 Utica -Rome, NY	2.1
NY Herkimer; NY Oneida.	
Non-SMSA Counties	2.5
NY Cayuga; NY Cortland; NY Franklin; NY Jefferson; NY Lewis; NY St. Lawrence.	

009 Rochester, NY:

SMSA Counties:

6840 Rochester, NY	5.3
NY Livingston; NY Monroe; NY Ontario; NY Orleans; NY Wayne.	
Non-SMSA Counties	5.9
NY Genesee; NY Seneca; NY Yates.	

010 Buffalo, NY:

SMSA Counties:

1280 Buffalo, NY	7.7
NY Erie; NY Niagara.	
Non-SMSA Counties	6.3
NY Allegany; NY Cattaraugus; NY Chautauqua; NY Wyoming. PA McKean; PA Potter.	

011 Binghamton - Elmira, NY:

SMSA Counties

0960 Binghamton, NY - PA	1.1
NY Broome; NY Tioga; PA Susquehanna.	
2335 Elmira, NY	2.2
NY Chemung	
Non-SMSA Counties	1.2
NY Chenango; NY Delaware; NY Otsego; NY Schuyler; NY Steuben; NY Tompkins; PA Bradford; PA Tioga.	

012 New York, NY:

SMSA Counties:

1163 Bridgeport - Stamford - Norwalk - Danbury, CT _____ CT Fairfield.	10.2
3640 Jersey City, NJ _____ NJ Hudson.	12.8
4410 Long Branch - Asbury Park, NJ _____ NJ Monmouth	9.5
5380 Nassau – Suffolk, NY _____ NY Nassau; NY Suffolk.	5.8
5460 New Brunswick - Perth Amboy - Sayreville, NJ. NJ Middlesex _____	5.8
5600 New York NY, NJ . NJ Bergen; NY Putnam; NY Rockland; NY Westchester _____	22.6

The following goal ranges are applicable to the indicated trades in the counties of Bronx, Kings, New York, Queens, and Richmond.

Electricians	9.0 to 10.2
Carpenters	27.6 to 32.0
Steam fitters	12.2 to 13.5
Metal lathers	24.6 to 25.6
Painters	28.6 to 26.0
Operating Engineers	25.6 to 26.0
Plumbers	12.0 to 14.5
Iron workers (struct)	25.9 to 32.0
Elevator constructors	5.5 to 6.5
Bricklayers	13.4 to 15.5
Asbestos workers	22.8 to 28.0
Roofers	6.3 to 7.5
Iron workers (ornamental)	22.4 to 23.0
Cement masons	23.0 to 27.0
Glaziers	16.0 to 20.0
Plasterers	15.8 to 18.0
Teamsters	22.0 to 22.5
Boilermakers	13.0 to 15.5
All others	16.4 to 17.5

5640 Newark, NJ _____ NJ Essex; NJ Morris; NJ Somerset; NJ Union.	17.3
6040 Paterson - Clifton - Passaic., NJ _____ NJ Passaic.	12.9
6460 Poughkeepsie, NY _____ NY Dutchese	6.4
Non-SMSA Counties _____ NJ Hunterdon; NJ Ocean; NJ Sussex; NY Orange; NY Sullivan; NY Ulster; PA Pike.	17.0

Pennsylvania:

013 Scranton - Wilkes-Barre, PA: SMSA Counties	
5745 Northeast Pennsylvania _____ PA Lackawanna; PA Luzerne; PA Monroe.	0.6
Non-SMSA Counties 0.5 PA Columbia; PA Wayne; PA Wyoming.	
014 Williamsport, PA: SMSA Counties	
9140 Williamsport, PA _____	1.0

PA Lycoming.	
Non-SMSA Counties	0.7
PA Cameron; PA Centre; PA Clearfield; PA Clinton; PA Elk; PA Jefferson;	
PA Montour; PA Northumberland; PA Snyder; PA Sullivan; PA Union.	
015 Erie, PA:	
SMSA Counties:	
2360 Erie, PA	2.8
PA Erie.	
Non-SMSA Counties	1.8
PA Clarion; PA Crawford; PA Forest; PA Venango; PA Warren.	
016 Pittsburgh, PA:	
SMSA Counties	
0280 Altoona, PA	1.0
PA Blair.	
3680 Johnson, PA	1.3
PA Cambria; PA Somerset.	
6280 Pittsburgh, PA	6.3
PA Allegheny; PA Beaver; PA Washington; PA Westmoreland.	
Non-SMSA Counties	4.8
MD Allegany; MD Garrett; PA Armstrong; PA Bedford; PA Butler;	
PA Fayette; PA Greene; PA Indiana; WV Mineral.	
017 Harrisburg - York - Lancaster, PA:	
SMSA Counties	
3240 Harrisburg PA	6.2
PA Cumberland; PA Dauphin; PA Perry.	
4000 Lancaster, PA	2.0
PA Lancaster.	
9280 York, PA	2.2
PA Adams; PA York.	
Non-SMSA-Counties	3.1
PA Franklin; PA Fulton; PA Huntingdon; PA Juniata; PA Lebanon; PA Mifflin.	
018 Philadelphia, PA:	
SMSA Counties	
0240 Allentown - Bethlehem - Easton, PA-NJ	1.6
NJ Warren; PA Carbon; PA Lehigh; PA Northampton.	
0560 Atlantic City, NJ	18.2
NJ Atlantic	
6160 Philadelphia, PA-NJ	17.3
NJ Burlington; NJ Camden; NJ Gloucester; PA Bucks; PA Chester;	
PA Delaware; PA Montgomery; PA Philadelphia.	
8680 Reading, PA	2.5
PA Berks.	
8480 Trenton, NJ	16.4
NJ Mercer.	
8760 Vineland - Millville - Bridgeton, NJ	16.0
NJ Cumberland.	
9160 Wilmington, DE-NJ-MD	12.3
DE Now Castle; MD Cecil; NJ Salem.	
Non-SMSA Counties	14.5
DE Kent; DE Sussex; NJ Cape May; PA Schuylkill.	

Maryland:

019 Baltimore, MD	
SMSA Counties:	
0720 Baltimore MD	23.0
MD Anne Arundel; MD Baltimore; MD Carroll; MD Harford; MD Howard;	
MD Baltimore City.	

Non-SMSA Counties	23.6
MD Caroline; MD Dorchester; MD Kent; MD Queen Annes; MD Somerset; MD Talbot; MD Wicomico; MD Worcester; VA Accomack; VA Northampton	

Washington DC:

020 Washington DC:	
SMSA Counties	
8840 Washington, DC-MD-VA	28.0
DC District of Columbia; MD Charles; Montgomery; MD Prince Georges; VA Arlington; VA Fairfax; VA Loudoun; VA Prince William; VA Alexandria; VA Fairfax City; VA Falls Church.	
Non-SMSA Counties	25.2
MD Calvert; MD Frederick; MD St. Marys; MD Washington; VA Clarke; VA Culpepper; VA Fauquier; VA Frederick; VA King George; VA Page; VA Rappahannock; VA Shenandoah; VA Spottsylvania; VA Stafford; VA Warren; VA Westmoreland; VA Fredericksburg; VA Winchester; WV Berkeley; WV Grant; WV Hampshire; WV Hardy; WV Jefferson; WV Morgan.	

Virginia:

021 Roanoke-Lynchburg VA:	
SMSA Counties:	
4640 Lynchburg, VA	19.3
VA Amherst; VA Appomattox; VA Campbell; VA Lynchburg.	
6800 Roanoke, VA	10.2
VA Botetourt; VA Craig; VA Roanoke VA; VA Roanoke City; VA Salem.	
Non-SMSA Counties	12.0
VA Alleghany, VA Augusta; VA Bath; VA Bedford; VA Bland; VA Carroll; VA Floyd; VA Franklin; VA Giles; VA Grayson; VA Henry; VA Highland; VA Montgomery; VA Nelson; VA Patrick; VA Pittsylvania; VA Pulaski; VA Rockbridge; VA Rockingham; VA Wythe; VA Bedford City; VA Buena Vista; VA Clifton Forge; VA Covington; VA Danville; VA Galex; VA Harrisonburg; VA Lexington; VA Martinsville; VA Radford; VA Staunton; VA Waynesboro; WV Pendleton.	
022 Richmond, VA:	
SMSA Counties:	
6140 Petersburg - Colonial Heights – Hopewell, VA	30.6
VA Dinwiddie; VA Prince George; VA Colonial Heights; VA Hopewell; VA Petersburg.	
6760 Richmond, VA	24.9
VA Charles City; VA Chesterfield; VA Goochland; VA Hanover; VA Henrico; VA New Kent; VA Powhatan; VA Richmond.	
Non-SMSA Counties	27.9
VA Albemarle; VA Amelia; VA Brunswick; VA Buckingham; VA Caroline; VA Charlotte; VA Cumberland; VA Essex; VA Fluvanna; VA Greene; VA Greensville; VA Halifax; VA King And Queen; VA King William; VA Lancaster; VA Louisa; VA Lunenburg; VA Madison; VA Mecklenburg; VA Northumberland; VA Nottoway; VA Orange; VA Prince Edward; VA Richmond; VA Sussex; VA Charlottesville; VA Emporia; VA South Boston.	
023 Norfolk - Virginia Beach - Newport News, VA:	
SMSA Counties:	
5680 Newport News-Hampton, VA....	27.1
VA Gloucester, VA James City; VA York; VA Hampton; VA Newport News; VA Williamsburg.	
5720 Norfolk - Virginia Beach – Portsmouth VA – NC	26.6
NC Currituck; VA Chesapeake; VA Norfolk; VA Portsmouth; VA Suffolk; VA Virginia Beach.	

Non-SMSA Counties	29.7
NC Bertie; NC Camden; NC Chowan; NC Gates; NC Hertford; NC Pasquotank; NC Perquimans; VA Isle of Wight; VA Matthews; VA Middlesex; VA Southampton; VA Surry; VA Franklin.	

North Carolina:

024 Rocky Mount - Wilson - Greenville NC:	
Non-SMSA Counties	31.7
NC Beaufort; NC Carteret; NC Craven; NC Dare; NC Edgecombe; NC Greene; NC Halifax; NC Hyde; NC Jones; NC Lenoir; NC Martin; NC Nash; NC Northampton; NC Pamlico; NC Pitt; NC Tyrrell; NC Washington; NC Wayne; NC Wilson	
025 Wilmington, NC:	
SMSA Counties:	
9200 Wilmington, NC	20.7
NC Brunswick; NC New Hanover.	
Non-SMSA counties	23.5
NC Columbus; NC Duplin; NC Onslow; NC Pender.	
026 Fayetteville, NC:	
SMSA Counties:	
2560 Fayetteville, NC	26.2
NC Cumberland.	
Non-SMSA Counties	33.5
NC Bladen; NC Hoke; NC Richmond; NC Robeson; NC Sampson; NC Scotland.	
027 Raleigh - Durham, NC.	
SMSA Counties:	
6640 Raleigh – Durham	22.8
NC Durham; NC Orange; NC Wake.	
Non-SMSA Counties	24.7
NC Chatham; NC Franklin; NC Granville; NC Harnett; NC Johnston; NC Lee; NC Person; NC Vance; NC Warren.	
028 Greensboro - Winston Salem - High Point, NC:	
SMSA Counties:	
1300 Burlington, NC	16.2
NC Alamance.	
3120 Greensboro - Winston Salem – High Point NC	16.4
NC Davidson; NC Forsyth; NC Guilford; NC Randolph; NC Stokes; NC Yadkin.	
Non-SMSA Counties	15.5
NC Alleghany; NC Ashe; NC Caswell; NC Davie; NC Montgomery; NC Moore; NC Rockingham; NC Surry; NC Watauga; NC Wilkes.	
029 Charlotte, NC:	
SMSA Counties:	
1520 Charlotte – Gastonia, NC	18.5
NC Gaston; NC Mecklenburg; NC Union.	
Non-SMSA Counties	15.7
NC Alexander; NC Anson; NC Burke; NC Cabarrus; NC Caldwell; NC Catawba; NC Cleveland; NC Iredell; NC Lincoln; NC Rowan; NC Rutherford; NC Stanley; SC Chester; SC Lancaster SC York.	
030 Asheville, NC	
Non-SMSA Counties:	
0480 Asheville, NC	8.5
NC Buncombe; NC Madison.	
Non-SMSA Counties	6.3
NC Avery; NC Cherokee; NC Clay; NC Graham; NC Heywood; NC Henderson; NC Jackson; NC McDowell; NC Macon; NC Mitchell; NC Swain; NC Transylvania; NC Yancey.	

South Carolina:

031 Greenville – Spartanburg, SC:	
SMSA Counties:	
3160 Greenville –Spartanburg, SC	16.0
SC Greenville; SC Pickens; SC Spartanburg.	
Non-SMSA Counties	17.8
SC Polk; SC Abbeville; SC Anderson; SC Cherokee; SC Greenwood; SC Laurens; SC Oconee; SC Union.	
032 Columbia, SC	
SMSA Counties:	
1760 Columbia, SC	23.4
SC Lexington; SC Richland.	
Non-SMSA Counties	32.0
SC Calhoun SC Clarendon; SC Fairfield; SC Kershaw; SC Lee; SC Newberry; SC Orangeburg; SC Saluda; SC Sumter	
033 Florence, SC	
Non-SMSA Counties	33.0
SC Chesterfield; SC Darlington; SC Dillon; SC Florence; SC Georgetown; SC Horry; SC Marion; SC Marlboro; SC Williamsburg.	
034 Charleston - North Charleston, SC	
SMSA Counties	
1440 Charleston - North Charleston, SC	30.0
SC Berkeley; SC Charleston; SC Dorchester.	
Non-SMSA Counties	30.7
SC Collection	

Georgia:

035 Augusta, GA:	
SMSA Counties:	
0600 Augusta, GA – SC	27.2
GA Columbia; GA Richmond; SC Aiken	
Non-SMSA Counties	32.8
GA Burke; GA Emanuel; GA Glascock; GA Jefferson; GA Jenkins; GA Lincoln; GA McDuffie; GA Taliaferro; GA Warren; GA Wilkes; SC Allendale, SC Bamberg; SC Barnwell; SC Edgefield; SC McCormick	
036 Atlanta, GA	
SMSA Counties	
0520 Atlanta	21.2
GA Butts; GA Cherokee; GA Clayton; GA Cobb; GA DeKalb; GA Douglas; GA Fayette; GA Forsyth; GA Fulton; GA Gwinnett; GA Henry, GA Newton; GA Paulding; GA Rockdale; GA Walton	
Non-SMSA Counties	19.5
GA Banks; GA Barrow; GA Bartow; GA Carroll; GA Clarke; GA Coweta; GA Dawson; GA Elbert; GA Fannin; GA Floyd; GA Franklin; GA Gilmer; GA Gordon; GA Greene; GA Habersham; GA Hall; GA Haralson; GA Hart; GA Heard; GA Jackson; GA Jasper; GA Lamar, GA Lumpkin; GA Madison, GA Morgan; GA Oconee, GA Oglethorpe; GA Pickens; GA Pike; GA Polk; GA Rabun, GA Spalding; GA Stephens; GA Towns; GA Union; GA Upson; GA White.	
037 Columbus, GA:	
SMSA Counties	
1800 Columbus	29.6
AL Russell; GA Chattahoochee; GA Columbus.	
Non-SMSA Counties	31.6
AL Chambers; AL Lee; GA Harris; GA Marion; GA Meriwether; GA Quitman; GA Schley; GA Stewart; GA Sumter; GA Talbot; GA Troup; GA Webster.	

038 Macon, GA:	
SMSA Counties	
4660 Macon, GA	27.5
GA Bibb; GA Houston; GA Jones; GA Twiggs.	
Non-SMSA Counties	
GA Baldwin; GA Bleckley; GA Crawford; GA Crisp; GA Dodge; GA Dooly; GA Hancock;	
GA Johnson; GA Laurens; GA Macon; GA Monroe; GA Peach; GA Pulaski; GA	
Putnam. GA Taylor; GA Telfair; GA Treutlen; GA Washington; GA Wheeler; GA Wilcox;	
GA Wilkinson.	
039 Savannah, GA:	
SMSA Counties:	
7520 Savannah, GA	30.6
GA Bryan; GA Chatham; GA Effingham	
Non-SMSA Counties	
GA Appling; GA Atkinson; GA Bacon; GA Bullock; GA Candler; GA Coffee;	
GA Evans; GA Jeff Davis; GA Liberty; GA Long; GA McIntosh; GA Montgomery;	
GA Screven; GA Tattinall; GA Toombs; GA Wayne; SC Beaufort; SC Hampton; SC Jasper.	
040 Albany, GA	
SMSA Counties	
0120 Albany, GA	32.1
GA Dougherty; GA Lee.	
Non-SMSA Counties	
GA Baker; GA Ben Hill; GA Berrien; GA Brooks; GA Calhoun; GA Clay; GA Clinch; GA	
Colquitt; GA Cook; GA Decatur; GA Early; GA Echols; GA Grady; GA Irwin; GA Lanier;	
GA Lowndes; GA Miller; GA Mitchell; GA Randolph; GA Seminole, GA Terrell; GA	
Thomas; GA Tift; GA Turner; GA Worth.	

Florida:

041 Jacksonville, FL:	
SMSA Counties	
2900 Gainesville, FL	20.6
FL Alachua	
3600 Jacksonville, FL	21.8
FL Baker; FL Clay; FL Duval; FL Nassau; FL St. Johns.	
Non-SMSA Counties	
FL Bradford; FL Columbia; FL Dade; FL Gilchrist; FL Hamilton; FL LaFayette;	
FL Levy; FL Marion; FL Putnam; FL Suwannee; FL Union; GA Brantley; GA Camden;	
GA Charlton; GA Glynn; GA Pierce; GA Ware.	
042 Orlando - Melbourne - Daytona Beach, FL.	
SMSA Counties:	
2020 Daytona Beach, FL	15.7
FL Volusia.	
4900 Melbourne – Tutusville – Cocoa, FL	10.7
FL Brevard.	
5960 Orlando, FL	15.5
FL Orange; FL Osceola; FL Seminole.	
Non-SMSA Counties	
FL Flagler; FL Lake; FL Sumter.	
043 Miami - Fort Lauderdale, FL:	
SMSA Counties:	
2680 Fort Lauderdale – Hollywood, FL	15.5
FL. Broward.	
5000 Miami, FL	39.5
FL Dade.	
8960 West Palm Beach - Boca Raton, FL	22.4
FL Palm Beach.	

Non-SMSA Counties	30.4
FL Glades; FL Hendry; FL Indian River; FL Martin; FL Monroe; FL Okeechobee; FL St. Lucie.	
044 Tampa - St Petersburg, FL	
SMSA Counties:	
1140 Bradenton, FL	15.9
FL Manatee.	
2700 Fort Myers, FL	15.3
FL Lee.	
3980 Lakeland - Winter Haven, FL	18.0
FL Polk	
7510 Sarasota, FL	10.5
FL Sarasota.	
8280 Tampa - St. Petersburg, FL	17.9
FL Hillsborough, FL Pasco; FL Pinellas	
Non-SMSA Counties	17.1
FL Charlotte; FL Citrus; FL Collier, FL Desoto; FL Hardee; FL Hernando; FL Highlands.	
045 Tallahassee, FL:	
SMSA Counties:	
8240 Tallahassee, FL	24.3
FL Leon; FL Wakulla.	
Non-SMSA Counties:	29.5
FL Calhoun; FL Franklin; FL Gadsden; FL Jackson; FL Jefferson; FL Liberty; FL Madison; FL Taylor.	
046 Pensacola - Panama City, FL	
SMSA Counties:	
8615 Panama City, FL	14.1
FL Bay.	
6080 Pensacola, FL	18.3
FL Escambia; FL Santa Rosa.	
Non-SMSA Counties	15.4
FL Gulf; FL Holmes; FL Okaloosa; FL Walton; FL Washington.	

Alabama:

047 Mobile, AL	
SMSA Counties:	
5160 Mobile, AL	26.9
AL Baldwin; AL Mobile.	
6026 Pascagoula - Moss, Point MS	16.9
MS Jackson.	
Non-SMSA Counties	26.4
AL Choctaw; AL Clarke; AL Conecuh; AL Escambia; AL Monroe; AL Washington; AL Wilcox; MS George; MS Greene.	
048 Montgomery, AL:	
SMSA Counties	
5240 Montgomery, AL	29.9
AL Autauga; AL Elmore; AL Montgomery.	
Non-SMSA Counties	29.9
AL Barbour; AL Bullock; AL Butler; AL Coffee; AL Coosa; AL Covington; AL Crenshaw; AL Dale; AL Dallas; AL Geneva; AL Henry; AL Houston; AL Lowndes; AL Macon; AL Perry; AL Pike; AL Tallapoosa.	
049 Birmingham, AL:	
SMSA Counties:	
0450 Anniston, AL	14.3
AL Calhoun.	

1000 Birmingham, AL	24.9
AL Jefferson; AL St. Clair; AL Shelby; AL Walker; AL Etowah	
8600 Tuscaloosa, AL	20.6
AL Tuscaloosa.	
Non-SMSA Counties	20.7
AL Bibb; AL Blount; AL Cherokee; AL Chilton; AL Clay; AL Cleburne; AL Cullman; AL Fayette; AL Greene; AL Hale; AL Lamar; AL Marion; AL Pickens; AL Randolph; AL Sumter; AL Talladega; AL Winston.	
050 Huntsville – Florence, AL:	
SMSA Counties:	
2650 Florence, AL	11.9
AL Colbert; AL Lauderdale.	
3440 Huntsville, AL	12.0
AL Limestone; AL Madison; AL Marshall.	
Non-SMSA Counties	11.2
AL Franklin; AL Lawrence AL Morgan; TN Lincoln.	

Tennessee:

051 Chattanooga, TN:	
SMSA Counties:	
1560 Chattanooga, TN – GA	12.5
GA Catoosa; GA Dade; GA Walker; TN Hamilton; TN Marion; TN Sequatchie.	
Non-SMSA Counties	8.6
AL De Kalb; AL Jackson; GA Chattooga; GA Murray; GA Whitfield; TN Bledsoe; TN Bradley; TN Grundy; TN McMinn; TN Meigs; TN Monroe; TN Polk; TN Rhea.	
052 Johnson City - Kingsport - Bristol, TN-VA:	
SMSA Counties:	
3660 Johnson City - Kingsport - Bristol. TN – VA	2.6
TN Carter; TN Hawkins; TN Sullivan; TN Unicoi; TN Washington; VA Scott; VA Washington; VA Bristol.	
Non-SMSA Counties	3.2
TN Greene; TN Hancock; TN Johnson; VA Buchanan; VA Dickenson; VA Lee; VA Russell; VA Smyth; VA Tazewell; VA Wise; VA Norton; WV McDowell, WV Mercer.	
053 Knoxville, TN	
SMSA Counties:	
3840 Knoxville, TN	6.6
TN Anderson; TN Blount; TN Knox; TN Union.	
Non-SMSA Counties	4.5
KY Bell; KY Harlan; KY Knox; KY Laurel; KY McCreary; KY Wayne; KY Whitley; TN Campbell; TN Claiborne; TN Cocke; TN Cumberland; TN Fentress; TN Grainger, TN Hamblen; TN Jefferson; TN Loudon; TN Morgan; TN Roane; TN Scott; TN Sevier.	
054 Nashville, TN:	
SMSA Counties:	
1660 Clarksville - Hopkinsville, TN - KY	18.2
KY Christian; TN Montgomery.	
5360 Nashville - Davidson, TN	15.8
TN Cheatham, TN Davidson; TN Dickson; TN Robertson; TN Rutherford; TN Sumner; TN Williamson; TN Wilson.	
Non-SMSA Counties	12.0
KY Allen; KY Barren; KY Butler; KY Clinton; KY Cumberland; KY Edmonson; KY Logan; KY Metcalfe; KY Monroe; KY Simpson; KY Todd; KY Trigg; KY Warren; TN Bedford; TN Cannon; TN Clay; TN Coffee; TN DeKalb; TN Franklin; TN Giles; TN Hickman; TN Houston; TN Humphreys; TN Jackson; TN Lawrence; TN Lewis; TN Macon; TN Marshall; TN Maury; TN Moore; TN Overton; TN Perry; TN Pickett;	

TN Putnam; TN Smith; TN Stewart; TN Trousdale; TN Van Buren; TN Warren;
 TN Wayne; TN White.

055 Memphis, TN:

SMSA Counties:

4920 Memphis, TN-AR-MS _____ 32.3

AR Critteriden; MS Do Soto; TN Shelby; TN Tipton.

Non-SMSA Counties _____ 26.5

AR Clay; AR Craighead; AR Cross; AR Greene; AR Lawrence; AR Lee;
 AR Mississippi; AR Phillips; AR. Poinsett; AR Randolph; AR St. Francis; MS Alcorn;
 MS Benton; MS Bolivar; MS Calhoun; MS Carroll; MS Chickasaw, MS Clay;
 MS Coahoma; MS Grenada; MS Itawamba; MS Lafayette; MS Lee; MS Leflore;
 MS Marshall; MS Monroe; MS Montgomery; MS Panola; MS Pontotoc; MS Prentiss;
 MS Quitman; MS Sunflower; MS Tallahatchie; MS Tate; MS Tippah; MS Tishomingo;
 MS Union; MS Washington; MS Webster. MS Yalobusha; MO Dunklin;
 MO New Madrid; MO Pemiscot; TN Benton; TN Carroll; TN Chester; TN Crockett;
 TN Decatur; TN Dyer; TN Fayette; TN Gibson; TN Hardeman; TN Hardin;
 TN Haywood; TN Henderson; TN Henry; TN Lake; TN Lauderdale; TN McNairy;
 TN Madison; TN Obion; TN Weakley.

Kentucky:

056 Paducah, KY:

Non-SMSA Counties _____ 5.2

IL Hardin; IL Massac; IL Pope; KY Ballard; KY Caldwell; KY Calloway. KY Carlisle;
 KY Crittenden; KY Fulton; KY Graves; KY Hickman; KY Livingston; KY Lyon. KY
 McCracken; KY Marshall.

057 Louisville, KY:

SMSA Counties:

4520 Louisville, KY-IN _____ 11.2

IN Clark; IN Floyd; KY Bullitt; KY Jefferson; KY Oldham.

Non-SMSA Counties _____ 9.6

IN Crawford; IN Harrison; IN Jefferson; IN Orange; IN Scott; IN Washington;
 KY Breckinridge; KY Grayson; KY Hardin; KY Hart; KY Henry; KY Larue; KY Marion;
 KY Meade; KY Nelson; KY Shelby; KY Spencer; KY Trimble; KY Washington.

058 Lexington, KY

SMSA Counties

4280 Lexington-Fayette, KY _____ 10.8

KY Bourbon; KY Clark; KY Fayette; KY Jessamine; KY Scott; KY Woodford.

Non-SMSA Counties _____ 7.0

KY Adair KY Anderson; KY Bath; KY Boyle; KY Breathitt; KY Casey; KY Clay;
 KY Estill; KY Franklin; KY Garrard; KY Green; KY Harrison; KY Jackson; KY Knott;
 KY Lee; KY Leslie; KY Letcher; KY Lincoln; KY Madison; KY Magoffin; KY Menifee;
 KY Mercer; KY Montgomery; KY Morgan. KY Nicholas; KY Owsley; KY Perry;
 KY Powell; KY Pulaski; KY Rockcastle; KY Russell; KY Taylor; KY Wolfe.

West Virginia:

059 Huntington, WV:

SMSA Counties:

3400 Huntington – Ashland, WV-KY-OH _____ 2.9

KY Boyd; KY Greenup; OH Lawrence; WV Cabell; WV Wayne.

Non-SMSA Counties _____ 2.5

KY Carter; KY Elliott; KY Floyd; KY Johnson; KY Lawrence; KY Martin; KY Pike;
 KY Rowan; OH Gallia; WV Lincoln; WV Logan; WV Mason; WV Mingo.

060 Charleston, WV

SMSA Counties:

1480 Charleston, WV	4.9
WV Kanawha; WV Putnam.	
Non-SMSA Counties	4.2
WV Boone; WV Braxton; WV Calhoun; WV Clay; Fayette; WV Gilmer; WV Greenbrier; WV Jackson; WV Monroe; WV Nicholas; WV Pocahontas; WV Raleigh; WV Roane; WV Summers; WV Webster; WV Wyoming.	
061 Morgantown-Fairmont; WV:	
Non-SMSA Counties	2.1
WV Barbour; WV Doddridge; WV Harrison; WV Lewis; WV Marion; WV Monongalia; WV Preston; WV Randolph; WV Taylor; WV Tucker, WV Upshur.	
062 Parkersburg, WV:	
SMSA Counties:	
6020 Parkersburg-Marietta. WV-OH	1.1
OH Washington; WV Wirt; WV Wood.	
Non-SMSA Counties	1.2
WV Pleasants; WV Ritchie.	
063 Wheeling - Steubenville - Wierton, WV-OH:	
SMSA Counties:	
8080 Steubenville-Wierton, OH-WV	4.3
OH Jefferson; WV Brooke; WV Hancock.	
9000 Wheeling, WV-OH	2.4
OH Belmont; WV Marshall; WV Ohio.	
Non-SMSA Counties	3.0
OH Harrison; OH Monroe; WV Tyler; WV Wetzel.	

Ohio:

064 Youngstown-Warren, OH:	
SMSA Counties:	
9320 Youngstown-Warren, OH	9.4
OH Mahoning; OH Trumbull.	
NonSMSA Counties	6.7
OH Columbiana; PA Lawrence; PA Mercer.	
065 Cleveland, OH:	
SMSA Counties:	
0080 Akron, OH	7.8
OH Portage; OH Summit.	
1320 Canton, OH	6.1
OH Carroll; OH Stark.	
1680 Cleveland, OH	16.1
OH Cuyahoga; OH Geauga; OH Lake; OH Medina.	
4440 Lorain-Elyria, OH	9.3
OH Lorain.	
4800 Mansfield, OH	6.3
OH Richland.	
Non-SMSA Counties:	
OH Ashland; OH Ashtabula; OH Coshocton; OH Crawford; OH Erie; OH Holmes; OH Huron; OH Tuscarawas; OH Wayne.	
066 Columbus, OH:	
SMSA Counties:	
1840 Columbus, OH	10.6
OH Delaware; OH Fairfield; Franklin; OH Madison; OH Pickaway.	
Non-SMSA Counties	7.3
OH Athens; OH Fayette; OH Guernsey; OH Hocking; OH Jackson; OH Knox; OH Licking; OH Marion; OH Meigs; OH Morgan; OH Morrow; OH Muskingum; OH Noble; OH Perry OH Pike; OH Ross; OH Scioto; OH Union; OH Vinton.	
067 Cincinnati, OH:	
SMSA Counties:	

1640 Cincinnati, OH-KY-IN	11.0
IN Dearborn; KY Boone; KY Campbell; KY Kenton; OH Clermont; OH Hamilton; OH Warren.	
3200 Hamilton-Middletown, OH	5.0
OH Butler.	
Non-SMSA Counties	9.2
IN Franklin; IN Ohio; IN Ripley; IN Switzerland; KY Bracken; KY Carroll; KY Fleming; KY Gallatin; KY Grant; KY Lewis; KY Mason; KY Owen; KY Pendleton; KY Robertson; OH Adams; OH Brown; OH Clinton; OH Highland.	
068 Dayton, OH:	
SMSA Counties:	
2000 Dayton, OH	11.5
OH Greene; ON Miami; OH Montgomery; OH Preble.	
7960 Springfield, OH	7.8
OH Champaign; OH Clark.	
Non-SMSA Counties	9.9
OH Darke; OH Logan; ON Shelby.	
069 Lima, OH:	
SMSA Counties:	
4320 Lima, OH	4.4
OH Allen; OH Auglaize; OH Putnam; OH Van Wert.	
Non-SMSA Counties	3.5
OH Hardin; OH Mercer.	
070 Toledo, OH:	
SMSA Counties:	
8400 Toledo, OH-MI	8.8
MI Monroe; OH Fulton; OH Lucas; OH Ottawa; OH Wood.	
Non-SMSA Counties	7.3
MI Lenawee; OH Hancock; OH Henry; OH Sandusky; OH Seneca; OH Wyandot.	

Michigan:

071 Detroit, MI:	
SMSA Counties:	
0440 Ann Arbor, MI	8.5
MI Washtenaw.	
2160 Detroit, MI	17.7
MI Lapeer; MI Livingston; MI Macomb; MI Oakland; MI St. Clair; MI Wayne.	
2640 Flint, MI	12.6
MI Genesee; MI Shiawassee.	
Non-SMSA Counties	16.7
MI Sanilac.	
072 Saginaw, MI:	
SMSA Counties:	
0800 Bay City, MI	2.2
MI Bay.	
6960 Saginaw, MI	14.3
MI Saginaw.	
Non-SMSA Counties	5.2
MI Alcona; MI Alpena; MI Arenac; MI Cheboygan; MI Chippewa; MI Clare; MI Crawford; MI Gladwin; MI Gratiot; MI Huron; MI Iosco; MI Isabella; MI Luce; MI Mackinac; MI Midland; MI Montmorency; MI Ogemaw; MI Oscoda; MI Otsego; MI Presque Isle; MI Roscommon; MI Tuscola.	
073 Grand Rapids, MI:	
SMSA Counties:	
3000 Grand Rapids, MI	5.2
MI Kent; MI Ottawa.	

5320 Muskegon - Norton Shores - Muskegon Heights, MI _____	9.7
MI Muskegon; MI Oceana.	
Non-SMSA Counties _____	4.9
MI Allegan; MI Antrim; MI Benzie; MI Charlevoix; MI Emmet; MI Grand Traverse; MI Kalkaska; MI Lake; MI Leelanau; MI Manistee; MI Mason; MI Mecosta; MI Missaukee; MI Montcalm; MI Newaygo; MI Osceola; MI Wexford.	
074 Lansing - Kalamazoo, MI:	
SMSA Counties:	
0780 Battle Creek, MI _____	7.2
MI Barry; MI Calhoun.	
3520 Jackson, MI _____	5.1
MI Jackson.	
3720 Kalamazoo-Portage, MI _____	5.9
MI Kalamazoo; MI Van Buren.	
4040 Lansing-East Lansing, MI _____	5.5
MI Clinton; MI Eaton; MI Ingham; MI Ionia.	
Non-SMSA Counties _____	5.5
MI Branch; MI Hillsdale.	

Indiana:

075 South Bend, IN:	
SMSA Counties:	
7800 South Bend, IN _____	7.1
IN Marshall; IN St. Joseph,	
2330 Elkhart IN _____	4.0
IN Elkhart.	
Non-SMSA Counties _____	6.2
IN Fulton; IN Kosciusko; IN Lagrange; MI Berrien; MI Cass; MI St. Joseph.	
076 Fort Wayne, IN:	
Non-SMSA Counties _____	4.4
IN Allen; IN Dekalb; IN Wells; IN Huntington; IN Noble; IN Steuben; IN Whitley; OH Defiance; OH Paulding; OH Williams.	
077 Kokomo-Marion, IN:	
SMSA Counties:	
3850 Kokomo, IN _____	4.4
IN Howard; IN Tipton.	
Non-SMSA Counties _____	3.7
IN Cass; IN Grant; IN Miami; IN Wabash.	
078 Anderson-Muncie, IN:	
SMSA Counties:	
0400 Anderson, IN _____	4.9
IN Madison.	
5280 Muncie, IN _____	5.3
IN Delaware.	
Non-SMSA Counties _____	3.9
IN Blackford; IN Fayette; IN Henry; IN Jay; IN Randolph; IN Union; IN Wayne.	
079 Indianapolis, IN:	
SMSA Counties:	
1020 Bloomington, IN _____	3.1
IN Monroe.	
3480 Indianapolis, IN _____	12.5
IN Boone; IN Hamilton; IN Hendricks; IN Johnson; IN Marion; IN Morgan; IN Shelby.	
Non-SMSA Counties _____	9.7
IN Bartholomew; IN Brown; IN Daviess; IN Decatur; IN Greene; IN Jackson; IN Jennings; IN Lawrence; IN Martin; IN Owen; IN Putnam; IN Rush.	

080 Evansville, IN:	
SMSA Counties	
2440 Evansville, IN-KY	4.8
IN Gibson; IN Posey; IN Vanderburgh; IN Warrick; KY Henderson.	
5990 Owensboro, KY	4.7
KY Daviess.	
Non-SMSA Counties	3.5
IL Edwards; IL Gallatin; IL Hamilton; IL Lawrence; IL Saline; IL Wabash; IL White; IN Dubois; IN Knox; IN Perry; IN Pike; IN Spencer; KY Hancock; KY Hopkins; KY McLean; KY Muhlenberg; KY Ohio; KY Union; KY Webster.	
081 Terre Haute, IN:	
SMSA Counties:	
8320 Terre Haute, IN	3.1
IN Clay; IN Sullivan; IN Vermillion; IN Vigo.	
Non-SMSA Counties	2.5
IL Clark; IL Crawford; IN Parke.	
082 Lafayette, IN:	
SMSA Counties:	
3920 Lafayette - West Lafayette, IN	2.7
IN Tippecanoe.	
Non-SMSA Counties	1.5
IN Benton; IN Carroll; IN Clinton; IN Fountain; IN Montgomery; IN Warren; IN White.	

Illinois:

083 Chicago, IL:	
SMSA Counties:	
1600 Chicago, IL	19.6
IL Cook; IL Du Page; IL Kane; IL Lake; IL McHenry; IL Will.	
2960 Gary - Hammond - East Chicago, IN	20.9
IN Lake; IN Porter.	
3740 Kankakee, IL	9.1
IL Kankakee.	
3800 Kenosha, WI	3.0
WI Kenosha.	
Non-SMSA Counties	18.4
IL Bureau; IL De Kalb; IL Grundy; IL Iroquois; IL Kendall; IL La Salle; IL Livingston; IL Putnam; IL Jasper; IN Laporte; IN Newton; IN Pulaski; IN Starke.	
084 Champaign-Urbana, IL:	
SMSA Counties:	
1400 Champaign - Urbana – Rantoul, IL	7.8
IL Champaign.	
Non-SMSA Counties	4.8
IL Coles; IL Cumberland; IL Douglas; IL Edgar; IL Ford; IL Platt; IL Vermilion.	
085 Springfield-Decatur, IL:	
SMSA Counties:	
2040 Decatur, IL	7.6
IL Macon.	
7880 Springfield, IL	4.5
IL Menard; IL Sangamon.	
Non-SMSA Counties	4.0
IL Cass; IL Christian; IL De Witt; IL Logan; IL Morgan; IL Moultrie; IL Scott; IL Shelby.	
086 Quincy, IL:	
Non-SMSA Counties	3.1
IL Adams; IL Brown; IL Pike; MO Lewis; MO Marlon; MO Pike; MO Rails.	

087 Peoria, IL:	
SMSA Counties	
1040 Bloomington - Normal, IL_____	2.5
IL McLean.	
8120 Peoria, IL_____	4.4
IL Peoria; IL Tazewell; IL Woodford.	
Non-SMSA Counties_____	
IL Fulton; IL Knox; IL McDonough; IL Marshall; IL Mason; IL Schuyler;	
IL Stark; IL Warren.	
088 Rockford, IL:	
SMSA Counties:	
6880 Rockford, IL_____	6.3
IL Boone; IL Winnebago.	
3620 Janesville - Beloit WI_____	3.1
WI Rock	
Non-SMSA Counties_____	
IL Lee; IL Ogle; IL Stephenson.	

Wisconsin:

089 Milwaukee, WI:	
SMSA Counties:	
5080 Milwaukee, WI_____	8.0
WI Milwaukee; WI Ozaukee; WI Washington; WI Waukesha.	
6600 Racine, WI_____	8.4
WI Racine.	
Non-SMSA Counties_____	
WI Dodge; WI Jefferson; WI Sheboygan; WI Walworth.	
090 Madison, WI:	
SMSA Counties:	
4720 Madison, WI_____	2.2
WI Dane.	
Non-SMSA Counties_____	
WI Adams; WI Columbia; WI Green; WI Iowa; WI Marquette; WI Richland; WI Sauk.	
091 La Crosse, WI:	
SMSA Counties:	
3870 LaCrosse. WI_____	0.9
Non-SMSA Counties_____	
MN Houston; MN Winona; WI Buffalo; WI Jackson; WI Juneau; WI Monroe;	
WI Trempealeau; WI Vernon.	
092 Eau Claire, WI:	
SMSA Counties:	
2290 Eau Claire, WI_____	0.5
WI Chippewa; WI Eau Claire.	
Non-SMSA Counties_____	
WI Barron; WI Dunn; WI Pepin; WI Rusk; WI Sawyer; WI Washburn.	
093 Wausau, WI:	
Non-SMSA Counties_____	
WI Clark; WI Langlade; WI Lincoln; WI Marathon; WI Oneida; WI Portage;	
WI Price; WI Taylor; WI Vilas; WI Wood.	
094 Appleton - Green Bay - Oshkosh, WI:	
SMSA Counties:	
0460 Appleton-Oshkosh, WI_____	0.9
WI Calumet; WI Outaramie; WI Winnebago.	
3080 Green Bay, WI_____	1.3
WI Brown.	

Non-SMSA Counties	1.0
MI Alger; MI Baraga; MI Delta; MI Dickinson; MI Houghton; MI Iron; MI Keweenaw; MI Marquette; MI Menominee; MI Schoolcraft; WI Door; WI Florence; WI Fond Du Lac; WI Forest WI Green Lake; WI Kewaunee; WI Manitowoc; WI Marinette; WI Menominee; WI Oconto; WI Shawano; WI Waupaca; Waushara.	
095 Duluth, MN:	
SMSA Counties:	
2240 Duluth - Superior, MN-WI	1.0
MN St Louis; WI Douglas.	
Non-SMSA Counties	1.2
MI Gogebic; MI Ontonagon; MN Carlton; MN Cook; MN Itasca; MN Koochiching; MN Lake; WI Ashland; WI Bayfield; WI Iron.	

Minnesota:

096 Minneapolis-St. Paul, MN:	
SMSA Counties:	
5120 Minneapolis-St. Paul, MN-WI	2.9
MN Anoka; MN Carver; MN Chisago; MN Dakota; MN Hennepin; MN Ramsey; MN Scott; MN Washington; MN Wright; MN St. Croix.	
6980 St. Cloud, MN	0.5
MN Benton; MN Sherburne; MN Stearns.	
Non-SMSA Counties	2.2
MN Aitkin; MN Big Stone; MN Blue Earth; MN Brown; MN Cass; MN Chippewa; MN Crow Wing; MN Douglas; MN Faribault; MN Goodhue; MN Grant; MN Isanti; MN Kanabec; MN Kandiyohi; MN Lac Qui Parle; MN Le Sueur; MN McLeod; MN Martin; MN Meeke; MN Mille Lacs; MN Mornson; MN Nicollet; MN Pine; MN Pope; MN Renville; MN Rice; MN Sibley; MN Stevens; MN Swift; MN Todd; MN Traverse; MN Wadena; MN Waseca; MN Watonwan; MN Yellow Medicine; WI Burnett; WI Pierce; WI Polk.	
097 Rochester, MN:	
SMSA Counties:	
6820 Rochester, MN	1.4
MN Olmsted.	
Non-SMSA Counties	0.9
MN Dodge; MN Fillmore; MN Freeborn; MN Mower; MN Steele; MN Wabasha.	

Iowa:

098 Dubuque, IA:	
SMSA Counties:	
2200 Dubuque, IA	0.6
IA Dubuque	
Non-SMSA Counties	0.5
IL Jo Daviess; IA Allamakee; IA Clayton; IA Delaware, IA Jackson; IA Winneshiek; WI Crawford; WI Grant; WI Lafayette.	
099 Davenport-Rock Island-Moline, IA-IL:	
SMSA Counties:	
1960 Davenport-Rock Island-Moline, IA-IL	4.6
IL Henry; IL Rock Island; IA Scott.	
Non-SMSA Counties	3.4
IL Carroll; IL Hancock; IL Henderson; IL Mercer; IL Whiteside; IA Clinton; IA Des Moines; IA Henry; IA Lee; IA Louisa; IA Muscatine; MO Clark.	
100 Cedar Rapids, IA:	
SMSA Counties:	
1360 Cedar Rapids, IA	1.7
IA Linn.	
Non-SMSA Counties	1.5

IA Benton; IA Cedar; IA Iowa; IA Johnson; IA Jones; IA Washington.	
101 Waterloo, IA:	
SMSA Counties:	
8920 Waterloo-Cedar Falls, IA	4.7
IA Black Hawk.	
Non-SMSA Counties	2.0
IA Bremer; IA Buchanan; IA Butler; IA Cerro Gordo; IA Chickasaw; IA Fayette; IA Floyd; IA Franklin; IA Grundv; IA Hancock; IA Hardin; IA Howard; IA Mitchell; IA Winnegago; IA Worth.	
102 Fort Dodge, IA:	
Non-SMSA Counties	0.4
IA Bueno Vista; IA Calhoun; IA Carroll; IA Clay; IA Dickinson; IA Emmet; IA Greene; IA Hamilton; IA Humboldt; IA Kossuth; IA Palo Alto; IA Pocahontas; IA Sac; IA Webster; IA Wright.	
103 Sioux City, IA:	
SMSA Counties:	
7720 Sioux City, IA-NE	1.9
IA Woodbury; NE Dakota.	
Non-SMSA Counties	1.2
IA Cherokee, IA Crawford; IA Ida; IA Monona; IA O'Brien; IA Plymouth; IA. Sioux; NE Antelope; NE Cedar; NE Cuming; NE Dixon; NE Knox; NE Madison; NE Pierce; NE Stanton; NE Thurston; NE Wayne; SD Bon Homme; SD Clay; SD Union; SD Yankton.	
104 Des Moines, IA:	
SMSA Counties:	
2120 Des Moines, IA	4.5
IA Polk; IA Warren.	
Non-SMSA Counties	2.4
IA Adair; IA Appanoose; IA Boone; IA Clarke; IA Dallas; IA Davis; IA Decatur; IA Guthrie; IA Jasper; IA Jefferson; IA Keokuk; IA Lucas; IA Madison; IA Mahaska; IA Marion; IA Marshall; IA Monroe; IA Poweshiek; IA Ringgold; IA Story; IA Tama; IA Union; IA Van Buren; IA Wapello; IA Wayne.	

Missouri:

105 Kansas City, MO:	
SMSA Counties:	
3760 Kansas City, MO-KS	12.7
KS Johnson; KS Wayandotte; MO Cass; MO Clay; MO Jackson; MO Platte; MO Ray.	
4150 Lawrence, KS	7.2
7000 St Joseph, MO	3.2
MO Andrew; MO Buchanan.	
Non-SMSA Counties	10.0
KS Anderson; KS Atchison; KS Brown; KS Doniphan; KS Franklin; KS Leavenworth; KS Linn; KS Miami; MO Atchison; MO Bates; MO Benton; MO Caldwell; MO Carroll; MO Clinton; MO Daviess; MO Dekalb; MO Gentry; MO Grundy; MO Harrison; MO Henry; MO Holt; MO Johnson; MO Lafayette; MO Livingston; MO Mercer; MO Nodaway; MO Pettis; MO Saline; MO Worth.	
106 Columbia, MO:	
SMSA Counties:	
1740 Columbia, MO; MO Boone	6.3
Non-SMSA Counties	4.0
MO Adair; MO Audrain; MO Callaway; MO Camden; MO Chariton; MO Cole; MO Cooper; MO Howard; MO Knox; MO Linn; MO Macon; MO Miller; MO Moniteau; MO Monroe; MO Morgan; MO Osage; MO Putnam; MO Randolph; MO Schuyler; MO Scotland; MO Shelby; MO Sullivan.	

107 St. Louis, MO:	
SMSA Counties:	
7040 St. Louis, MO-IL	14.7
IL Clinton; IL Madison; IL Monroe; IL St. Clair; MO Franklin; MO Jefferson; MO St. Charles; MO St. Louis; MO St. Louis City.	
Non-SMSA Counties	11.4
IL Alexander; IL Bond; IL Calhoun; IL Clay; IL Effingham; IL Fayette; IL Franklin; IL Greene; IL Jackson; IL Jasper; IL Jefferson; IL Jersey; IL Johnson; IL Macoupin; IL Marion; IL Montgomery; IL Perry; IL Pulaski; IL Randolph; IL Richland; IL Union; IL Washington; IL Wayne; IL Williamson; MO Bollinger; MO Butler; MO Cape Girardeau; MO Carter; MO Crawford; MO Dent; MO Gasconade; MO Iron; MO Lincoln; MO Madison; MO Maries; MO Mississippi; MO Montgomery; MO Perry; MO Phelps; MO Reynolds; MO Ripley; MO St. Francis; MO Ste. Genevieve; MO Scott; MO Stoddard; MO Warren; MO Washington; MO Wayne.	
108 Springfield, MO:	
SMSA Counties:	
7920 Springfield, MO	2.0
MO Christian; MO Greene.	
Non-SMSA Counties	2.3
KS Allen; KS Bourbon; KS Cherokee; KS Crawford; KS Labette; KS Montgomery; KS Neosho; KS Wilson; KS Woodson; MO Barry; MO Barton; MO Cedar; MO Dade; MO Dallas; MO Douglas; MO Hickory; MO Howell; MO Jasper; MO Laclede; MO Lawrence; MO McDonald; MO Newton; MO Oregon; MO Ozark; MO Polk; MO Pulaski; MO St. Clair; MO Shannon; MO Stone; MO Taney; MO Texas; MO Vernon; MO Webster; MO Wright; OK Craig; OK Ottawa.	

Arkansas:

109 Fayetteville, AR:	
Non-SMSA Counties	3.3
AR Baxter; AR Benton; AR Boone; AR Carroll; AR Madison; AR Marion; AR Newton; AR Searcy; AR Washington; OK Adair; OK Delaware.	
110 Fort Smith, AR:	
SMSA Counties:	
2720 Fort Smith, AR-OK	5.6
AR Crawford; AR Sebastian; OK Le Flore; OK Sequoyah.	
Non-SMSA Counties	6.6
AR Franklin; AR Logan; AR Polk; AR Scott; OK Choctaw; OK Haskell; OK Latimer; OK McCurtain; OK Pittsburg; OK Pushmataha.	
111 Little Rock-North Little Rock, AR:	
SMSA Counties:	
4400 Little Rock-North Little Rock, AR	15.7
AR Pulaski; AR Saline.	
6240 Pine Bluff, AR	31.2
AR Jefferson	
Non-SMSA Counties	16.4
AR Arkansas; AR Ashley; AR Bradley; AR Calhoun; AR Chicott; AR Clark; AR Calhoun; AR Cleveland; AR Conway; AR Dallas; AR Desha; AR Drew; AR Faulkner; AR Fulton; AR Garland; AR Grant; AR Hot Springs; AR Independence; AR Iward; AR Jackson; AR Johnson; AR Lincoln; AR Lonoke; AR Monroe; AR Montgomery; AR Ouachita; AR Perry; AR Pope; AR Prairie; AR Sharp; AR Stone; AR Union; AR Van Buren; AR While; AR Woodruff; AR Yell.	

Mississippi:

112 Jackson, MS:	
SMSA Counties:	
3560 Jackson, MS	30.3
MS Hinds; MS Rankin.	
Non-SMSA Counties	32.0
MS Attala; MS Choctaw; MS Choctaw; MS Clarke; MS Copiah;	
MS Covington; MS Franklin; MS Holmes; MS Humphreys; MS Issaquena;	
MS Jasper; MS Jefferson; MS Jefferson Davis; MS Jones; MS Kemper;	
MS Lauderdale; MS Lawrence; MS Leake; MS Lincoln; MS Lowndes;	
MS Madison; MS Neshoba; MS Newton; MS Noxubee; MS Oktibbeha;	
MS Scott; MS Sharkey; MS Simpson; MS Smith; MS Warren; MS Wayne;	
MS Winston; MS Yazoo.	

Louisiana:

113 New Orleans, LA:	
SMSA Counties	
0920 Biloxi-Gulfport, MS	19.2
MS Hancock; MS Harrison; MS Stone.	
5560 New Orleans, LA	31.0
LA Jefferson; LA Orleans; LA St. Bernard; LA St. Tammany.	
Non-SMSA Counties	27.7
LA Assumption; LA Lafourche; LA Plaquemines; LA St. Charles; LA St. James;	
LA St. John The Baptist; LA Tangipahoa; LA Terrebonne; LA Washington; MS Forrest;	
MS Lamar; MS Marion; MS Pearl River; MS Perry; MS Pike; MS Walthall.	
114 Baton Rouge, LA:	
SMSA Counties:	
0760 Baton Rouge, LA	26.1
LA Ascension; LA East Baton Rouge; LA Livingston; LA West Baton Rouge.	
Non-SMSA Counties	30.4
LA Concordia; LA E. Feliciana; LA Iberville; LA Pointe Coupee; LA St. Helena;	
LA West Feliciana; MS Adams; MS Amite; MS Wilkinson.	
115 Lafayette, LA:	
SMSA Counties:	
3880 Lafayette, LA	20.6
LA Lafayette.	
Non-SMSA Counties	24.1
LA Acadia; LA Evangeline; LA Iberia; LA St. Landry; LA St. Martin;	
LA St. Mary; LA Vermillion.	
116 Lake Charles, LA:	
SMSA Counties:	
3960 Lake Charles, LA	19.3
LA Calcasieu.	
Non-SMSA Counties	17.8
LA Allen; LA Beauregard; LA Cameron; LA Jefferson Davis LA Vernon.	
117 Shreveport, LA:	
SMSA Counties:	
0220 Alexandria, LA	25.7
LA Grant; LA Rapides.	
7680 Shreveport, LA	29.3
LA Bossier; LA Caddo; LA Webster.	
Non-SMSA Counties	29.3
LA Avoyelles; LA Bienville; LA Claiborne; LA De Soto; LA Natchitoches;	
LA Red River; LA Sabine; LA Winn.	

118 Monroe, LA:
 SMSA Counties:
 5200 Monroe, LA _____ 22.8
 LA Ouachita.
 Non-SMSA Counties _____ 27.9
 LA Caldwell; LA Catahoula; LA East Carroll; LA Franklin; LA Jackson; LA La Salle; LA Lincoln;
 LA Madison; LA Morehouse; LA Richland; LA Tensas; LA Union; LA West Carroll.

Texas:

119 Texarkana, TX:
 SMSA Counties:
 8360 Texarkana, TX-Texarkana, AR _____ 19.7
 AR Little River; AR Miller; TX Bowie.
 Non-SMSA Counties _____ 20.2
 AR Columbia; AR Hempstead; AR Howard; AR Lafayette; AR Nevada; AR Pike;
 AR Sevier; TX Camp; TX Cass; TX Lamar; TX Morris; TX Red River; TX Titus.

120 Tyler-Longview, TX:
 SMSA Counties:
 4420 Longview, TX _____ 22.8
 TX Gregg; TX Harrison.
 8640 Tyler, TX _____ 23.5
 TX Smith.
 Non-SMSA Counties _____ 22.5
 TX Anderson; TX Angelina; TX Cherokee; TX Henderson; TX Houston; TX Marion;
 TX Nacogdoches; TX Panola; TX Rusk; TX San Augustine; TX Shelby; TX Upshur;
 TX Wood.

121 Beaumont-Port Arthur, TX:
 SMSA Counties:
 0840 Beaumont-Port Arthur Orange, TX _____ 22.6
 TX Hardin; TX Jefferson; TX Orange.
 Non-SMSA Counties _____ 22.6
 TX Jasper; TX Newton; TX Sabine; TX Tyler.

122 Houston, TX:
 SMSA Counties
 1260 Bryan-College Station, TX _____ 23.7
 TX Brazos.
 2920 Galveston-Texas City, TX _____ 28.9
 TX Galveston.
 3360 Houston, TX _____ 27.3
 TX Brazoria; TX Fort Bend; TX Harris; TX Liberty, TX Montgomery, TX Waller.
 Non-SMSA Counties _____ 27.4
 TX Austin; TX Bureson; TX Calhoun; TX Chambers; TX Colorado; TX De Witt;
 TX Fayette; TX Goliad; TX Grimes; TX Jackson; TX Lavaca; TX Leon;
 TX Madison; TX Matagorda; TX Polk; TX Robertson; TX San Jacinto; TX Trinity;
 TX Victoria; TX Walker; TX Washington; TX Wharton.

123 Austin, TX:
 SMSA Counties:
 0640 Austin, TX _____ 24.1
 TX Hays; TX Travis; TX Williamson.
 Non-SMSA Counties _____ 24.2

TX Bastrop; TX Blanco; TX Burnet; TX Caldwell; TX Lee; TX Llano.

124 Waco-Killeen-Temple, TX:
 SMSA Counties:
 3810 Killeen-Temple, TX. _____ 16.4
 TX Belt TX Coryall.
 8800 Waco, TX _____ 20.7
 TX McLermax

Non-SMSA Counties _____	18.6
TX Bosque; TX Falls; TX Freestone; TX Hamilton; TX Hill; TX Lampasas; TX Limestone; TX Milam; TX Mills.	
125 Dallas-Fort Worth, TX:	
SMSA Counties	
1920 Dallas-Fort Worth, TX _____	18.2
TX Collier; TX Dallas; TX Denton; TX Ellis; TX Hood; TX Johnson; TX Kaufman; TX Parker; TX Rockwall; TX Tarrant; TX Wise.	
7640 Sherman-Denison, TX _____	9.4
TX Grayson.	
Non-SMSA Counties _____	17.2
OK Bryan; TX Cooke; TX Delta; TX Erath; TX Fannin; TX Franklin; TX Hopkins; TX Hunt; TX Jack; TX Montague; TX Navarro; TX Palo Pinto; TX Rains; TX Somervell; TX Van Zandt.	
126 Wichita Falls, TX:	
SMSA Counties:	
9080 Wichita Falls, TX: _____	12.4
TX Clay; TX Wichita.	
Non-SMSA Counties _____	11.0
TX Archer; TX Baylor; TX Cottle; TX Foard; TX Hardeman; TX Wilbarger; TX Young.	
127 Abilene, TX:	
SMSA Counties:	
0040 Abilene, TX _____	11.6
TX Callahan; TX Jones; TX Taylor.	
Non-SMSA Counties _____	10.9
TX Brown; TX Coleman; TX Comanche; TX Eastland; TX Fisher; TX Haskell; TX Kent; TX Knox; TX Mitchell; TX Nolan; TX Scurry; TX Shackelford; TX Stephens; TX Stonewall; TX Throckmorton.	
128 San Angelo, TX:	
SMSA Counties:	
7200 San Angelo, TX _____	19.2
TX Tom Green.	
Non-SMSA Counties _____	20.0
TX Coke; TX Concha; TX Crockett; TX Irion; TX Kimble; TX McCulloch; TX Mason; TX Menard; TX Reagan; TX Runnels; TX San Saba; TX Schleicher; TX Sterling; TX Sutton, TX Terrell.	
129 San Antonio, TX:	
SMSA Counties:	
4080 Laredo _____	87.3
TX Webb.	
7240 San Antonio, TX _____	47.8
TX Bexar; TX Comal; TX Guadalupe.	
Non-SMSA Counties _____	49.4
TX Atascosa; TX Bandera; TX Dimmit; TX Edwards; TX Frio; TX Gillespie; TX Gonzales; TX Jim Hogg; TX Karnes; TX Kendall; TX Kerr; TX Kinney; TX La Salle; TX McMullen; TX Maverick; TX Medina; TX Real; TX Uvalde; TX Val Verde; TX Wilson; TX Zapata; TX Zavala.	
130 Corpus Christi, TX:	
SMSA Counties:	
1880 Corpus Christi, TX _____	41.7
TX Nueces; TX San Patricio.	
Non-SMSA Counties _____	44.2
TX Aransas; TX Bee; TX Brooks; TX Duval; TX Jim Wells; TX Kenady; TX Kyberg; TX Live Oak; TX Refugio.	
131 Brownsville-McAllen-Harlingen, TX:	
SMSA Counties:	
1240 Brownsville-Harlingen-San Benito, TX _____	71.0
TX Cameron.	
4880 McAllen-Pharr-Edinburg, TX _____	72.8

TX Hidalgo.	
Non-SMSA Counties _____	72.9
TX Starr; TX Willacy.	
132 Odessa-Midland, TX:	
SMSA Counties:	
5040 Midland, TX _____	19.1
TX Midland.	
5800 Odessa, TX _____	15.1
TX Ector.	
Non-SMSA Counties _____	18.9
TX Andrews; TX Crane; TX Glasscock; TX Howard; TX Loving; TX Martin;	
TX Pecos; TX Reeves; TX Upton; TX Ward; TX Winkler.	
133 El Paso, TX:	
SMSA Counties:	
2320 El Paso, TX _____	57.8
TX El Paso.	
Non-SMSA Counties _____	49.0
NM Chaves; NM Dona Ana; NM Eddy; NM Grant; NM Hidalgo; NM Luna; NM Otero;	
NM Sierra, TX Brewster; TX Culberson; TX Hudspeth; TX Jeff Davis; TX Presidio.	
134 Lubbock, TX:	
SMSA Counties:	
4600 Lubbock _____	19.6
TX Lubbock.	
Non-SMSA _____	19.5
NM Lea; NM Roosevelt ; TX Bailey; TX Borden; TX Cochran; TX Crosby;	
TX Dawson; TX Dickens; TX Floyd; TX Gaines; TX Garza; TX Hale; TX Hockley;	
TX King; TX Lamb; TX Lynn; TX Motley; TX Terry; TX Yoakum.	
135 Amarillo, TX:	
SMSA Counties:	
0320 Amarillo, TX _____	9.3
TX Potter; TX Randall.	
Non-SMSA Counties _____	11.0
NM Curry; NM Harding; NM Quay; NM Union; OK Beaver; OK Cimarron; OK Texas;	
TX Armstrong; TX Briscoe; TX Carson; TX Castro; TX Childress; TX Collingsworth; TX	
Dallam; TX Deaf Smith; TX Donley; TX Gray; TX Hall; TX Hansford; TX Hartley; TX	
Hemphill; TX Hutchinson; TX Lipscomb; TX Moore; TX Ochitree; TX Oldham; TX	
Parmer; TX Roberts; TX Sherman; TX Swisher; TX Wheeler.	

Oklahoma:

136 Lawton, OK:	
SMSA Counties:	
4200 Lawton, OK _____	14.8
OK Comanche.	
Non-SMSA Counties _____	10.8
OK Cotton; OK Green; OK. Harmon; OK Jackson; OK Jefferson; OK Kiowa;	
OK Stephens; OK Tillman.	
137 Oklahoma City, OK:	
SMSA Counties	
5880 Oklahoma City, OK _____	10.2
OK Canadian; OK Cleveland; OK McClain; OK Oklahoma; OK Pottawatomie.	
Non-SMSA Counties _____	9.0
OK Alfalfa; OK Atoka; OK Beckham; OK Blaine; OK Caddo; OK Carter; OK Coat;	
OK Custer; OK Dewey; OK Ellis; OK Garfield; OK Garvin; OK Grady; OK Grant;	
OK Harper; OK Hughes; OK Johnston; OK Kingfisher; OK Lincoln; OK Logan; OK	
Love; OK Major; OK Marshall; OK Murray, OK Okfuskee; OK Pontotoc; OK Roger	
Mills; OK Seminole; OK Washita; OK Woods; Ok Woodward.	

138 Tulsa, OK:
 SMSA Counties:
 8560 Tulsa, OK _____ 10.2
 OK Creek; OK Mayes; OK Osage; OK Rogers; OK Tulsa; OK Wagoner.
 Non-SMSA Counties _____ 10.0
 OK Cherokee; OK Key; OK McIntosh; OK Muskogee; OK Noble; OK Nowata; OK Okmulgee; OK Pawnee; OK Payne; OK Washington.

Kansas:

139 Wichita, KS:
 SMSA Counties:
 9040 Wichita, KS _____ 7.9
 KS Butler; KS Sedgwick.
 Non-SMSA Counties _____ 5.7
 KS Barber; KS Barton; KS Chase; KS Chautauqua; KS Clark; KS Comanche. KS Cowley; KS Edwards; KS Elk; KS Finney; KS Ford; KS Grant; KS Gray; KS Greeley; KS Greenwood; KS Hamilton; KS Harper; KS Harvey; KS Haskell; KS Hodgeman; KS Kearny; KS Kingman; KS Kiowa; KS Lane; KS McPherson; KS Marion; KS Meade; KS Morton; KS Ness; KS Pawnee; KS Pratt; KS Reno; KS Rice; KS Rush; KS Scott; KS Seward; KS Stafford; KS Stanton; KS Stevens; KS Sumner, KS Wichita.

140 Salina, KS:
 Non-SMSA Counties _____ 1.5
 KS Cheyenne; KS Cloud; KS Decatur; KS Dickinson; KS Ellis; KS Ellsworth; KS Gove; KS Graham; KS Jewell; KS Lincoln; KS Logan; KS Mitchell; KS Norton; KS Osborne; KS Ottawa; KS Phillips; KS Rawlins; KS Republic; KS Rooks; KS Russell; KS Saline; KS Sheridan; KS Sherman; KS Smith; KS Thomas; KS Trego; KS Wallace.

141 Topeka, KS:
 SMSA Counties:
 8440 Topeka, KS _____ 9.0
 KS Jefferson; KS Osage; KS Shawnee.
 Non-SMSA Counties _____ 8.5
 KS Clay; Coffey; KS Geary; KS Jackson; KS Lyon; KS Marshall; KS Morris; KS Nemaha; KS Pottawatomie, KS Riley; KS Wabaunsee; KS Washington.

Nebraska:

142 Lincoln, NE:
 SMSA Counties:
 4360 Lincoln, NE _____ 2.8
 NE Lancaster.
 Non SMSA Counties _____ 1.9
 NE Butler; NE Fillmore; NE Gage; NE Jefferson; NE Johnson; NE Nemaha; NE Otoe; NE Pawnee; NE Polk; NE Richardson; NE Saline, NE Seward; NE Thayer; NE York.

143 Omaha, NE:
 SMSA Counties:
 5920 Omaha, NE-IA _____ 7.6
 IA Pottawattamie; NE Douglas; NE Sarpy.
 Non-SMSA _____ 6.3
 IA Adams; IA Audubon; IA Cass; IA Fremont; IA Harrison; IA Mills; IA Montgomery; IA Page; IA Shelby; IA Taylor; NE Burt; NE Cass; NE Colfax; NE Dodge; NE Platte; NE Saunders; NE Washington.

144 Grand Island, NE:
 Non SMSA Counties _____ 1.4
 NE Adams; NE Aurther; NE Blaine; NE Boyd; NE Brown; NE Buffalo; NE Chase; NE Cherry; NE Clay; NE Custer; NE Dawson; NE Dundy; NE Franklin; NE Frontier; NE Fumas; NE Garfield; NE Gosper; NE Grant; NE Greeley, NE Hall; NE Hamilton;

NE Harlan; NE Hayes; NE Hitchcock; NE Holt; NE Hooker; NE Howard; NE Kearney;
 NE Keith; NE Keya Paha; NE Lincoln; NE Logan; NE Loup; NE McPherson;
 NE Merrick; NE Nance; NE Nuckolls; NE Perkins; NE Phelps; NE Red Willow;
 NE Rock; NE Sherman; NE Thomas; NE Valley; NE Webster; NE Wheeler.

145 Scottsbluff, NE:
 Non-SMSA Counties _____ 5.3
 NE Banner; NE Box Butt; NE Cheyenne; NE Dawes; NE Deuel; NE Garden;
 NE Kimball; NE Morrill; NE Scotts Buff; NE Sheridan; NE Sioux; NE Goshen.

South Dakota:

146 Rapid City, SD:
 SMSA Counties:
 6660 Rapid City, SD _____ 3.4
 SD Pennington; SD Meade.
 Non-SMSA Counties _____ 7.9
 SD Bennett; SD Buffalo; SD Butte; SD Campbell; SD Corson; SD Custer; SD Dewey
 (Armstrong); SD Fall River; SD Haakon; SD Harding; SD Hughes; SD Hyde; SD
 Jackson; SD Jones; SD Lawrence; SD Lyman; SD Mellette; SD Perkins; SD Potter;
 SD Shannon (Washington); SD Stanley; SD Sully; SD Todd; SD Tripp; SD Walworth;
 SD Washabaugh; SD Ziebach; WY Crook; WY Niobrara; WY Weston.

147 Sioux Falls, SD:
 SMSA Counties:
 7760 Sioux Falls, SD _____ 1.2
 SD Minnehaha.
 Non-SMSA Counties _____ 0.8
 IA Lyon; IA Osceola; MN Cottonwood; MN Jackson;. MN Lincoln; MN Lyon; MN
 Murray, MN Nobles; MN Pipestone; MN Redwood; MN Rock; SD Aurora; SD Beadle;
 SD Brookings; SD Brule; SD Charles Mix; SD Davison; SD Douglas; SD Gregory; SD
 Hand; SD Hanson; SD Hutchinson; SD Jerauld; SD Kingsbury; SD Lake; SD Lincoln;
 SD McCook, SD Miner, SD Moody, SD Sanborn; SD Turner.

148 Aberdeen, SD:
 Non-SMSA Counties _____ 1.3
 SD Brown; SD Clark; SD Codington; SD Day; SD Deuel; SD Edmunds; SD Faulk;
 SD Grant; SD Hamlin; SD McPherson; SD Marshall; SD Roberts; SD Spink.

North Dakota:

149 Fargo-Moorhead, ND-MN:
 Non-SMSA Counties _____ 0.7
 MN Becker MN Clay; MN Cass; MN Wilkin; ND Barnes; ND Dickey; ND Eddy;
 ND Foster; ND Griggs; ND La Moure; ND Logan; ND McIntosh; ND Ransom;
 ND Richland; ND Sargent; ND Steele; ND Stutsman; ND Traill.

150 Grand Forks, ND:
 SMSA Counties:
 2985 Grand Forks, ND-MN _____ 1.2
 MN Polk; ND Grand Forks.
 Non-SMSA Counties _____ 2.0
 MN Beltrami; MN Clearwater MN Hubbard. MN Kittson; MN Lake of the Woods;
 MN Mahnomen; MN Marshall; MN Norman; MN Pennington; MN Red Lake;
 MN Roseau; MN Benson; ND Cavalier; ND Nelson; ND Pembina;
 ND Ramsey; ND Towner; ND Walsh.

151 Bismarck, ND:
 SMSA Counties:
 1010 Bismarck, ND _____ 0.4
 ND Burleigh; ND Morton.

Non-SMSA Counties	1.3
ND Adams; ND Billings; ND Bowman; ND Dunn; ND Emmons; ND Golden Valley; ND Grant; ND Hettinger; ND Kidder; ND Mercer; ND Oliver; ND Sheridan; ND Sioux; ND Slope; ND Stark; ND Wells.	
152 Minot, ND:	
Non-SMSA Counties	4.4
MT Daniels; MT Richland; MT Roosevelt; MT Sheridan; ND Bottineau; ND Burke; ND Divide; ND McHenry; ND McKenzie; ND McLean; ND Mountrail; ND Pierce; ND Renville; ND Rolette; ND Ward; ND Williams.	

Montana:

153 Great Falls, MT:	
SMSA Counties:	
3040 Great Falls, MT	3.2
MT Cascade.	
Non-SMSA Counties	4.1
MT Blaine; MT Broadwater; MT Chouteau; MT Fergus; MT Glacier; MT Hill; MT Jefferson; MT Judith Basin; MT Lewis and Clark; MT Liberty; MT Meagher; MT Petroleum; MT Phillips; MT Pondera; MT Teton; MT Toole; MT Valley; MT Wheatland.	
154 Missoula, MT:	
Non-SMSA Counties	2.7
MT Beaverhead; MT Deer Lodge; MT Flathead; MT Granite; MT Lincoln; MT Madison; MT Mineral; MT Missoula; MT Powell; MT Ravalli; MT Sanders; MT Silver Bow; MT Lake.	
155 Billings, MT:	
SMSA Counties:	
0880 Billings, MT	3.3
MT Yellowstone.	
Non-SMSA Counties	3.3
MT Big Horn; MT Carbon; MT Carter; MT Custer; MT Dawson; MT Fallon; MT Gallatin; MT Garfield; MT Golden Valley; MT McCone; MT Musselshell; MT Park; MT Powder River; MT Prairie; UT Rosebud; MT Stillwater, MT Sweet Grass; MT Treasure; MT Wilboux; MT Yellowstone Nat'l Park; WY Big Horn; WY Hot Springs; WY Park; WY Sheridan; WY Washakie.	

Wyoming:

156 Cheyenne-Casper, WY:	
Non-SMSA Counties	7.5
CO Jackson; WY Albany; WY Campbell; WY Carbon; WY Converse; WY Fremont WY Johnson; WY Laramie; WY Natrona, WY Platte.	

Colorado:

157 Denver, CO:	
SMSA Counties:	
2080 Denver-Boulder, CO	13.8
CO Adams; CO Arapahoe; CO Boulder. CO Denver; CO Douglas; CO Gilpin; CO Jefferson.	
2670 Fort Collins, CO	6.9
CO Larimer.	
3060 Greeley, CO	13.1
CO Weld.	

Non-SMSA Counties	12.8
CO Cheyenne; CO Clear Creek; CO Elbert CO Grand; CO Kit Carson; CO Logan; CO Morgan; CO Park; CO Phillips; :CO Sedgwick; CO Summit; CO Washington; CO Yuma.	
158 Colorado Springs-Pueblo, CO:	
SMSA Counties:	
1720 Colorado Springs, CO	10.9
CO EL Paso; CO Teller.	
6560 Pueblo, CO	27.5
CO Pueblo.	
Non-SMSA Counties	19.0
CO Alamosa; CO Baca; CO Bent; CO Chaffee; CO Conejos; CO Costilla; CO Crowley; CO Custer; CO Fremont; CO Huerfano; CO Kiowa; CO Lake; CO Las Animas; CO Lincoln; CO Mineral; CO Otero; CO Prowers; CO Rio Grande; CO Saguache.	
159 Grand Junction, CO:	
Non-SMSA Counties	
	10.2
CO Archuleta; CO Delta; CO Dolores; CO Eagle; CO Garfield; CO Gunnison; CO Hinsdale; CO La Plata, CO Mesa; CO Moffat; CO Montezuma; CO Montrose; CO Ouray; CO Pitkin; CO Rio Blanco; CO Routt; CO San Juan; CO San Miguel; UT Grand; UT San Juan.	

New Mexico:

160 Albuquerque, NM:	
SMSA Counties.	
0200 Albuquerque, NM	38.3
NM Bernalillo; NM Sandoval.	
Non-SMSA Counties	45.9
NM Citron. NM Colfax; NM De Baca; NM Guadalupe; NM San Juan; NM San Miguel; NM Santa Fe; NM Socorro; NM Taos; NM Torraine; NM Valencia.	

Arizona:

161 Tucson, AZ:	
SMSA Counties:	
8520 Tucson, AZ	24.1
AZ Pima.	
Non-SMSA Counties	27.0
AZ Cochise; AZ Graham; AZ Greenlee; AZ Santa Cruz.	
162 Phoenix, AZ:	
SMSA Counties:	
6200 Phoenix, AZ	15.8
AZ Maricopa.	
Non-SMSA Counties	19.6
AZ Apache; AZ Coconino; AZ Gila; AZ Mohave; AZ Navajo; AZ Pinal; AZ Yavapai; AZ Yuma.	

Nevada:

163 Las Vegas, NV:	
SMSA Counties:	
4120 Las Vegas, NV	13.9
NV Clark.	

Non-SMSA Counties	12.6
NV Esmeralda; NV Lincoln; NV Nye; UT Beaver; UT Garfield; UT Iron; UT Kane; UT Washington.	
164 Reno, NV:	
SMSA Counties:	
6720 Reno, NV	8.2
NV Washoe.	
Non-SMSA Counties	9.2
NV Churchill; NV Douglas; NV Elko; NV Eureka; NV Humboldt; NV Lander; NV Lyon; NV Mineral; NV Pershing; NV Storey; NV White Pine; NV Carson City	

Utah:

165 Salt Lake City, Ogden, UT:	
SMSA Counties	
6520 Provo-Orem, UT	2.4
UT Utah.	
7160 Salt Lake City-Ogden, UT	6.0
UT Davis; UT Salt Lake; UT Toole; UT Weber.	
Non-SMSA Counties	5.1
ID Bear Lake; ID Franklin; ID Oneida; UT Box Elder; UT Cache; UT Carbon; UT Daggett; UT Duchesne; UT Emery; UT Juab; UT Millard; UT Morgan; UT Piute; UT Rich; UT Sanpete; UT Sevier; UT Summit; UT Uintah -UT Wasatch; UT Wayne; WY Lincoln; WY Sublette; WY Sweetwater; WY Uinta.	

Idaho:

166 Pocatello-Idaho Falls, ID:	
Non-SMSA Counties	
	4.0
ID Bannock; ID Bingham; ID Blaine; ID Bonneville; ID Butte; ID Camas; ID Caribou; ID Cassia; ID Clark; ID Custer; ID Fremont; ID Gooding; ID Jefferson; ID Jerome; ID Lemini; ID Lincoln; ID Madison; ID Minidoka; ID Power; ID Teton; ID Twin Falls; WY Teton.	
167 Boise City, ID:	
SMSA Counties:	
1080 Boise City, ID	2.3
ID Ada.	
Non-SMSA Counties	4.4
ID Adams; ID Boise; ID Canyon; ID Elmore; ID Gem; ID Owyhee; ID Payette; ID Valley; ID Washington; OR Harney; OR Malheur.	

Washington:

168 Spokane, WA:	
SMSA Counties:	
7840 Spokane, WA	2.8
WA Spokane.	
Non-SMSA Counties	3.0
ID Benewah; ID Bonner; ID Boundary; ID Clearwater; ID Idaho; ID Kootena; ID Latah; ID Lewis; ID Nez Perce; ID Shoshone; WA Adams; WA Asotin; WA Columbia; WA Ferry; WA Garfield; WA Lincoln; WA Pend Orelle; WA Stevens; WA Whitman.	
169 Richland, WA:	
SMSA Counties:	
6740 Richland-Kennewick, WA	5.4
WA Benton; WA Franklin.	
Non-SMSA Counties	3.8

OR Baker; OR Gilliam; OR Grant; OR Morrow; OR Umatilla; OR Union;
OR Wallowa; OR Wheeler; WA Walla Walla.

170 Yakima, WA:

SMSA Counties:	
9260 Yakima, WA _____	9.7
WA Yakima.	
Non-SMSA Counties _____	7.2
WA Chelan; WA Douglas; WA Grant; WA Kittitas; WA Okanogan.	

171 Seattle, WA:

SMSA Counties:	
7600 Seattle-Everett, WA _____	7.2
WA King; WA Snohomish.	
8200 Tacoma, WA _____	6.2
WA Pierce.	
Non-SMSA Counties _____	6.2
WA Clallam; WA Grays Harbor; WA Island; WA Jefferson; WA Kitsap; WA Lewis; WA Mason; WA Pacific; WA San Juan; WA Skaqil; WA Thurston; WA Whatcom.	

Oregon:

172 Portland, OR:

SMSA Counties:	
6440 Portland, OR-WA _____	4.5
OR Clackamas; OR Multnomah; OR Washinton; WA Clark.	
7080 Salem OR _____	2.9
OR Marion; OR Polk.	
Non-SMSA Counties:	
OR Benton; OR Clatsop; OR Columbia; OR Crook; OR Deschutes; OR Hood River; OR Jefferson; OR Lincoln; OR Linn; OR Sherman; OR Tillammok; OR Wasco; OR Yamhill; WA Cowlitz; WA Klickitat; WA Skamania; WA Wahkiakum.	

173 Eugene, OR:

SMSA Counties:	
2400 Eugene-Springfield, OR _____	2.4
OR Lane.	
Non-SMSA Counties _____	2.4
OR Coos; OR Curry; OR Douglas; OR Jackson; OR Josephine; OR Klamath; OR Lake	

California:

174 Redding, CA:

Non-SMSA Counties _____	6.8
CA Lassen; CA Modoc; CA Plumas; CA, Shasta; CA Siskiyou; CA Tehama.	

175 Eureka, CA:

Non-SMSA Counties _____	6.6
CA Del Norte; CA Humboldt; CA Trinity.	

176 San Francisco-Oakland-San Jose, CA:

SMSA Counties:	
7120 Salinas-Seaside-Monterey, CA _____	28.9
CA Monterey.	
7360 San Francisco-Oakland, CA _____	25.8
CA Alameda; CA Contra Costa; CA Marin; San Francisco; CA San Mateo.	
7400 San Jose, CA _____	19.6
CA Santa Clara.	
7485 Santa Cruz, CA _____	14.9
CA Santa Cruz.	
7500 Santa Rosa, CA _____	9.1
CA Sonoma.-	

8720 Vallejo-Fairfield-Napa, CA _____	17.1
CA Napa; CA Solano.	
Non-SMSA Counties _____	23.2
CA Lake; CA Mendocino; CA San Benito.	
177 Sacramento, CA:	
SMSA Counties:	
6920 Sacramento, CA _____	16.1
CA Placer; CA Sacramento; CA Yolo.	
Non-SMSA Counties _____	14.3
CA Butte; CA Colusa; CA El Dorado; CA Glenn; CA Nevada; CA Sierra; CA Sutter; CA Yuba.	
178 Stockton-Modesto, CA:	
SMSA Counties:-	
5170 Modesto, CA _____	12.3
CA Stanislaus	
8120 Stockton, CA _____	24.3
CA San Joaquin.	
Non-SMSA Counties _____	19.8
CA Alpine; CA Amador; CA Calaveras; CA Mariposa; CA Merced, CA Tuolumne.	
179 Fresno-Bakersfield, CA:	
SMSA Counties:	
0680 Bakersfield, CA _____	19.1
CA Kent	
2840 Fresno, CA _____	26.1
CA Fresno	
Non-SMSA Counties _____	23.6
CA Kings; CA Madera CA Tulare.	
180 Los Angeles, CA:	
SMSA Counties.	
0360 Anaheim-Santa Ana-Garden Grove, CA _____	11.9
CA Orange.	
4480 Los Angeles-Long Beach, CA _____	28.3
CA Los Angeles	
6000 Oxnard-Simi Valley-Ventura, CA _____	21.5
CA Ventura	
6780 Riverside-San Bernardino-Ontario, CA _____	19.0
CA Riverside; CA San Bernadino.	
7480 Santa Barbara-Santa Maria-Lompoc, CA _____	19.7
CA Santa Barbara.	
Non-SMSA Counties _____	24.6
CA Inyo; CA Mono; CA San Luis - Obispo.	
181 San Diego, CA:	
SMSA Counties	
7320 San Diego, CA _____	16.9
CA San Diego.	
Non-SMSA Counties _____	16.2
CA Imperial	

Alaska:

182 Anchorage, AK:	
SMSA Counties:	
0380 Anchorage, AK _____	8.7
AK Anchorage Division.	
Non-SMSA Counties _____	15.1
AK Aleutian Islands Division; AK Angoon Division; AK Barrow-North Slope Division; AK Bethel Division; AK Bristol Bay Borough; AK Bristol Bay Division; AK Cordova McCarthy Division; AK Fairbanks Division; AK Haines Division; AK Juneau Division;	

AK Kenai-Cook Inlet Division; AK Ketchikan Division; AK Kobuk Division; AK Kodiak Division; AK Kwskokwim Division; AK Matanuska-Susitna Division; AK Nome Division; AK Outer Ketchikan Division; AK Prince of Wales Division; AK Seward Division; AK Sitka Division; AK Skagaway-Yakutat Division; AK Southeast Fairbanks Division; AK Upper Yukon Division; AK Valdez-Citina-Whittier Division; AK Wade Hampton Division; AK Wrangell-Petersburg Division; AK Yukon-Koyukuk Division.

Hawaii:

183 Honolulu, HI:	
SMSA Counties:	
3320 Honolulu, HI	69.1
HI Honolulu.	
Non-SMSA Counties	70.4
HI Hawaii; HI Kauai; HI Maui; HI Kalowao.	

CERTIFICATION REGARDING LOBBYING LOWER TIER COVERED TRANSACTIONS

Applicants should review the instructions for certification included in the regulations before completing this form. Signature on this form provides for compliance with certification requirements under 15 CFR Part 28, "New Restrictions on Lobbying."

LOBBYING

As required by Section 1352, Title 31 of the U.S. Code, and implemented at 15 CFR Part 28, for persons entering into a grant, cooperative agreement or contract over \$100,000 or a loan or loan guarantee over \$150,000 as defined at 15 CFR Part 28, Sections 28.105 and 28.110, the applicant certifies that to the best of his or her knowledge and belief, that:

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

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

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

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure occurring on or before October 23, 1996, and of not less than \$11,000 and not more than \$110,000 for each such failure occurring after October 23, 1996.

Statement for Loan Guarantees and Loan Insurance

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

In any funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this commitment providing for the United States to insure or guarantee a loan, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

Submission of this statement is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required statement shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure occurring on or before October 23, 1996, and of not less than \$11,000 and not more than \$110,000 for each such failure occurring after October 23, 1996.

As the duly authorized representative of the applicant, I hereby certify that the applicant will comply with the above applicable certification.

NAME OF APPLICANT

AWARD NUMBER AND/OR PROJECT NAME

Search this index for the appropriate County

PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE

What % to use?

SIGNATURE

DATE

NOTE: To find the Goals for minority participi

**U. S. DEPARTMENT OF COMMERCE
ECONOMIC DEVELOPMENT ADMINISTRATION**



**EDA CONTRACTING PROVISIONS
FOR CONSTRUCTION PROJECTS**

These EDA Contracting Provisions for Construction Projects (EDA Contracting Provisions) are intended for use by recipients receiving federal assistance from the U. S. Department of Commerce - Economic Development Administration (EDA). They contain provisions specific to EDA and other federal provisions not normally found in non-federal contract documents. The requirements contained herein must be incorporated into all construction contracts and subcontracts funded wholly or in part with federal assistance from EDA.

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1. **DEFINITIONS**

Agreement – The written instrument that is evidence of the agreement between the Owner and the Contractor overseeing the Work.

Architect/Engineer - The person or other entity engaged by the Recipient to perform architectural, engineering, design, and other services related to the work as provided for in the contract.

Contract – The entire and integrated written agreement between the Owner and the Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

Contract Documents – Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents.

Contractor – The individual or entity with whom the Owner has entered into the Agreement.

Drawings or Plans – That part of the Contract Documents prepared or approved by the Architect/Engineer that graphically shows the scope, extent, and character of the Work to be performed by the Contractor.

EDA - The United States of America acting through the Economic Development Administration of the U.S. Department of Commerce or any other person designated to act on its behalf. EDA has agreed to provide financial assistance to the Owner, which includes assistance in financing the Work to be performed under this Contract. Notwithstanding EDA's role, nothing in this Contract shall be construed to create any contractual relationship between the Contractor and EDA.

Owner – The individual or entity with whom the Contractor has entered into the Agreement and for whom the Work is to be performed.

Project – The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

Recipient – A non-Federal entity receiving a Federal financial assistance award directly from EDA to carry out an activity under an EDA program, including any EDA-approved successor to the entity.

Specifications – That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

Subcontractor – An individual or entity having direct contract with the Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

Work – The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

2. **APPLICABILITY**

The Project to which the construction work covered by this Contract pertains is being assisted by the United States of America through federal assistance provided by the U.S. Department of Commerce - Economic Development Administration (EDA). Neither EDA, nor any of its departments, entities, or employees is a party to this Contract. The following EDA Contracting Provisions are included in this Contract and all subcontracts or related instruments pursuant to the provisions applicable to such federal assistance from EDA.

3. **FEDERALLY REQUIRED CONTRACT PROVISIONS**

(a) All contracts in excess of the simplified acquisition threshold - currently fixed at \$150,000 (*see* 41 U.S.C. §§ 134 and 1908) must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as may be appropriate.

(b) All contracts in excess of \$10,000 must address termination for cause and for convenience by the Recipient including the manner by which it will be effected and the basis for settlement.

(c) All construction contracts awarded in excess of \$10,000 by recipients of federal assistance and their contractors or subcontractors shall contain a provision requiring compliance with Executive Order 11246 of September 24, 1965, *Equal Employment Opportunity*, as amended by Executive Order 11375 of October 13, 1967, and Department of Labor implementing regulations at 41 C.F.R. part 60.

(d) All prime construction contracts in excess of \$2,000 awarded by Recipients must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. §§ 3141-3148) as supplemented by Department of Labor regulations at 29 C.F.R. part 5. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (18 U.S.C. § 874 and 40 U.S.C. § 3145) as supplemented by Department of Labor regulations at 29 C.F.R. part 3.

(e) All contracts awarded by the Recipient in excess of \$100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. §§ 3702 and 3704 (the Contract Work Hours and Safety Standards Act) as supplemented by Department of Labor regulations at 29 C.F.R. part 5.

(f) All contracts must include EDA requirements and regulations that involve a requirement on the contractor or sub-contractor to report information to EDA, the Recipient or any other federal agency.

- (g) All contracts must include EDA requirements and regulations pertaining to patent rights with respect to any discovery or invention which arises or is developed in the course of or under such contract.
- (h) All contracts must include EDA requirements and regulations pertaining to copyrights and rights in data.
- (i) All contracts and subgrants in excess of \$150,000 must contain a provision that requires compliance with all applicable standards, orders, or requirements issued under the Clean Air Act (42 U.S.C. § 7401 *et seq.*) and the Federal Water Pollution Control Act (Clean Water Act) (33 U.S.C. § 1251 *et seq.*), and Executive Order 11738, *Providing for Administration of the Clean Air Act and the Federal Water Pollution Control Act With Respect to Federal Contracts, Grants, or Loans*.
- (j) Contracts must contain mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 U.S.C. § 6201).
- (k) Contracts must contain a provision ensuring that contracts are not to be made to parties on the government wide Excluded Parties List System in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 C.F.R. part 180.
- (l) Contracts must contain a provision ensure compliance with the Byrd Anti-Lobbying Amendment (31 U.S.C. § 1352) under which contractors that apply or bid for an award of \$100,000 or more must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. § 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.
- (m) If the Recipient is a state agency or agency of a political subdivision of a state, any contract awarded must contain a provision ensuring compliance with section 6002 of the Solid Waste Disposal Act (42 U.S.C. § 6962), as amended by the Resource Conservation and Recovery Act related to the procurement of recovered materials.

4. **REQUIRED PROVISIONS DEEMED INSERTED**

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 be read and 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 of correction.

5. **INSPECTION BY EDA REPRESENTATIVES**

The authorized representatives and agents of EDA shall be permitted to inspect all work, materials, payrolls, personnel records, invoices of materials, and other relevant data and records.

6. **EXAMINATION AND RETENTION OF CONTRACTOR'S RECORDS**

(a) The Owner, EDA, or the Comptroller General of the United States, or any of their duly authorized representatives shall, generally until three years after final payment under this contract, have access to and the right to examine any of the Contractor's directly pertinent books, documents, papers, or other records involving transactions related to this contract for the purpose of making audit, examination, excerpts, and transcriptions.

(b) The Contractor agrees to include in first-tier subcontracts under this contract a clause substantially the same as paragraph (a) above. "Subcontract," as used in this clause, excludes purchase orders that do not exceed \$10,000.

(c) The periods of access and examination in paragraphs (a) and (b) above for records relating to (1) appeals under the disputes clause of this contract, (2) litigation or settlement of claims arising from the performance of this contract, or (3) costs and expenses of this contract to which the Owner, EDA, or Comptroller General or any of their duly authorized representatives has taken exception shall continue until disposition of such appeals, litigation, claims, or exceptions.

7. **CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES**

Immediately after execution and delivery of the contract, and before the first partial payment is made, the Contractor shall deliver to the Owner an estimated construction progress schedule in a form satisfactory to the Owner, showing the proposed dates of commencement and completion of each of the various subdivisions of work required under the Contract Documents and the anticipated amount of each monthly payment that will become due to the Contractor in accordance with the progress schedule. The Contractor also shall furnish the Owner (a) a detailed estimate giving a complete breakdown of the contract price and (b) periodic itemized estimates of work done for the purpose of making partial payments thereon. The costs employed in making up any of these schedules will be used only to determine the basis of partial payments and will not be considered as fixing a basis for additions to or deductions from the contract price.

8. **CONTRACTOR'S TITLE TO MATERIAL**

No materials, supplies, or equipment for the work shall be purchased by the Contractor or by any subcontractor that is subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. The Contractor warrants and guarantees that he/she has good title to all work, materials, and equipment used by him/her in the Work, free and clear of all liens, claims, or encumbrances.

9. **INSPECTION AND TESTING OF MATERIALS**

All materials and equipment used in the completion of the Work shall be subject to adequate inspection and testing in accordance with accepted standards. The laboratory or inspection agency shall be selected by the Owner. Materials of construction, particularly those upon which the strength and durability of any structure may depend, shall be subject to inspection and testing to establish conformance with specifications and suitability for intended uses.

10. **"OR EQUAL" CLAUSE**

Whenever a material, article, or piece of equipment is identified in the Contract Documents by reference to manufacturers' or vendors' names, trade names, catalogue numbers, etc., it is intended merely to establish a standard. Any material, article, or equipment of other manufacturers and vendors that will perform adequately the duties imposed by the general design will be considered equally acceptable provided the material, article, or equipment so proposed is, in the opinion of the Architect/Engineer, of equal substance and function. However, such substitution material, article, or equipment shall not be purchased or installed by the Contractor without the Architect/Engineer's written approval.

11. **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 that is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Architect/Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by the Owner in the Contract Documents.

(b) To the fullest extent permitted by Laws and Regulations, the Contractor shall indemnify and hold harmless the Owner and the Architect/Engineer, and the officers, directors, 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.

12. **CLAIMS FOR EXTRA COSTS**

No claims for extra work or cost shall be allowed unless the same was done in pursuance of a written order from the Architect/Engineer approved by the Owner.

13. **CONTRACTORS AND SUBCONTRACTORS INSURANCE**

(a) The Contractor shall not commence work under this Contract until the Contractor has obtained all insurance reasonably required by the Owner, nor shall the Contractor allow any subcontractor to commence work on his/her subcontract until the insurance required of the subcontractor has been so obtained and approved.

(b) Types of insurance normally required are:

- (1) Workers' Compensation
- (2) Contractor's Public Liability and Property Damage
- (3) Contractor's Vehicle Liability
- (4) Subcontractors' Public Liability, Property Damage and Vehicle Liability
- (5) Builder's Risk (Fire and Extended Coverage)

(c) **Scope of Insurance and Special Hazards:** The insurance obtained, which is described above, shall provide adequate protection for the Contractor and his/her subcontractors, respectively, against damage claims that may arise from operations under this contract, whether such operations be by the insured or by anyone directly or indirectly employed by him/her and also against any of the special hazards that may be encountered in the performance of this Contract.

(d) **Proof of Carriage of Insurance:** The Contractor shall furnish the Owner with certificates showing the type, amount, class of operations covered, effective dates, and dates of expiration of applicable insurance policies.

14. **CONTRACT SECURITY BONDS**

(a) If the amount of this Contract exceeds \$150,000, the Contractor shall furnish a performance bond in an amount at least equal to one hundred percent (100%) of the Contract price as security for the faithful performance of this Contract and also a payment bond in an amount equal to one hundred percent (100%) of the Contract price or in a penal sum not less than that prescribed by State, Territorial, or local law, as security for the payment of all persons performing labor on the Work under this Contract and furnishing materials in connection with this Contract. The performance bond and the payment bond may be in one or in separate instruments in accordance with local law. Before final acceptance, each bond must be approved by EDA. If the amount of this Contract does not exceed \$150,000, the Owner shall specify the amount of the payment and performance bonds.

(b) All bonds shall be in the form prescribed by the Contract Documents except as otherwise provided in applicable laws or regulations, and shall be executed by such sureties as are named in the current list of *Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies* as published in Treasury Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's

authority to act. Surety companies executing the bonds must also be authorized to transact business in the state where the Work is located.

15. **LABOR STANDARDS - DAVIS-BACON AND RELATED ACTS**
(as required by section 602 of PWEDA)

(a) **Minimum Wages**

(1) All laborers and mechanics employed or working upon the site of the Work in the construction or development of the Project will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act at 29 C.F.R. part 3, the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at the time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor, which is attached hereto and made a part hereof, regardless of any contractual relationship that may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of 29 C.F.R. § 5.5(a)(1)(iv); also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 C.F.R. § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein, provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates determined under 29 C.F.R. § 5.5(a)(1)(ii) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(2) (i) Any class of laborers or mechanics to be employed under the Contract, but not listed in the wage determination, shall be classified in conformance with the wage determination. EDA shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

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

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

(C) The proposed wage rate, including any bona fide fringe benefits, bears a

reasonable relationship to the wage rates contained in the wage determination.

(ii) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and EDA or its designee agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by EDA or its designee to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210.

(iii) In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and EDA or its designee do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), EDA or its designee shall refer the questions, including the views of all interested parties and the recommendation of EDA or its designee, to the Administrator for determination.

(iv) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(2)(ii) or (iii) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

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

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

(b) **Withholding**

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

have ceased. EDA or its designee may, after written notice to the Contractor, disburse such amounts withheld for and on account of the Contractor or subcontractor to the respective employees to whom they are due. The Comptroller General shall make such disbursements in the case of direct Davis-Bacon Act contracts.

(c) **Payrolls and basic records**

(1) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the Work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the Work in the construction or development of the Project. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 C.F.R. § 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, the plan or program is financially responsible, and the plan or program has been communicated in writing to the laborers or mechanics affected, and provide records that show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(2) (i) For each week in which Contract work is performed, the Contractor shall submit a copy of all payrolls to the Owner for transmission to EDA or its designee. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 C.F.R. part 5.5(a)(3)(i). This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose. It may be purchased from the Superintendent of Documents (Federal Stock Number 029-005-00014-1), U.S. Government Printing Office, Washington, D.C. 20402; or downloaded from the U.S. Department of Labor's website at <https://www.dol.gov/whd/forms/wh347.pdf>. The prime Contractor is responsible for the submission of copies of payrolls by all subcontractors

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

(A) That the payroll for the payroll period contains the information required to be maintained under 29 C.F.R. § 5.5(a)(3)(i) and that such information is correct and complete;

(B) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the Contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 C.F.R. part 3; and

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

(iii) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 15(c)(2)(ii) of this section.

(iv) The falsification of any of the above certifications may subject the Contractor or subcontractor to civil or criminal prosecution under section 1001 of Title 18 and section 3729 of Title 31 of the U.S. Code.

(3) The Contractor or subcontractor shall make the records required under paragraph 15(c)(1) of this section available for inspection, copying, or transcription by authorized representatives of EDA or its designee or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit the required records or to make them available, EDA or its designee may, after written notice to the Contractor or Owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 C.F.R. § 5.12.

(d) **Apprentices and Trainees.**

(1) **Apprentices.** Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training (Bureau), or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any

apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a Contractor is performing construction on a Project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(2) **Trainees.** Except as provided in 29 C.F.R. § 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program that has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman's hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(3) **Equal employment opportunity.** The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity

requirements of Executive Order 11246, *Equal Employment Opportunity*, as amended, and 29 C.F.R. part 30.

(e) **Compliance with Copeland Anti-Kickback Act Requirements.** The Contractor shall comply with the Copeland Anti-Kickback Act (18 U.S.C. § 874 and 40 U.S.C. § 3145) as supplemented by Department of Labor regulations (29 C.F.R. part 3, “Contractors and Subcontractors on Public Buildings or Public Works Financed in Whole or in Part by Loans or Grants of the United States”). The Act provides that the Contractor and any subcontractors shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which they are otherwise entitled. The Owner shall report all suspected or reported violations to EDA.

(f) **Subcontracts.** The Contractor and any subcontractors will insert in any subcontracts the clauses contained in 29 C.F.R. §§ 5.5(a)(1) through (10) and such other clauses as EDA or its designee may require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime Contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 C.F.R. § 5.5.

(g) **Contract termination; debarment.** The breach of the contract clauses in 29 C.F.R. § 5.5 may be grounds for termination of the contract, and for debarment as a Contractor and a subcontractor as provided in 29 C.F.R. § 5.12.

(h) **Compliance with Davis-Bacon and Related Act Requirements.** All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 C.F.R. parts 1, 3, and 5 are herein incorporated by reference in this contract.

(i) **Disputes concerning labor standards.** Disputes arising out of the labor standards provisions of this Contract shall not be subject to the general disputes clause of this Contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 C.F.R. parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and EDA or its designee, the U.S. Department of Labor, or the employees or their representatives.

(j) **Certification of Eligibility.**

(1) By entering into this Contract, the Contractor certifies that neither it nor any person or firm that has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 C.F.R. § 5.12(a)(1).

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

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

16. **LABOR STANDARDS - CONTRACT WORK HOURS AND SAFETY STANDARDS ACT**

As used in this paragraph, the terms “laborers” and “mechanics” include watchmen and guards.

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

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

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

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

17. **EQUAL EMPLOYMENT OPPORTUNITY**

(a) The Recipient hereby agrees that it will incorporate or cause to be incorporated into any contract for construction work, or modification thereof, as defined in the regulations of the Secretary of Labor at 41 C.F.R. chapter 60, which is paid for in whole or in part with funds obtained from EDA, the following equal opportunity clause:

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

Economic Development Administration
Contracting Provisions for Construction Projects

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

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

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

(4) The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers representatives of the Contractor's commitments hereunder, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

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

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

(7) In the event of the Contractor's noncompliance with the nondiscrimination clauses of

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

(8) The Contractor will include the portion of the sentence immediately preceding paragraph 17(a)(1) and the provisions of paragraphs 17(a)(1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as EDA or the Secretary of Labor may direct as a means of enforcing such provisions, including sanctions for noncompliance. Provided, however, that in the event the Contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction by EDA or the Secretary of Labor, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

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

(10) The Recipient agrees that it will assist and cooperate actively with EDA and the Secretary of Labor in obtaining the compliance of contractors and subcontractors with the equal opportunity clause and the rules, regulations, and relevant orders of the Secretary of Labor, that it will furnish EDA and the Secretary of Labor such information as they may require for the supervision of such compliance, and that it will otherwise assist EDA in the discharge of the EDA's primary responsibility for securing compliance.

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

to the Department of Justice for appropriate legal proceedings.

(b) Exemptions to Above Equal Opportunity Clause (41 C.F.R. chapter 60):

(1) Contracts and subcontracts not exceeding \$10,000 (other than Government bills of lading, and other than contracts and subcontracts with depositories of Federal funds in any amount and with financial institutions which are issuing and paying agents for U.S. savings bonds and savings notes) are exempt. The amount of the Contract, rather than the amount of the federal financial assistance, shall govern in determining the applicability of this exemption.

(2) Except in the case of subcontractors for the performance of construction work at the site of construction, the clause shall not be required to be inserted in subcontracts below the second tier.

(3) Contracts and subcontracts not exceeding \$10,000 for standard commercial supplies or raw materials are exempt.

18. **CONTRACTING WITH SMALL, MINORITY AND WOMEN'S BUSINESSES**

(a) If the Contractor intends to let any subcontracts for a portion of the work, the Contractor shall take affirmative steps to assure that small, minority and women's businesses are used when possible as sources of supplies, equipment, construction, and services.

(b) Affirmative steps shall consist of:

(1) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;

(2) Ensuring that small and minority businesses and women's business enterprises are solicited whenever they are potential sources;

(3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses and women's business enterprises;

(4) Establishing delivery schedules, where the requirements of the contract permit, which encourage participation by small and minority businesses and women's business enterprises;

(5) Using the services and assistance of the U.S. Small Business Administration, the Minority Business Development Agency of the U.S. Department of Commerce, and State and local governmental small business agencies;

(6) Requiring each party to a subcontract to take the affirmative steps of this section; and

(7) The Contractor is encouraged to procure goods and services from labor surplus area firms.

19. **HEALTH, SAFETY, AND ACCIDENT PREVENTION**

(a) In performing this contract, the Contractor shall:

- (1) Ensure that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to their health and/or safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation;
- (2) Protect the lives, health, and safety of other persons;
- (3) Prevent damage to property, materials, supplies, and equipment; and
- (4) Avoid work interruptions.

(b) For these purposes, the Contractor shall:

- (1) Comply with regulations and standards issued by the Secretary of Labor at 29 C.F.R. part 1926. Failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act (40 U.S.C. §§ 3701 – 3708); and
- (2) Include the terms of this clause in every subcontract so that such terms will be binding on each subcontractor.

(c) The Contractor shall maintain an accurate record of exposure data on all accidents incident to work performed under this Contract resulting in death, traumatic injury, occupational disease, or damage to property, materials, supplies, or equipment, and shall report this data in the manner prescribed by 29 C.F.R. part 1904.

(d) The Owner shall notify the Contractor of any noncompliance with these requirements and of the corrective action required. This notice, when delivered to the Contractor or the Contractor's representative at the site of the Work, shall be deemed sufficient notice of the noncompliance and corrective action required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to take corrective action promptly, the Owner may issue an order stopping all or part of the Work until satisfactory corrective action has been taken. The Contractor shall not base any claim or request for equitable adjustment for additional time or money on any stop order issued under these circumstances.

(e) The Contractor shall be responsible for its subcontractors' compliance with the provisions of this clause. The Contractor shall take such action with respect to any subcontract as EDA, or the Secretary of Labor shall direct as a means of enforcing such provisions.

20. **CONFLICT OF INTEREST AND OTHER PROHIBITED INTERESTS**

- (a) No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept, or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction or material supply contract or any subcontract in connection with the construction of the Project, shall become directly or indirectly interested personally in this Contract or in any part hereof.
- (b) No officer, employee, architect, attorney, engineer, or inspector of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the Project, shall become directly or indirectly interested personally in this Contract or in any part thereof, any material supply contract, subcontract, insurance contract, or any other contract pertaining to the Project.
- (c) The Contractor may not knowingly contract with a supplier or manufacturer if the individual or entity who prepared the Contract Documents has a corporate or financial affiliation with the supplier or manufacturer.
- (d) The Owner's officers, employees, or agents shall not engage in the award or administration of this Contract if a conflict of interest, real or apparent, may be involved. Such a conflict may arise when: (i) the employee, officer or agent; (ii) any member of their immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above, has a financial interest in the Contractor. The Owner's officers, employees, or agents shall neither solicit nor accept gratuities, favors, or anything of monetary value from the Contractor or subcontractors.
- (e) If the Owner finds after a notice and hearing that the Contractor, or any of the Contractor's agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of the Owner or EDA in an attempt to secure this Contract or favorable treatment in awarding, amending, or making any determinations related to the performance of this Contract, the Owner may, by written notice to the Contractor, terminate this Contract. The Owner may also pursue other rights and remedies that the law or this Contract provides. However, the existence of the facts on which the Owner bases such findings shall be an issue and may be reviewed in proceedings under the dispute resolution provisions of this Contract.
- (f) In the event this Contract is terminated as provided in paragraph (e) of this section, the Owner may pursue the same remedies against the Contractor as it could pursue in the event of a breach of this Contract by the Contractor. As a penalty, in addition to any other damages to which it may be entitled by law, the Owner may pursue exemplary damages in an amount (as determined by the Owner) which shall not be less than three nor more than ten times the costs the Contractor incurs in providing any such gratuities to any such officer or employee.

21. **RESTRICTIONS ON LOBBYING**

(a) This Contract, or subcontract is subject to 31 U.S.C. § 1352, regarding lobbying restrictions. The section is explained in the common rule, 15 C.F.R. part 28 (55 FR 6736-6748, February 26, 1990). Each bidder under this Contract or subcontract is generally prohibited from using federal funds for lobbying the Executive or Legislative Branches of the Federal Government in connection with this EDA Award.

(b) **Contract Clause Threshold:** This Contract Clause regarding lobbying must be included in each bid for a contract or subcontract exceeding \$100,000 of federal funds at any tier under the EDA Award.

(c) **Certification and Disclosure:** Each bidder of a contract or subcontract exceeding \$100,000 of federal funds at any tier under the federal Award must file Form CD-512, *Certification Regarding Lobbying – Lower Tier Covered Transactions*, and, if applicable, Standard Form-LLL, *Disclosure of Lobbying Activities*, regarding the use of any nonfederal funds for lobbying. Certifications shall be retained by the Contractor or subcontractor at the next higher tier. All disclosure forms, however, shall be forwarded from tier to tier until received by the Recipient of the EDA Award, who shall forward all disclosure forms to EDA.

(d) **Continuing Disclosure Requirement:** Each Contractor or subcontractor that is subject to the Certification and Disclosure provision of this Contract Clause is required to file a disclosure form at the end of each calendar quarter in which there occurs any event that requires disclosure or that materially affects the accuracy of the information contained in any disclosure form previously filed by such person. Disclosure forms shall be forwarded from tier to tier until received by the Recipient of the EDA Award, who shall forward all disclosure forms to EDA.

(e) **Indian Tribes, Tribal Organizations, or Other Indian Organizations:** Indian tribes, tribal organizations, or any other Indian organizations, including Alaskan Native organizations, are excluded from the above lobbying restrictions and reporting requirements, but only with respect to expenditures that are by such tribes or organizations for lobbying activities permitted by other federal law. An Indian tribe or organization that is seeking an exclusion from Certification and Disclosure requirements must provide EDA with the citation of the provision or provisions of federal law upon which it relies to conduct lobbying activities that would otherwise be subject to the prohibitions in and to the Certification and Disclosure requirements of 31 U.S.C. § 1352, preferably through an attorney's opinion. Note, also, that a non-Indian subrecipient, contractor, or subcontractor under an award to an Indian tribe, for example, is subject to the restrictions and reporting requirements.

22. **HISTORICAL AND ARCHAEOLOGICAL DATA PRESERVATION**

The Contractor agrees to facilitate the preservation and enhancement of structures and objects of historical, architectural or archaeological significance and when such items are found and/or unearthed during the course of project construction. Any excavation by the Contractor that uncovers an historical or archaeological artifact shall be immediately reported to the Owner and a representative of EDA. Construction shall be temporarily halted pending the notification process and further directions issued by EDA after consultation with the State Historic

Preservation Officer (SHPO) for recovery of the items. *See* the National Historic Preservation Act of 1966 (54 U.S.C. § 300101 *et seq.*, formerly at 16 U.S.C. § 470 *et seq.*) and Executive Order No. 11593 of May 31, 1971.

23. **CLEAN AIR AND WATER**

Applicable to Contracts in Excess of \$150,000

(a) **Definition.** “Facility” means any building, plant, installation, structure, mine, vessel, or other floating craft, location, or site of operations, owned, leased, or supervised by the Contractor or any subcontractor, used in the performance of the Contract or any subcontract. When a location or site of operations includes more than one building, plant, installation, or structure, the entire location or site shall be deemed a facility except when the Administrator, or a designee, of the United States Environmental Protection Agency (EPA) determines that independent facilities are collocated in one geographical area.

(b) In compliance with regulations issued by the EPA, 2 C.F.R. part 1532, pursuant to the Clean Air Act, as amended (42 U.S.C. § 7401 *et seq.*); the Federal Water Pollution Control Act, as amended (33 U.S.C. § 1251 *et seq.*); and Executive Order 11738, the Contractor agrees to:

(1) Not utilize any facility in the performance of this contract or any subcontract which is listed on the Excluded Parties List System, part of the System for Award Management (SAM), pursuant to 2 C.F.R. part 1532 for the duration of time that the facility remains on the list;

(2) Promptly notify the Owner if a facility the Contractor intends to use in the performance of this contract is on the Excluded Parties List System or the Contractor knows that it has been recommended to be placed on the List;

(3) Comply with all requirements of the Clean Air Act and the Federal Water Pollution Control Act, including the requirements of section 114 of the Clean Air Act and section 308 of the Federal Water Pollution Control Act, and all applicable clean air and clean water standards; and

(4) Include or cause to be included the provisions of this clause in every subcontract and take such action as EDA may direct as a means of enforcing such provisions.

24. **USE OF LEAD-BASED PAINTS ON RESIDENTIAL STRUCTURES**

(a) If the work under this Contract involves construction or rehabilitation of residential structures over \$5,000, the Contractor shall comply with the Lead-based Paint Poisoning Prevention Act (42 U.S.C. § 4831). The Contractor shall assure that paint or other surface coatings used in a residential property does not contain lead equal to or in excess of 1.0 milligram per square centimeter or 0.5 percent by weight or 5,000 parts per million (ppm) by weight. For purposes of this section, “residential property” means a dwelling unit, common areas, building exterior surfaces, and any surrounding land, including outbuildings, fences and play equipment affixed to the land, belonging to an owner and available for use by residents, but not

including land used for agricultural, commercial, industrial or other non-residential purposes, and not including paint on the pavement of parking lots, garages, or roadways.

- (b) As a condition to receiving assistance under PWEDA, recipients shall assure that the restriction against the use of lead-based paint is included in all contracts and subcontracts involving the use of federal funds.

25. **ENERGY EFFICIENCY**

The Contractor shall comply with all standards and policies relating to energy efficiency which are contained in the energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 U.S.C. § 6201) for the State in which the Work under the Contract is performed.

26. **ENVIRONMENTAL REQUIREMENTS**

When constructing a Project involving trenching and/or other related earth excavations, the Contractor shall comply with the following environmental constraints:

- (1) **Wetlands.** When disposing of excess, spoil, or other construction materials on public or private property, the Contractor shall not fill in or otherwise convert wetlands.
- (2) **Floodplains.** When disposing of excess, spoil, or other construction materials on public or private property, the Contractor shall not fill in or otherwise convert 100 year floodplain areas delineated on the latest Federal Emergency Management Agency (FEMA) Floodplain Maps, or other appropriate maps, i.e., alluvial soils on Natural Resource Conservation Service (NRCS) Soil Survey Maps.
- (3) **Endangered Species.** The Contractor shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of the Contractor, the Contractor will immediately report this evidence to the Owner and a representative of EDA. Construction shall be temporarily halted pending the notification process and further directions issued by EDA after consultation with the U.S. Fish and Wildlife Service.

27. **DEBARMENT, SUSPENSION, INELIGIBILITY, AND VOLUNTARY EXCLUSIONS**

As required by Executive Orders 12549 and 12689, *Debarment and Suspension*, 2 C.F.R. Part 180 and implemented by the Department of Commerce at 2 C.F.R. part 1326, for prospective participants in lower tier covered transactions (except subcontracts for goods or services under the \$25,000 small purchase threshold unless the subrecipient will have a critical influence on or substantive control over the award), the Contractor agrees that:

- (1) By entering into this Contract, the Contractor and subcontractors certify, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared Economic Development Administration Contracting Provisions for Construction Projects

ineligible, or voluntarily excluded from participation in this Contract by any federal department or agency.

(2) Where the Contractor or subcontractors are unable to certify to any of the statements in this certification, the Contractor or subcontractors shall attach an explanation to this bid.

See also 2 C.F.R. part 180 and 2 C.F.R. § 200.342.

28. **EDA PROJECT SIGN**

The Contractor shall supply, erect, and maintain in good condition a Project sign according to the specifications provided by EDA. To the extent practical, the sign should be a free standing sign. Project signs shall not be located on public highway rights-of-way. Location and height of signs will be coordinated with the local agency responsible for highway or street safety in the Project area, if any possibility exists for obstructing vehicular traffic line of sight. Whenever the EDA site sign specifications conflict with State law or local ordinances, the EDA Regional Director will permit such conflicting specifications to be modified so as to comply with State law or local ordinance.

29. **BUY AMERICA**

To the greatest extent practicable, contractors are encouraged to purchase American-made equipment and products with funding provided under EDA financial assistance awards.

EDA PROJECT SIGN

The Contractor shall supply, erect, and maintain in good condition a project sign according to the specifications set forth below:

EDA SITE SIGN SPECIFICATIONS

Size: 4' x 8' x ¾"

Materials: Exterior grade/MDO plywood (APA rating A-B)

Supports: 4" x 4" x 12' posts with 2" x 4" cross branching

Erection: Posts shall be set a minimum of three feet deep in concrete footings that are at least 12" in diameter.

Paint: Outdoor enamel

Colors: Jet Black, Blue (PMS300), and Gold (PMS7406). Specifically, on white background the following will be placed:

The U. S. Department of Commerce seal in blue, black, and gold;

“EDA” in blue;

“U. S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT

ADMINISTRATION” in black;

“In partnership with” in blue;

(Actual name of the) “EDA Grant Recipient” in black;

Lettering: Specific fonts are named below; positioning will be as shown on the attached illustration.

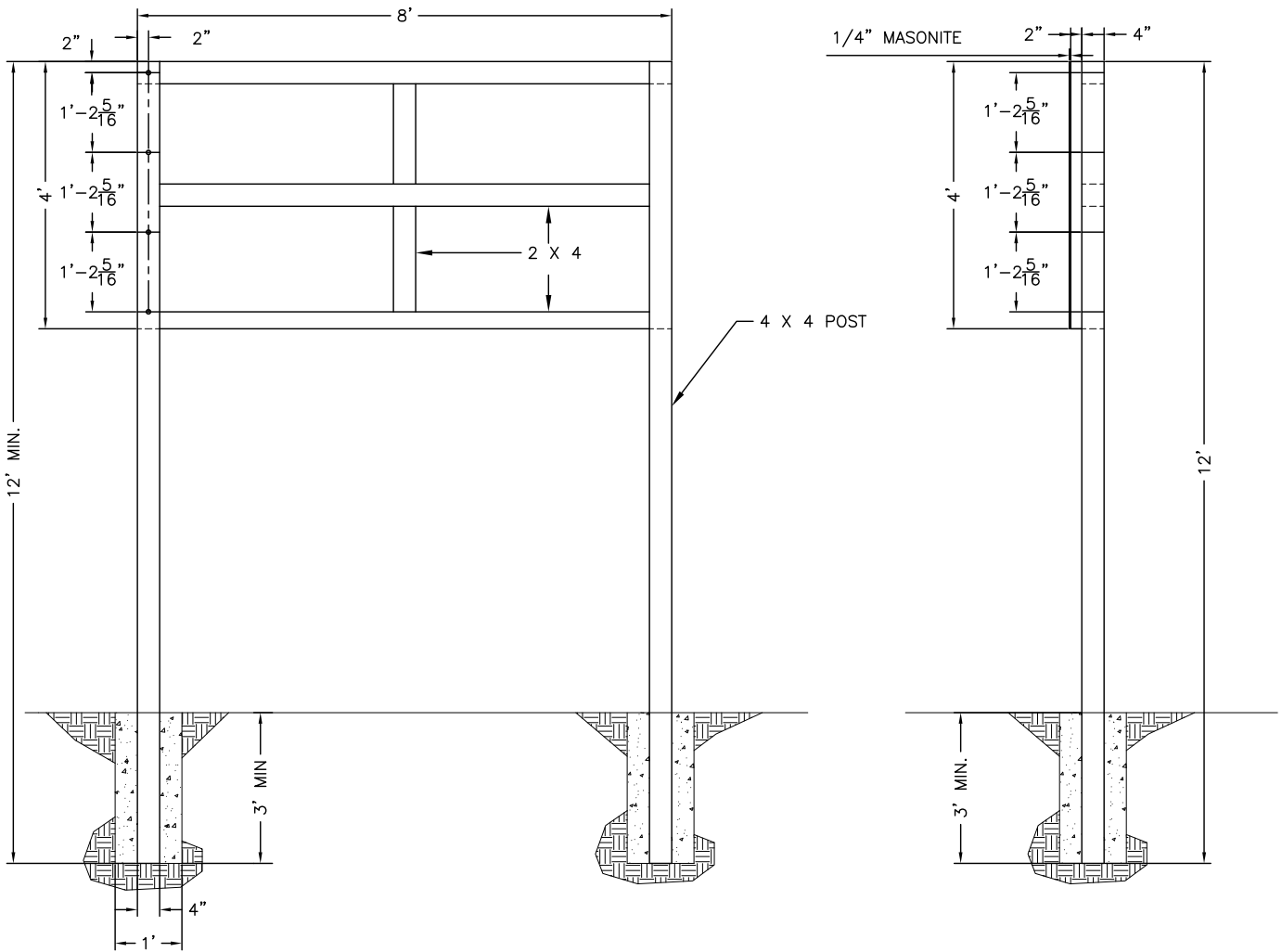
“U. S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT
ADMINISTRATION” use Bank Gothic Medium - **BANK GOTHIC MED**

“In partnership with” use Univers™ 55 Oblique - **Univers 55**

(Name of) “EDA Grant Recipient” use Univers™ Extra Black 85 **Univers 85**

Project signs will not be erected on public highway rights-of-way. If any possibility exists for obstruction to traffic line of sight, the location and height of the sign will be coordinated with the agency responsible for highway or street safety in the area.

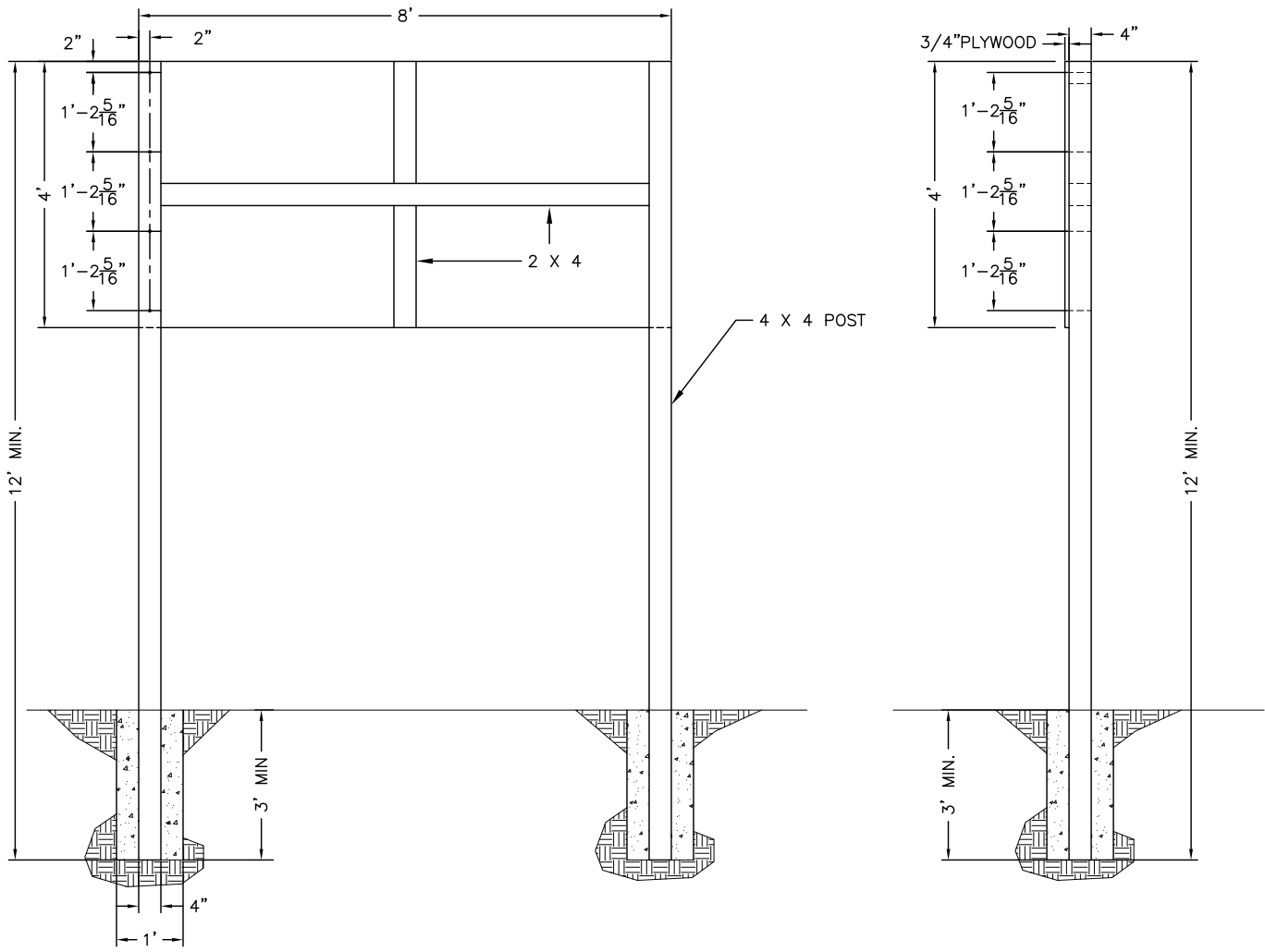
The EDA Regional Director may permit modifications to these specifications if they conflict with state law or local ordinances.



SIGN A
MASONITE SIGN
SCALE: 3/8" = 1'

PROJECT - SIGN A

ECONOMIC DEVELOPMENT ADMINISTRATION



SIGN B
PLYWOOD SIGN
SCALE: 3/8" = 1'

PROJECT - SIGN B

ECONOMIC DEVELOPMENT ADMINISTRATION



EDA

U.S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT ADMINISTRATION

In partnership with

<EDA Grant Recipient Name>



EDA

Black
Blue= PMS300
Gold= PMS7406

U.S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT ADMINISTRATION

In partnership with

<EDA Grant Recipient Name>

2.0"

1.5"

4.0"

3.0"

3.0"

3.75"

15.0"

13.5"

1.75"

1.75"

10"

48"

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. Access to site.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and drawing conventions.
7. Miscellaneous provisions.

- B. Related Requirements:

1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Eden WWTP North Aeration Basin Replacement

1. Project Location: 204 Mebane Bridge Rd, Eden, NC 27288

- B. Owner: City of Eden

- C. Owner's Representative: Jon Mendenhall, City Manager
City of Eden, NC

- D. Engineer: Dewberry Engineers Inc., Danville, VA, Drew Arnold, 434-549-8499.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

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

1. Demolition of existing in ground concrete basin structure.
2. Construction of concrete reactor tanks in the North Aeration Basin

3. Diversion of raw water to South Aeration Basin during construction
4. Construction of a new blower building.
5. Installation of High-Speed Turbo Blowers
6. Installation of fine bubble membrane diffusers
7. Installation of large bubble mixing system
8. Integration of new equipment into existing SCADA
9. Construction of a mixing chamber to receive influent, RAS, and filter backwash with baffling
10. Installation of 48" pipe from the headworks to the mixing chamber
11. Construction of a new splitter box
12. Installation of 42" pipe from the mixing chamber to the new splitter box
13. Site grading and access road improvements

B. Type of Contract:

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

1.5 CONSTRUCTION SCHEDULE AND SEQUENCE

- A. The wastewater treatment plant will stay in operation, contractor should maintain operations for City of Eden so they meet effluent permit conditions
- B. The Contractor shall prepare and submit to the Owner and his representative for review approval of the construction sequence plan and schedule. The plan will be submitted at the preconstruction meeting for discussion.
- C. The Contractor will be required to utilize bypass pumping for certain aspects of the project. The Contractor is responsible for setting up and maintaining bypass pumping systems in satisfactory conditions such that do not cause an overflow of existing tanks. When using bypassing pumping for diversion of influent flows from the headworks to the South Aeration basin while installing the new influent splitter box, the Contractor must provide a bypass pumping system capable of delivering 27 MGD. This pumping arrangement should be met with utilizing 2 duty pumps, plus 1 pump in standby. The pumps shall also be equipped with autodialing capabilities for alarming the Contractor and Operations when a pump has a fail condition. The bypass pump manufacturer must also have the capability of replacing an out of service pump within 24 hours. The Contractor may also utilize bypass pumping when tying into the Secondary Clarifier Splitter Box. A temporary plug may suffice in the crossover pipe between the South Aeration Basin and Clarifier Splitter Box, but if bypass pumping is elected by the Contractor, this system should also have the same pumping requirements as the influent splitter box above.
- D. Prior to demolishing the existing North Aeration Basin structure, the contractor shall lime stabilize, remove, and place any biosolids present on the sludge drying beds. Lime stabilization shall be performed in accordance with EPA 503b regulations for Class B biosolids.

1.6 OWNER-FURNISHED ITEMS

- A. Owner-Furnished Items:

1. Provide those properties and/or easements for construction which are shown on the drawings.

1.7 ACCESS TO SITE

- A. Provide those properties and/or easements for construction which are shown on the drawings.
- B. General: Contractor shall have full use of Project site for construction operations during construction period and the standard work hours. Contractor's use of Project site is limited only by Owner's right to perform day to day operations at the wastewater facility.
- C. Use of Site: Limit use of Project site to work in areas 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 storage of materials unless agreed to by Owner.
 - 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.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weather-tight condition throughout construction period. Repair damage caused by construction operations.

1.8 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy 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. Engineer will prepare a Certificate of Substantial Completion for each specific portion of the Work to be placed in operation prior to Owner acceptance of the completed Work.

2. 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.

1.9 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing facility to normal business working hours of 7:30 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated or approved by the Owner in writing.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. NPDES Permit Compliance: no construction activities shall result in overflows or bypasses to state waters. Also construction activities shall not impact the City's ability to meet effluent permit limits.
- E. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- F. Nonsmoking Building: Smoking is not permitted within the facility or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.
- G. Controlled Substances: Use of tobacco products and other controlled substances within the existing facility is not permitted.

1.10 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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. 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 published as part of the schedule on Drawings.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this or other contract documents for this project.

1.11 GENERAL PROJECT REQUIREMENTS

- A. Intent of Drawings:
 - 1. The drawings are diagrammatic only, intending to show general features and locations of piping, equipment, fixtures, and specialties, and do not necessarily show all required offsets and details. All work shall be accurately laid out with reference to the drawings and in cooperating with other trades to avoid conflicts and to obtain a neat and workmanlike installation.
 - 2. The drawings are not intended to be rigid in specified details and where they may be in conflict with requirements of the other drawings, or of any applicable code or ordinance, or with recommendations of the manufacturers of any equipment actually furnished, installed or connected, the work hereunder includes the making of such adjustments as may be required to cause all such equipment to be installed and connected in conformance with such codes, ordinances or recommendations for the safe, proper, efficient operation of the equipment.
- B. Intent of the Specifications: The specifications format has been chosen, merely for the convenience of the reader, as a means of presenting information. This method of presentation is not intended to delegate responsibilities for parts of the work, define subcontracts.
- C. Reference to Standard Specifications: Reference to standard specifications such as ASTM, ANSI, AWWA, etc. shall be specification in effect at the date of advertisement unless otherwise stated.
- D. Discrepancies on Plans and Specifications: If the Contractor observes that the drawings and specifications are at difference therewith, he shall promptly notify the Engineer in writing, and any necessary changes shall be adjusted as provided in the contract for changes in the work. If the Contractor performs any work knowing, or could have reasonably foreseen such differences, or that the work is contrary to any laws, ordinances, rules and regulations, and without such notice to the Engineer, he shall bear all cost arising there from. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern.

- E. **Tools, Plant and Equipment:** If at any time before the commencement or during the progress of the work, tools, plant or equipment appear to the Owner to be insufficient, inefficient, or inappropriate to secure the quality of the work required or the proper rate of progress, the Owner may order the Contractor to increase their efficiency, to improve their character, to augment their number or to substitute new tools, plant, or equipment as the case may be, and the Contractor must conform to such order, but the failure of the Owner to demand such an increase of efficiency, number or improvements shall not relieve the Contractor of his obligation to secure the quality of work and the rate of progress necessary to complete the work within the time allowed and to the satisfaction of the Owner. This in no way puts the Owner in control of the work, or the Contractor's means and methods of completing the work.

- F. **Maintenance of Service, Prior Use by Owner:** All existing utilities, both public and private, including sewer, gas, water, electrical services, etc., shall be protected and their operation shall be maintained throughout the course of the work. Any temporary shutdown of an existing service shall be arranged between Contractor and the responsible agency. The Contractor shall assume full responsibility and hold the Owner harmless from the result of any damage that may occur as a result of the Contractor's activities. Prior to completion of the work, the Owner (by agreement with the Contractor) may take over the operation and/or use of the completed project or portions thereof. Such prior use of facilities by the Owner shall not be deemed as acceptance of any work or relieve the Contractor from any of the requirements of the Contract Documents.

- G. **Code, Laws, and Regulations:**
 - 1. It is intended herein that all work to be performed under this section be in compliance with the latest editions of all applicable Federal, State and local codes, laws, and regulations governing standards, of design, construction workmanship, materials, types of equipment and methods of installation in Rockingham County, NC. If the contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Engineer, he shall bear all cost arising therefrom.
 - 2. It shall be the Contractor's responsibility to comply with an Erosion and Sediment Control Plan for his part of this work and to otherwise comply with the North Carolina Erosion and Sediment Control Law.

- H. **Safety and Health Requirements:** The Contractor shall comply with the Department of Labor's Safety and Health Requirements 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) and all amendatory requirements thereof.

- I. **Accidents:** The Contractor shall provide, at the site, such equipment and medical facilities as necessary to supply first-aid service to anyone who may be injured. The Contractor must promptly report in writing to the Owner all accidents whatsoever arising out of, or in connection with the performance of the work whether on, or adjacent to, the site and which caused death, personal injury, or property damages, giving full details and statements of witness. In addition, if death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Engineer and the Owner. If any claim is made by anyone against the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the Owner, giving full details of the claim.

- J. **Permits and License Agreements:** Where applicable, if construction conditions imposed by the North Carolina Department of Transportation construction permits and any part of these

specifications differ, the more stringent requirements shall prevail unless directed otherwise by the Engineer. The following permits will be required as a part of the project:

1. NC DEQ Land Disturbance Permit. This permit has been obtained through NC Department of Energy, Mineral and Land Resources. The Contractor shall be responsible for any fees required for construction.
 2. Rockingham County Building and Zoning Permit. The Contractor is responsible for obtaining this permit.
- K. Traffic Safety: The Contractor shall furnish and maintain all necessary barricades. By-pass signs, electrical flasher warning lights, etc., necessary to maintain traffic during construction, in compliance with the safety requirements of the Town of Boydton. The Contractor shall be responsible for maintaining a safe and passable roadway surface at all times. Streets may be closed only with express permission and approved detour routes.
- L. Traffic Requirements: The Contractor must comply with the following:
1. When one-way traffic is being maintained, it shall be flagged at all times, and no one-way traffic shall be allowed during hours after dark.
 2. Blocking of entrances will be permitted only when absolutely necessary, and provisions for safe ingress and egress to adjoining property must be provided.
 3. All detouring of traffic shall be approved and schedules with the County and/or North Carolina Department of Transportation. Contractor shall provide and maintain required signs or other warning devices.
 4. Local Fire and Police stations shall be advised, in writing, of work schedule and all detours, if any.
 5. Coordinate and receive permission from Railroad for any traffic, deliveries and construction equipment crossing railroad tracks, right-of-ways, or other facilities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 General

- A. Contractor shall execute all construction work stated in this and all Sections in the manner specified or illustrated in the Contract Documents and Drawings. Any omission in these Specifications does not release the Contractor from the responsibility to complete the work or any part of the work to the satisfaction of the Owner or his representative.

3.2 Inspections and Tests

- A. Inspections and Test at Mills and Site Installations: Where deemed necessary, inspection and test of materials and equipment may be made at the place of manufacturer prior to shipment. In order to facilitate such shop or mill inspection, the Contractor shall immediately, upon placing

orders for materials and equipment, mail copies of such shop or mill inspection, the Contractor shall immediately, upon placing orders for materials and equipment, mail copies of such orders to the Engineer, and shall afford ample time to permit the Engineer to have proper and necessary tests made prior to any shipment.

- B. Tests of Work in Place: The following tests are specified for work under this Title and shall be successfully completed prior to substantial completion:
1. Pump drawdown testing.
 2. Blower startup testing.
 3. Large bubble mixing system startup testing.
 4. Proper startup of equipment and controls.
 5. Satisfactory startup of SCADA.

END OF SECTION 011000

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 2. Divisions 02 through 32 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 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 in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify 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 CSI Form 13.1A or as otherwise agreed by Engineer.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable. Declare either "substitution for cause" or "substitution for convenience".

- b. Coordination 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 substitution 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 and 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. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
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.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 14 calendar 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. Requested substitution provides sustainable design characteristics that specified product provided.
- c. Substitution request is fully documented and properly submitted.
- d. Requested substitution will not adversely affect Contractor's construction schedule.
- e. Requested substitution has received necessary approvals of authorities having jurisdiction.
- f. Requested substitution is compatible with other portions of the Work.
- g. Requested substitution has been coordinated with other portions of the Work.
- h. Requested substitution provides specified warranty.

- A. Substitutions for Convenience: Submit requests for substitution immediately on discovery of need for change, but not later than 14 calendar 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. Requested substitution provides sustainable design characteristics that specified product provided.
- c. Substitution request is fully documented and properly submitted.
- d. Requested substitution will not adversely affect Contractor's construction schedule.
- e. Requested substitution has received necessary approvals of authorities having jurisdiction.
- f. Requested substitution is compatible with other portions of the Work.
- g. Requested substitution has been coordinated with other portions of the Work.
- h. Requested substitution provides specified warranty.

- i. Substitutions must offer advantage to the Owner in at least one of the following ways:
- j. Significant reduction in contract sum.
- k. Significant reduction in contract time.
- l. Significant, provable enhanced performance of the final project.

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. Division 01 Section "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on form included elsewhere in the contract documents.

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 Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 14 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum 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 immediately notify the Owner's representative upon discovery of the condition. 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 Sum 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 Division 01 Section "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 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor on EJCDC Documents C-941.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Work Change Directive: Engineer may issue a Work Change Directive on EJCDC Document C-940. 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 Sum 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

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. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Division 01 Section "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. Match payment items with major work activities.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. 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 seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table and approved construction schedule of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each major work activity.

1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Engineer.
 - c. Engineer's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
2. Arrange schedule of values consistent with format of EJCDC Document C-620.
3. 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.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. 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.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

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.
 - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Submit Application for Payment to Engineer by the 25th of the month. The period covered by each Application for Payment is one month, ending on the 25th.
 - 1. Submit draft copy of Application for Payment seven days prior to due date for review by Engineer.
- C. Application for Payment Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included in Project Manual.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored on-site, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

- F. Transmittal: Submit four signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period and payments covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.
- H. 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 (preliminary if not final).
 4. List of Contractor's staff assignments.
 5. List of Contractor's principal consultants.
 6. Copies of building permits.
 7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 8. Certificates of insurance and insurance policies.
 9. Performance and payment bonds.
- I. 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.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted as referenced in Section 017700.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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. Requests for Information (RFIs).
 - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: 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, and telephone number 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: Fifteen (15) days prior to 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 and telephone numbers, including home, office, and 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. 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, which depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities 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. Site testing.
 - 6. Project closeout activities.
 - 7. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out 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.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown 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. Indicate functional and spatial relationships of components of structural, civil, mechanical, and electrical systems.
 - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate 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. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, and electrical equipment.
 2. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 3. 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.
 4. 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.
 5. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.

- d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 6. Review: Engineer will review coordination drawings to confirm that 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 changes as directed and resubmit.
 7. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Division 01 Section "Submittal Procedures."
- C. 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 Portable Data File (PDF) format.
 4. Engineer will not furnish Contractor digital data files of Drawings for use in preparing coordination digital data files.

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified. Contractor will submit RFIs on behalf of his subcontractors and suppliers.
1. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as 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. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Engineer.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.

13. 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 Adobe Acrobat PDF format.
- D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven working 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 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 Division 01 Section "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 10 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 updated log at each monthly progress meeting. Include the following:
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Engineer.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Engineer's response was received.
- 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 five (5) days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT MEETINGS

- A. General: Engineer will schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved and individuals whose presence is required, of date and time of each meeting.
- B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Contractor, but no later than 15 days after execution of the Agreement.
 1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner; 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.
 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Critical work sequencing and long-lead items.
 - c. Designation of key personnel and their duties.
 - d. Lines of communications.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of record documents.
 - l. Use of the premises and existing building.
 - m. Work restrictions.
 - n. Working hours.
 - o. Responsibility for temporary facilities and controls.
 - p. Procedures for disruptions and shutdowns.
 - q. Parking availability.
 - r. Office, work, and storage areas.
 - s. Equipment deliveries and priorities.
 - t. First aid.
 - u. Security.
 - v. Progress cleaning.
 4. Minutes: Engineer will record and distribute meeting minutes.

- C. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Engineer, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Engineer, 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. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Responsibility for removing temporary facilities and controls.
 4. Minutes: Engineer will record and distribute meeting minutes.
- D. Progress Meetings: Engineer will conduct progress meetings at monthly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:

- 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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. Material location reports.
 - 5. Site condition reports.
 - 6. Special reports.
- B. Related Requirements:
 - 1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
 - 2. Division 01 Section "Quality Requirements" for submitting a 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 logically precedes another activity in the network.
 - 3. Successor Activity: An activity that logically follows another activity in the network.
- B. Event: The starting or ending point of an activity.
- C. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 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.
- D. Resource Names and Loading: The allocation of manpower and equipment necessary for the completion of 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, where indicated.
 2. Two paper copies.
- B. Startup construction schedule.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period, but in no case smaller than 24"x36".
1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Special Reports: Submit at time of unusual event.
- H. Qualification Data: For scheduling consultant.

1.5 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, 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 logical sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. 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.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Breakdown activities so no activity is longer than 20 days, unless specifically allowed by Engineer.
 - 2. Procurement Activities: Include procurement process activities for the following long lead 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.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 - 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing in accordance with requirements for each major component.
 - 5. 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.
 - 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. 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 Restrictions: Show the effect of the following items on the schedule:
 - a. Uninterruptible services.
 - b. Use of premises restrictions.
 - 2. 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.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

- E. 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, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- F. Computer Scheduling Software: Prepare schedules using current version of Microsoft Project.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. 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.
 - 2. Show the following in columns for each activity:
 - a. Early Start
 - b. Early Finish
 - c. Duration in Days
 - d. Predecessor
 - e. Resource Name

2.3 REPORTS

- A. 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.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities.

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.
- B. 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.

END OF SECTION 013200

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 requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 4. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule 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. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 - 3. 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 date of fabrication.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Engineer's Digital Data Files: Electronic digital data files of the Contract Drawings will not be provided by Engineer for Contractor's use in preparing submittals.
- 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 different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Engineer reserves the right to return without action on a submittal requiring coordination with other submittals until related submittals can be compiled and sent by Contractor.
- 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 14 calendar days from date of receipt by Engineer for initial review of each submittal. 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 14 calendar days from date of receipt by Engineer for review of each resubmittal.
- D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide adequate space on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - f. Name of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
 4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will discard submittals received from sources other than Contractor.
 - a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
 - 1) Project name.
 - 2) Date.

- 3) Destination (To:).
- 4) Source (From:).
- 5) Name and address of Engineer.
- 6) Name of Contractor.
- 7) Name of firm or entity that prepared submittal.
- 8) Names of subcontractor, manufacturer, and supplier.
- 9) Category and type of submittal.
- 10) Submittal purpose and description.
- 11) Specification Section number and title.
- 12) Specification paragraph number or drawing designation and generic name for each of multiple items.
- 13) Drawing number and detail references, as appropriate.
- 14) Indication of full or partial submittal.
- 15) Transmittal number, numbered consecutively.
- 16) Submittal and transmittal distribution record.
- 17) Remarks.
- 18) Signature of transmitter.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. The contractor shall utilize an electronic project management system for transmission of submittals, RFIs, and pay applications such as Procore.com or another approved web based system. The contractor shall be responsible for fees related to this system and providing access to the Engineers (up to five), Inspectors (up to three), and Owner (up to three).
2. Requirement in first subparagraph below can be performed automatically using PDF publishing software.
3. 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.
4. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
5. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
6. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Engineer.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.

- g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Transmittal number, numbered consecutively.
 - p. Submittal and transmittal distribution record.
 - q. Other necessary identification.
 - r. Remarks.
7. Metadata: Include the following information as keywords in the electronic submittal file metadata:
- a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- F. Options: Identify options requiring selection by Engineer.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. 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.
- I. 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.
- J. 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.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Action Submittals: Submit three plus the desired amount to be returned paper copies of each submittal unless otherwise indicated.
 2. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Engineer will not return copies.
 3. Certificates and Certifications Submittals: Provide 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.
 4. Provide a copy of specification section for each major equipment, controls, and instrumentations with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. ***Failure to include a copy of the marked-up specifications sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause of rejection of the entire submittal with no further consideration.***
- B. 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 not suitable 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 showing 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 or concurrent with Samples.
 6. Submit Product Data in the following format:
 - a. Three plus the desired number to be returned paper copies of Product Data unless otherwise indicated.
 - b. One (1) PDF electronic file.
- C. 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.
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. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
 3. Submit Shop Drawings in the following format:
 - a. Three opaque copies of each submittal plus the desired number to be returned.
 - b. One PDF electronic file.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 3. 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.

4. 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 three full set(s) 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.
- E. 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.
 5. Submit product schedule in the following format:
 - a. PDF electronic file.
- F. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- L. 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 Engineers and owners, and other information specified.
- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- N. 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.

- O. **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.
- P. **Product Certificates:** Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. **Material Certificates:** Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. **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.
- S. **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.
- T. **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:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- U. **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.
- V. **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 primers and substrate preparation needed for adhesion.
- W. **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.
- X. **Design Data:** Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 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 Certification: In addition to Shop Drawings, Product Data and other required submittals will submit three paper copies of certificate, 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.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action 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. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.2 ENGINEER'S ACTION

- A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. 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.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

- E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

END OF SECTION 013300

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 inspecting 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 -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Requirements:
 - 1. Divisions 02 through 32 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. 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.
- B. 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. Services do not include contract enforcement activities performed by Engineer.
- C. 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.

- D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. 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, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- I. 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.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but , to Engineer for a decision 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.

1.5 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.

- 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.

1.6 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, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making and witnessing 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, testing, and inspecting.
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, and telephone number 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 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, and telephone number 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 whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 QUALITY ASSURANCE

- A. General: 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.
- 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, 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. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- F. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- G. 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.

1.8 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

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. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these 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 inspecting 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 inspecting 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. **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 Division 01 Section "Submittal Procedures."
- C. **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.
- D. **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.
- E. **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 location 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 any duties of Contractor.
- F. **Associated Services:** Cooperate with agencies 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 inspecting. 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 inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, 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 Division 01 Section "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



Dewberry Engineers Inc. | 434.797.4497
551 Piney Forest Road | 434.797.4341 fax
Danville, VA 24540-3353 | www.dewberry.com

Statement of Special Inspections

Project Name: City of Eden WWTP North Aeration Basin Replacement

Date: November 2024

Building Permit Number:

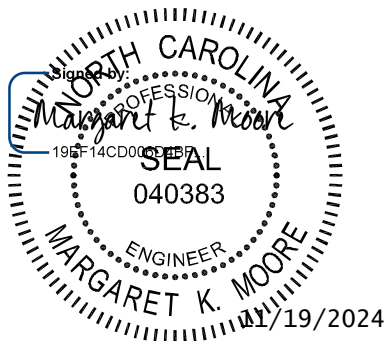
Project Address: 204 Mebane Bridge Road, Eden, NC 27288

Design Professional in Responsible Charge (DPIRC): Margaret K. Moore

The following information is being submitted in accordance with the Special Inspection provisions of the 2018 North Carolina State Building Code (NCSBC). Attached is the schedule of special inspections (SSI) required for this project. This completed form is required to be included in the project manual. After permit issuance, a listing of the special inspection firms (SIF) and the designated special inspectors (DSI) for each inspection type will be attached to this form prior to scheduling the pre-construction meeting. No work is permitted to be performed prior to the special inspections pre-construction meeting.

The DSI is responsible for verifying all information on each document prior to signing/sealing.
The DSI is responsible for verifying each document is the correct document.
The DSI is responsible for correcting any documents that have errors.
The DSI is responsible for verifying all DSI's maintain current certifications during the course of the project, as failure to maintain current certifications may result in a voided document. At the conclusion of each individual special inspection type, the DSI will complete a final report.

The special inspection program outlined herein, does not relieve the contractor or any other entity of any contractual duties, including quality control, quality assurance, or safety. The contractor is solely responsible for construction means, methods, and job site safety. Failure to adhere to the SI program as outlined herein, may result in a stop work notice being issued by the Department.



DPIRC: Margaret K. Moore

North Carolina Professional Engineer License No.: 040383

STRUCTURAL STEEL					AISC 360	
Check if Required	Required Verification and Inspection Task		Perform	Observe	Special Inspections Firm	Notes & Scope
☒	I.	INSPECTION TASKS PRIOR TO WELDING, AISC 360 TABLE N5.4-1				
	a.	Welding procedure specifications (WPSs) available	X	-		
	b.	Manufacturer certifications for welding consumables available	X	-		
	c.	Material identification (type/grade)	-	X		
	d.	Welder identification system	-	X		
	e.	Fit-up of groove welds (including joint geometry) <ul style="list-style-type: none"> • Joint penetration • Dimensions (alignment, root opening, root face, bevel) • Cleanliness (condition of steel surfaces) • Tacking (tack weld quality and location) • Backing type and fit (if applicable) 	-	X		
☒	f.	Configuration and finish of access holes	-	X		
	g.	Fit-up of fillet welds <ul style="list-style-type: none"> • Dimensions (alignment, gaps at root) • Cleanliness (condition of steel surfaces) • Tacking (tack weld quality and location) 	-	X		
	ii.	INSPECTION TASKS DURING WELDING, AISC 360 TABLE N5.4-2				
	a.	Use of qualified welders	-	X		
☒	b.	Control and handling of welding consumables <ul style="list-style-type: none"> • Packaging • Exposure control 	-	X		
	c.	No welding over cracked tack welds	-	X		
	d.	Environmental conditions <ul style="list-style-type: none"> • Wind speed within limits • Precipitation and temperature 	-	X		
	e.	WPS followed <ul style="list-style-type: none"> • Settings on welding equipment • Travel speed • Selected welding materials • Shielding gas type/flow rate • Preheat applied • Interpass temperature maintained (min./max.) • Proper positions (F, V, H, OH) 	-	X		
	f.	Welding techniques <ul style="list-style-type: none"> • Interpass and final cleaning • Each pass within profile limitations • Each pass meets quality requirements 	-	X		

☒	III.	INSPECTION TASKS AFTER WELDING, AISC 360 TABLE N5.4-3				
	a.	Welds cleaned	-	X		
	b.	Size, length and location of welds	X	-		
	c.	Welds meet visual acceptance criteria <ul style="list-style-type: none"> • Crack prohibition • Weld/base-metal fusion • Crater cross section • Weld profiles • Weld size • Undercut • Porosity 	X	-		
	d.	Arc strikes	X	-		
	e.	k-area	X	-		
	f.	Backing removed and welds tabs removed (if required)	X	-		
	g.	Repair activities	X	-		
	h.	Document acceptance or rejection of welded joint or member	X	-		
☒	IV.	INSPECTION TASKS PRIOR TO BOLTING, AISC 360 TABLE N5.6-1				
	a.	Manufacturer's certifications available for fastener materials	-	X		
	b.	Fasteners marked in accordance with ASTM requirements	-	X		
	c.	Proper fasteners selected for the joint detail (grade, type, bolt length if threads are to be exclude from shear plane)	-	X		
	d.	Proper bolting procedure selected for joint detail	-	X		
	e.	Connecting elements, including the appropriate faying surface condition and hole preparation, if specified, meet applicable requirements	-	X		
	f.	Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used	-	X		
	g.	Proper storage provided for bolts, nuts, washers and other fastener components	-	X		
☒	V.	INSPECTION TASKS DURING BOLTING, AISC 360 TABLE N5.6-2				
	a.	Fastener assemblies, of suitable condition, placed in all holes and washer (if required) are positioned as required	-	X		
	b.	Joint brought to the snug-tight condition prior to the pretensioning operation	-	X		
	c.	Fastener component not turned by the wrench prevented from rotating	-	X		
	d.	Fasteners are pretensioned in accordance with the RCSC Specification, progressing systematically from the most rigid point toward the free edges	-	X		
☒	VI.	INSPECTION TASKS AFTER BOLTING, AISC 360 TABLE N5.6-3				
	a.	Document acceptance or rejection of bolted connections	X	-		

<input type="checkbox"/>	VII.	INSPECTION OF STEEL ELEMENTS OF COMPOSITE CONSTRUCTION PRIOR TO CONCRETE PLACEMENT, AISC 360 TABLE N6.1				
	a.	Placement and installation of steel deck	X	-		
	b.	Placement and installation of steel headed stud anchors	X	-		
	c.	Document acceptance or rejection of steel elements	X	-		
<input type="checkbox"/>	VIII.	INSPECTION OR EXECUTION TASKS PRIOR TO DECK PLACEMENT, SDI QA/QC TABLE 1.1				
	a.	Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness	X	-		
	b.	Document acceptance or rejection of deck and deck accessories	X	-		
<input type="checkbox"/>	IX.	INSPECTION OR EXECUTION TASKS AFTER DECK PLACEMENT, SDI QA/QC TABLE 1.2				
	a.	Verify compliance of deck and all deck accessories installation with construction documents.	X	-		
	b.	Verify deck materials are represented by the mill certifications that comply with the construction documents	X	-		
	c.	Document acceptance or rejection of installation of deck and deck accessories	X	-		
<input type="checkbox"/>	X.	INSPECTION OR EXECUTION OF TASKS PRIOR TO DECK WELDING, SDI QA/QC TABLE 1.3				
	a.	Welding procedure specifications (WPS) available	-	X		
	b.	Manufacturer certifications for welding consumables available	-	X		
	c.	Material identification (type/grade)	-	X		
	d.	Check welding equipment	-	X		
<input type="checkbox"/>	XI.	INSPECTION OR EXECUTION TASKS DURING DECK WELDING, SDI QA/QC TABLE 1.4				
	a.	Use of qualified welders	-	X		
	b.	Control and handling of welding consumables	-	X		
	c.	Environmental conditions (wind speed, moisture, temperature)	-	X		
	d.	WPS followed	-	X		
<input type="checkbox"/>	XII.	INSPECTION OR EXECUTION TASKS AFTER DECK WELDING, SDI QA/QC TABLE 1.5				
	a.	Verify size and location of welds, including support, sidelap, and perimeter welds	X	-		
	b.	Welds meet visual acceptance criteria	X	-		
	c.	Verify repair activities	X	-		
	d.	Document acceptance or rejection of welds	X	-		
<input type="checkbox"/>	XIII.	INSPECTION OR EXECUTION TASKS PRIOR TO DECK MECHANICAL FASTENING, SDI QA/QC TABLE 1.6				
	a.	Manufacturer installation instructions available for mechanical fasteners	-	X		
	b.	Proper tools available for fastener installation	-	X		
	c.	Proper storage for mechanical fasteners	-	X		

<input type="checkbox"/>	XIV.	INSPECTION OR EXECUTION TASKS DURING DECK MECHANICAL FASTENING, SDI QA/QC TABLE 1.7				
	a.	Fasteners are positioned as required	-	X		
	b.	Fasteners are installed in accordance with manufacturer's instructions	-	X		
<input type="checkbox"/>	XV.	INSPECTION OR EXECUTION TASKS AFTER DECK MECHANICAL FASTENING, SDI QA/QC TABLE 1.8				
	a.	Check spacing, type, and installation of support fasteners	X	-		
	b.	Check spacing, type, and installation of sidelap fasteners	X	-		
	c.	Check spacing, type, and installation of perimeter fasteners	X	-		
	d.	Verify repair activities	X	-		
	e.	Document acceptance or rejection of mechanical fasteners	X	-		
<input checked="" type="checkbox"/>	XVI.	OTHER STEEL INSPECTION TASKS, AISC 360 SECTION N5.7				
	a.	Inspection during the placement of anchor rods or other embedments supporting structural steel:				
		(1) Verify diameter, grade, type and length	-	X		
		(2) Verify extent or depth of embedment into concrete, prior to placement of concrete	-	X		
	b.	Inspection of steel frame details for compliance with approved construction documents:				
		(1) Details such as braces and stiffeners	-	X		
		(2) Member locations	-	X		
		(3) Proper application of joint details at each connection.	-	X		
	c.	Material verification of structural steel:				
		(1) Identification markings to conform to AISC 360.	-	X		
	(2) Manufacturers' certified mill test reports.	-	X			

STRUCTURAL STEEL – SEISMIC FORCE RESISTING SYSTEM

AISC 341

Check if Required	Required Verification and Inspection Task	Perform	Observe	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I. NON-DESTRUCTIVE TESTING, AISC 341 SECTION J6.2				
	a. Where welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, the web shall be tested for cracks using MT.	X	-		
	b. UT shall be performed on 100% of CJP groove welds in materials 5/16 in. thick or greater. MT shall be performed on 25% of all beam-to-column CJP groove welds.	X	-		
	c. After joint completion, base metal thicker than 1.5 in. loaded in tension in the through-thickness direction in tee and corner joints, where the connected material is greater than 3/4 in. and contains CJP groove welds, shall be tested using UT for discontinuities behind and adjacent to the fusion line of such welds.	X	-		
	d. At welded splices and connections, thermally cut surfaces of beam copes and access holes shall be tested using MT or penetrant testing, when the flange thickness exceeds 1.5 in. for rolled shapes, or when the web thickness exceeds 1.5 in. for built-up shapes.	X	-		
	e. MT shall be performed on any weld and adjacent area of the reduced beam section (RBS) cut surface that has been repaired by welding, or on the base metal of the RBS cut surface if a sharp notch has been removed by grinding.	X	-		
	f. At the end of welds where weld tabs have been removed, MT shall be performed on the same beam-to-column joints receiving UT as required under Section J6.2b.	X	-		
<input type="checkbox"/>	II. INSPECTION OF COMPOSITE STRUCTURES PRIOR TO CONCRETE PLACEMENT, AISC 341 TABLE J9-1				
	a. Material identification of reinforcing steel (type/grade)	-	X		
	b. Determination of carbon equivalent for reinforcing steel other than ASTM A706	-	X		
	c. Proper reinforcing steel size, spacing and orientation	-	X		
	d. Reinforcing steel has not been rebent in the field	-	X		
	e. Reinforcing steel has been tied and supported as required	-	X		
	f. Required reinforcing steel clearances have been provided	-	X		
	g. Composite member has required size	-	X		
<input type="checkbox"/>	III. INSPECTION OF COMPOSITE STRUCTURES DURING CONCRETE PLACEMENT, AISC 341 TABLE J9-2				
	a. Concrete: Material identification (mix design, compressive strength, maximum large aggregate size, maximum slump)	-	X		
	b. Limits on water added at the truck or pump	-	X		
	c. Proper placement techniques to limit segregation	-	X		

<input type="checkbox"/>	IV.	INSPECTION OF COMPOSITE STRUCTURES AFTER CONCRETE PLACEMENT, AISC 341 TABLE J9-3				
	a.	Achievement of minimum specified concrete compressive strength at specified age	-	X		
<input type="checkbox"/>	V.	OTHER STEEL INSPECTIONS, AISC 341 TABLE J8-1				
	a.	Reduced beam section (RBS) requirements • Contour and finish • Dimensional tolerances	X	-		
	b.	Verify no holes or unapproved attachments are made within the protected zones.	X	-		

OPEN WEB STEEL JOISTS AND JOIST GIRDERS			NCSBC Table 1705.2.3			
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	Installation of open-web steel joists and joist girders.				
	a.	End connections - welding or bolted.	-	X		
	b.	Bridging - horizontal or diagonal.				
		(1) Standard bridging.	-	X		
		(2) Bridging that differs from the SJI specifications listed in Section 2207.1.	-	X		

CONCRETE CONSTRUCTION			NCSBC Table 1705.3			
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input checked="" type="checkbox"/>	I.	Inspect reinforcement, including prestressing tendons, and verify placement.	-	X		
<input type="checkbox"/>	II.	Reinforcing bar welding:				Only permitted as directed by EOR.
	a.	Verify weldability of reinforcing bars other than ASTM A 706;	-	X		
	b.	Inspect single-pass fillet welds, maximum 5/16", and	-	X		
	c.	Inspect all other welds.	X	-		
<input checked="" type="checkbox"/>	III.	Inspect anchors cast in concrete.	-	X		
<input checked="" type="checkbox"/>	IV.	Inspect anchors post-installed in hardened concrete members.				
	a.	Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads.	X	-		
	b.	Mechanical anchors and adhesive anchors not defined in 4.a.	-	X		
<input checked="" type="checkbox"/>	V.	Verify use of required design mix.	-	X		
<input checked="" type="checkbox"/>	VI.	Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	X	-		
<input checked="" type="checkbox"/>	VII.	Inspect concrete and shotcrete placement for proper application techniques.	X	-		
<input checked="" type="checkbox"/>	VIII.	Verify maintenance of specified curing temperature and techniques.	-	X		

<input checked="" type="checkbox"/>	IX.	Inspect prestressed concrete for:				
	a.	Application of prestressing forces; and	X	-		
	b.	Grouting of bonded prestressing tendons.	X	-		
<input checked="" type="checkbox"/>	X.	Inspect erection of precast concrete members.	-	X		
<input checked="" type="checkbox"/>	XI.	Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	-	X		
<input checked="" type="checkbox"/>	XII.	Inspect formwork for shape, location and dimensions of the concrete member being formed.	-	X		

MASONRY CONSTRUCTION – LEVEL B			ACI 530.1, Table 4			
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	Verify compliance with the approved submittals.	-	X		
<input type="checkbox"/>	II.	Verification of f'm and f'aac prior to construction, except where specifically exempted by this Code.	-	X		
<input type="checkbox"/>	III.	Verification of Slump flow and VSI as delivered to the project site for self-consolidating grout.	X	-		
<input type="checkbox"/>	IV.	As masonry construction begins, verify that the following are in compliance:				
	a.	Proportions of site-prepared mortar.	-	X		
	b.	Construction of mortar joints.	-	X		
	c.	Grade and size of prestressing tendons and anchorages.	-	X		
	d.	Location of reinforcement, connectors, and prestressing tendons and anchorages.	-	X		
	e.	Prestressing technique.	-	X		
	f.	Properties of thin-bed mortar for AAC masonry.				
		(1) Inspection of the first 5000 square feet.	X	-		
	(2) Inspections after the first 5000 square feet.	-	X			
<input type="checkbox"/>	V.	Prior to grouting, verify that the following are in compliance:				
	a.	Grout space.	-	X		
	b.	Grade, type, and size of reinforcement and anchor bolts, and prestressing tendons and anchorages.	-	X		
	c.	Placement of reinforcement, connectors, and prestressing tendons and anchorages.	-	X		
	d.	Proportions of site-prepared grout and prestressing grout for bonded tendons.	-	X		
	e.	Construction of mortar joints.	-	X		

<input type="checkbox"/>	VI.	Verify during construction:				
	a.	Size and location of structural elements.	-	X		
	b.	Type, size, and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction.	-	X		
	c.	Welding of reinforcement.	X	-		
	d.	Preparation, construction, and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F).	-	X		
	e.	Application and measurement of prestressing force.	X	-		
	f.	Placement of grout and prestressing grout for bonded tendons is in compliance.	X	-		
	g.	Placement of AAC masonry units and construction of thin-bed mortar joints.				
		(1) Inspection of the first 5000 square feet.	X	-		
	(2) Inspections after the first 5000 square feet.	-	X			
<input type="checkbox"/>	VII.	Observe preparation of grout specimens, mortar specimens, and/or prisms.	-	X		

MASONRY CONSTRUCTION – LEVEL C			ACI 530.1, Table 5			
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	Verify compliance with the approved submittals.	-	X		
<input type="checkbox"/>	II.	Verification of f _m and f _{aac} prior to construction and for every 5,000 square feet during construction.	-	X		
<input type="checkbox"/>	III.	Verification of proportions of materials in premixed or preblended mortar, prestressing grout, and grout other than self-consolidating grout, as delivered to the site.	-	X		
<input type="checkbox"/>	IV.	Verification of Slump flow and VSI as delivered to the project site for self-consolidating grout.	X	-		

<input type="checkbox"/>	V.	Verify that the following are in compliance:				
	a.	Proportions of site-mixed mortar and grout and prestressing grout for bonded tendons	-	X		
	b.	Grade, type, and size of reinforcement and anchor bolts, and prestressing tendons and anchorages.	-	X		
	c.	Placement of masonry units and construction of mortar joints.	-	X		
	d.	Placement of reinforcement, connectors, and prestressing tendons and anchorages.	X	-		
	e.	Grout space prior to grouting.	X	-		
	f.	Placement of grout and prestressing grout for bonded tendons.	X	-		
	g.	Size and location of structural elements.	-	X		
	h.	Type, size, and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction.	X	-		
	i.	Welding of reinforcement.	X	-		
	j.	Preparation, construction, and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F).	-	X		
	k.	Application and measurement of prestressing force.	X	-		
	l.	Placement of AAC masonry units and construction of thin-bed mortar joints.	X	-		
m.	Properties of thin-bed mortar for AAC masonry.	X	-			
<input type="checkbox"/>	VI.	Observe preparation of grout specimens, mortar specimens and/or prisms.	X	-		

SOILS		NCSBC Table 1705.6				
Check if Required	Required Verification and Inspection Task	Continuous	Periodic	Special Inspections Firm	Notes & Scope	
<input checked="" type="checkbox"/>	I. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	-	X			
<input checked="" type="checkbox"/>	II. Verify excavations are extended to proper depth and have reached proper material.	-	X			
<input checked="" type="checkbox"/>	III. Perform classification and testing of compacted fill materials.	-	X			
<input checked="" type="checkbox"/>	IV. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	X	-			
<input checked="" type="checkbox"/>	V. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	-	X			

DRIVEN DEEP FOUNDATIONS		NCSBC Table 1705.7				
Check if Required	Required Verification and Inspection Task	Continuous	Periodic	Special Inspections Firm	Notes & Scope	
<input type="checkbox"/>	I. Verify element materials. Sizes and lengths comply with the requirements.	X	-			
<input type="checkbox"/>	II. Determine capacities of test elements and conduct additional load tests, as required.	X	-			

<input type="checkbox"/>	III.	Inspect driving operations and maintain complete and accurate records for each element.	X	-		
<input type="checkbox"/>	IV.	Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record trip butt elevations and document any damage to foundation element.	X	-		
<input type="checkbox"/>	V.	For steel elements and concrete-filled elements, perform tests and additional special inspections in accordance with Section 1705.2.	-	X		
<input type="checkbox"/>	VI.	For concrete elements and concrete-filled elements, perform tests and additional special inspections in accordance with Section 1705.3	-	X		
<input type="checkbox"/>	VII.	For specialty elements, perform additional inspections as determined by the registered design professional in responsible charge.	-	X		

CAST-IN-PLACE DEEP FOUNDATIONS			NCSBC Table 1705.8			
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	Inspect drilling operations and maintain complete and accurate records for each element.	X	-		
<input type="checkbox"/>	II.	Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes.	X	-		
<input type="checkbox"/>	III.	For concrete elements, perform tests and additional special inspections in accordance with Section 1705.3.	-	-		

FABRICATED ITEMS			NCSBC Section 1705.10			
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input checked="" type="checkbox"/>	I.	Inspect fabrication of structural, load-bearing, or lateral load-resisting members or assemblies that are being conducted on the premises of a fabricator's shop that is not registered and approved to perform such work without special inspection.	X	-		
<input checked="" type="checkbox"/>	II.	Verify fabricator's certificate of compliance for structural members or assemblies that are being fabricated on the premises of the fabricator's shop that is registered and approved to perform such work.	X	-		

WIND RESISTANCE			NCSBC Section 1705.11			
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	A written statement of responsibility shall be provided in accordance with Section 1704.4.	-	-		
<input type="checkbox"/>	II.	Structural Wood				Except as noted in 1705.11.1
	a.	Field gluing operations of elements of the main windforce-resisting system.	X	-		
	b.	Nailing, bolting, anchoring, and other fastening of elements of the main windforce-resisting system, including: <ul style="list-style-type: none"> • Shear Walls • Diaphragms • Drag struts • Braces • Hold-downs 	-	X		
<input type="checkbox"/>	III.	Cold-formed Steel Light-Frame Construction				Except as noted in 1705.11.2
	a.	Welding operations of elements of the main windforce-resisting system.	-	X		
	b.	Screw attachment, bolting, anchoring, and other fastening of elements of the main windforce-resisting system, including: <ul style="list-style-type: none"> • Shear Walls • Diaphragms • Drag struts • Braces • Hold-downs 	-	X		
<input type="checkbox"/>	IV.	Wind-Resisting Components				
	a.	Roof covering, roof deck, and roof framing connections.	-	X		
	b.	Exterior wall covering and wall connections to roof and floor diaphragms and framing.	-	X		

SEISMIC RESISTANCE			NCSBC Section 1705.12			
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	A written statement of responsibility shall be provided in accordance with Section 1704.4.	-	-		
<input type="checkbox"/>	II.	Structural Wood:				Required for structures assigned to SDC C, D, E, or F.
	a.	Field gluing operations of elements of the main windforce-resisting system.	X	-		
	b.	Nailing, bolting, anchoring, and other fastening of elements of the main windforce-resisting system, including: <ul style="list-style-type: none"> • Shear Walls • Diaphragms • Drag struts • Braces • Hold-downs 	-	X		
<input type="checkbox"/>	III.	Cold-formed Steel Light-Frame Construction				Required for structures assigned to SDC C, D, E, or F.
	a.	Welding operations of elements of the main windforce-resisting system.	-	X		
	b.	Screw attachment, bolting, anchoring, and other fastening of elements of the main windforce-resisting system, including: <ul style="list-style-type: none"> • Shear Walls • Diaphragms • Drag struts • Braces • Hold-downs 	-	X		
<input type="checkbox"/>	IV.	Examine designated seismic systems requiring seismic qualification per 13.2.2 of ASCE 7. Verify that the label, anchorage, and mounting conform to the certificate of compliance.	-	-		Required for structures assigned to SDC C, D, E, or F.
<input type="checkbox"/>	V.	Inspect erection and fastening of architectural components, including: <ul style="list-style-type: none"> • Exterior cladding • Interior and exterior nonbearing walls • Interior and exterior veneer 				Required for structures assigned to SDC C, D, E, or F, except as noted in 1705.12.5.
<input type="checkbox"/>	VI.	Inspect the following plumbing, mechanical, and electrical components.				
	<input type="checkbox"/> a.	Anchorage of electrical equipment used for emergency or standby power systems.	-	X		Required for structures assigned to SDC C, D, E, or F.
	<input type="checkbox"/> b.	Anchorage of other electrical equipment	-	X		Required for structures assigned to SDC E, or F.
	<input type="checkbox"/> c.	Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units.	-	X		Required for structures assigned to SDC E or F.
	<input type="checkbox"/> d.	Installation and anchorage of ductwork designed to carry hazardous materials.	-	X		Required for structures assigned to SDC C, D, E, or F.
	<input type="checkbox"/> e.	Installation and anchorage of vibration isolation systems where the approved construction documents require a nominal clearance of 1/4 inch or less between the equipment and support frame restraint.	-	X		Required for structures assigned to SDC C, D, E, or F.
<input type="checkbox"/>	VII.	Inspect anchorage of storage racks that are eight feet or greater in height.	-	X		Required for structures assigned to SDC D, E, or F.
<input type="checkbox"/>	VIII.	Provide inspection for seismic isolation systems in seismically isolated structures.	-	X		Required for structures assigned to SDC B, C, D, E, or F.

<input type="checkbox"/>	IX.	Inspect installation of cold-formed special steel moment frames in the seismic force resisting system.	-	X		Required for structures assigned to SDC D, E, or F.
<input type="checkbox"/>	X.	Perform testing for seismic resistance and submit certificates of compliance in accordance with Section 1705.13.	-	-		

SPRAYED FIRE-RESISTANT MATERIALS						NCSBC Section 1705.14
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	Inspect spray-applied fire resistant materials per Section 1705.14.	-	X		Inspect surface conditions, applications, thickness, density, and bond strength in accordance with 1705.14.1-1705.14.6.

MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS						NCSBC Section 1705.15
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	Inspect mastic and intumescent fire-resistant coating in accordance with AWC1 12-B.	-	X		

EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)						NCSBC Section 1705.16
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	Inspect EIFS per Section 1705.16.	-	X		Except as noted in 1705.16.

FIRE-RESISTANT PENETRATIONS AND JOINTS						NCSBC Section 1705.17
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	Inspect penetration firestop systems tested and listed in accordance with 714.3.1.2 and 714.4.2.	-	X		Inspection in accordance with ASTM E2174.
<input type="checkbox"/>	II.	Inspect fire-resistant joint systems tested and listed in accordance with 715.3 and 715.4.	-	X		Inspection in accordance with ASTM E2393.

SMOKE CONTROL						NCSBC Section 1705.18
Check if Required	Required Verification and Inspection Task		Continuous	Periodic	Special Inspections Firm	Notes & Scope
<input type="checkbox"/>	I.	Inspect smoke control per Section 1705.18.	-	X		Inspect during ductwork, erection, and system testing. Inspect prior to covering (enclosing).

STRUCTURAL OBSERVATIONS		NCSBC Section 1704.6	
Check if Required	Required Observation Task		Notes & Scope
<input type="checkbox"/>	I.	Seismic Resistance	As required by 1704.6.1
<input type="checkbox"/>	II.	Wind Resistance	As required by 1704.6.2

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": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- 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. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

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 Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	American Concrete Institute www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association (Now part of CPA)	

AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Engineers (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)	
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(405) 780-7372
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA - The Engineered Wood Association)	
API	American Petroleum Institute www.api.org	(202) 682-8000
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASME	ASME International (American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040

ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500
AWCI	Association of the Wall and Ceiling Industry www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (Now WCMA)	
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association) www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000

EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(630) 942-6591
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110

NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902

C. Code 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
UBC	Uniform Building Code (See ICC)	

D. 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. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	(202) 761-0011
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000

EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
USDA	Department of Agriculture www.usda.gov	(202) 720-2791

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil Available from Defense Standardization Program www.dps.dla.mil	(215) 697-2664

Available from General Services Administration
www.gsa.gov

(202) 619-8925

Available from National Institute of Building Sciences
www.wbdg.org/ccb

(202) 289-7800

FTMS Federal Test Method Standard
(See FS)

MIL (See MILSPEC)

MIL-STD (See MILSPEC)

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

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 312319 "Dewatering" for disposal of ground water at Project site.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Engineer, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Sanitary sewerage services shall be provided by the City of Eden at no additional cost to the Contractor.
- C. Water Service: Potable water will be made available to the Contractor on site at no cost to the Contractor.
- D. Electric Power Service: Provide a meter and pay all electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. 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. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.
- B. Job Trailer: Provide a mobile trailer sized, furnished, and equipped to accommodate Contractor's personnel, City personnel, Inspector, records and provide for on-site meetings.
 - 1. Trailer shall include a space for the Inspector including desk, power supply, internet access, laptop or desktop computer, printer and paper, and records storage.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 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. Sanitary Facilities: Provide temporary toilets, wash 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.
- C. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead unless otherwise indicated.

- D. 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.

3.2 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.
- 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: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- 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. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

3.3 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial 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 Substantial 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. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01770 "Closeout Procedures."

END OF SECTION 015000

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. Division 01 Section "Substitution Procedures" for requests for substitutions.
 - 2. Division 01 Section "References" for applicable industry standards for products specified.

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, which is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process 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 specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
 - b. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 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.

1.6 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. Submit copies of manufacturer's instructions to Engineer as part of initial information or action submittal.
- 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 to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents. Warranty period commences at substantial completion, not upon receipt of products.
- B. Submittal Time: Comply with requirements in Division 01 Section "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 not in conflict with 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 "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. 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.

2. **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.
 3. **Products:**
 - a. **Restricted List:** 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.
 - b. **Nonrestricted List:** Where Specifications include a list of names of both available manufacturers and products, provide either one of the products listed or an unnamed product that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 4. **Manufacturers:**
 - a. **Restricted List:** Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - b. **Nonrestricted List:** Where Specifications include a list of available manufacturers, provide either a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
 5. **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 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.
- C. **Visual Matching Specification:** Where Specifications require "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 Division 01 Section "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 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.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: 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 with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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. Installation of the Work.
 - 2. Cutting and patching.
 - 3. Progress cleaning.
 - 4. Starting and adjusting.
 - 5. Protection of installed construction.
 - 6. Correction of the Work.
- B. Related Requirements:
 - 1. Division 01 Section "Summary" for limits on use of Project site.
 - 2. Division 01 Section "Submittal Procedures" for submitting surveys.
 - 3. Division 01 Section "Selective Structure Demolition" for demolition and removal of selected portions of equipment.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 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, 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 result in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Mechanical systems piping and ducts.
 - c. Control systems.
 - d. Communication systems.
 - e. Electrical wiring systems.
 - 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 result 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. Equipment supports.
 - e. Piping, ductwork, vessels, and equipment.
 - f. 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. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: 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.
 - 2. Submit material samples and data for approval prior to patching.
- C. Filling of Tanks or Basins: If tanks or basins had to be drained for performing the specified work, water can be obtained from the treatment facility's effluent.

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, 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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. 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 caused by differing field conditions outside the control of Contractor, submit a request for information to Engineer according to requirements in Division 01 Section "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. If discrepancies are discovered, notify Engineer promptly.
- B. General: Engage a licensed land surveyor to lay out the Work using 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.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

- D. 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 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmark(s), control point(s), and property corner(s).
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

- A. General: 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 noted.
- 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 the best possible results. 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.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

- F. Tools and Equipment: Do not use tools or equipment that produce harmful 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 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.
 - 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. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, 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 according to requirements in Division 01 Section "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 minimize 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 Division 02 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. 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 minimize 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 then apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. 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.

3.7 PROGRESS CLEANING

A. General: 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 (27 deg C).

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.

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 in Finished Areas: 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 Division 02 Section "Temporary Facilities and Controls."

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 assure 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. The following shall be satisfactory completed prior to substantial completion of the project:
 - 1. Filling
 - 2. Shakedown and testing
 - 3. Startup
 - 4. Training
- B. Upon completion of equipment replacement installation, repairs, and cleanup, fill the tank or basin to its maximum operating level with water, if necessary. Obtain the necessary water from the treated effluent. Upon completion of all operations, remove all temporary facilities and return disturbed areas to their original condition.
- C. Do not allow dirt, debris, or contaminants to enter waste treatment units.
- D. Start equipment and operating of each component in the presence of the manufacturer's or vendor's representative, Engineer, and Owner's representative to confirm proper operation. Remove malfunctioning units, replace with new units, and retest. Those units that operate at varying water levels shall be verified at maximum and minimum levels.
- E. Adjust equipment for proper operation. Adjust operating components for proper operation without binding. Replace damaged and malfunctioning controls and equipment.
- F. Shake Down Trials
 - 1. Coordinate date and time of trial with Engineer and Owner's representative. Trial shall consist of operating all system for a period of 48 hours. Divide operating period equally among duplicate equipment. Conclude trial when all systems have completed 48 hours of operation without failure.
- G. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements".
- H. Startup
 - 1. During startup period, Contractor shall operate all equipment as directed by the Engineer and shall continuously monitor its operation, making adjustment and repairs as necessary.

3.9 PROTECTION 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. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017320 - SELECTIVE STRUCTURE 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.

- B. Related Requirements:

- 1. Division 01 Section "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Division 01 Section "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed, and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, removal materials and equipment becomes property of Contractor.

1.5 INFORMATIONAL SUBMITTALS

- A. 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. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

B. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

C. Pre-demolition Photographs or Video: Submit before Work begins.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.7 FIELD CONDITIONS

A. Conduct selective demolition so Owner's operations will not be disrupted and building users will not be harmed.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

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. Hazardous materials will be removed by Owner before start of the Work.
2. 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that on utilities have been identified, disconnected, and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate, and measure the nature and extent of conflict. Promptly submit a written report to Engineer.
- D. 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.
 - 2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction videotapes or photographs.
 - 1. Comply with requirements specified in Division 01 Section "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide video or photos 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 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."

3.3 PREPARATION

- A. 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.
 1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: 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, moisture and humidity, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."
- C. Temporary Shoring: 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.

3.4 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. 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, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden

space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

4. Maintain adequate ventilation when using cutting torches.
 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 7. Dispose of demolished items and materials promptly and legally.
- B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements. Do not demolish building elements beyond what is indicated on Drawings without Engineer's approval.
- 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, within 5 miles of the site.
 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 and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 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.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, oils, solvents, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Existing Items to Be Removed and Salvaged:
 - 1. Electrical equipment and wire if requested by the City.
 - 2. Handrail and fence around the North Basin
 - 3. Effluent mechanical screen equipment.
 - 4. Effluent weir plate if requested by the City.

END OF SECTION 017320

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.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for progress cleaning of Project site.
 - 2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 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, final completion construction photographic documentation, 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 where applicable.
 - 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 test/adjust/balance 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. Complete startup and testing of systems and equipment.
 - 2. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 - 4. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 5. Complete final cleaning requirements, including touchup painting.

6. Touch up 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, which must be completed or corrected before certificate will be issued.

1. Reinspection: 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.

1.7 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 according to Section 01290 "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. Submit Consent of Surety to Final Payment.

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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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. 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.

2. Submit list of incomplete items in the following format:
 - a. One paper copy.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 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 (215-by-280-mm) 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.
 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- C. 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. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 3. Remove tools, construction equipment, machinery, and surplus material from Project site.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 01500 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 2. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

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.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed 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 operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.
- C. 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.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- 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."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: 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 Engineer.
 7. 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. 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: Enable bookmarking of 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.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm)

paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

- a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.

- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. 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.
- B. 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.
- C. 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.

- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. 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.
- B. 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.
- C. 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.
- D. 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.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. 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.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. 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 warranty and bond information, as described below.

- B. 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.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 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.
- D. 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.
- E. 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.
- F. 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.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. 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 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 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.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.
 - 1. 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.
- F. 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 operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
- B. Related Requirements:
 - 1. Division 01 Section "Execution" for final property survey.
 - 2. Division 01 Section "Closeout Procedures" for general closeout procedures.
 - 3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. Divisions 02 through 32 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.

PART 2 - PRODUCTS

2.1 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 archive 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 below first floor.
 - 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 sets 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. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Engineer determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 2. Consult Engineer for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification: As follows:

- a. Project name.
- b. Date.
- c. Designation "PROJECT RECORD DRAWINGS."
- d. Name of Engineer.
- e. Name of Contractor.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- 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. Maintenance of Record Documents and Samples: Store record documents and Samples 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.
- C. Update record drawings as the work progresses. Present and discuss updated record drawings at each monthly progress meeting for reviews.

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. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Related Requirements:
 - 1. Divisions 02 through 32 Sections for specific requirements for demonstration and training for products in those Sections.

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. Submit schedule a minimum of 30 days prior to each scheduled training.
- 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 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preconstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 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 has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.1 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. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. 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.
 - g. Contact information for equipment manufacturer's authorized representative.
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.
 - f. Instruction on use of special tools.

PART 3 - EXECUTION

3.1 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 Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 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. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times.
 1. Schedule training with Owner and Engineer with at least thirty 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.

END OF SECTION 017900

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, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Aeration Basin, Influent Splitter Box, Effluent Reactor Splitter Box, and RAS Blending Chamber.
 - 2. Blower Building Footings, Piers, Slab-on-Grade, and Equipment Pads.
 - 3. Exterior Concrete Aprons, Stairs, Pipe Support Foundations, Sidewalks and Bollard Foundations.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring

procedures, vapor-barrier installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Structural Engineer of Record.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer, testing agency.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Waterstops.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor barriers.
 - 11. Semirigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.
 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301.
 - 2. ACI 117.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- F. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60 , deformed.
- B. Plain-Steel Wire: ASTM A 1064.
- C. Deformed-Steel Wire: ASTM A 1064.
- D. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150, Type I.
 - 2. Blended Cement: ASTM C 595. ASTM C 595 cements that incorporate ASTM C 1157 cements are not permitted.
 - 3. Fly Ash: ASTM C 618, Class F.
- C. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1 inch, nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- F. Water: ASTM C 94 and potable.

2.6 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Available Manufacturers:
 - a. Bometals, Inc.
 - b. Greenstreak.
 - c. Meadows, W. R., Inc.
 - d. Murphy, Paul Plastics Co.
 - e. Progress Unlimited, Inc.
 - f. Tamms Industries, Inc.
 - g. Vinylex Corp.
 - h. Or approved equal.

2. Profile: Flat, dumbbell without center bulb.
 3. Dimensions: 6 inches by 3/8 inch thick.
- B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
- a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
 - b. Concrete Sealants Inc.; Conseal CS-231.
 - c. Greenstreak; Swellstop.
 - d. Henry Company, Sealants Division; Hydro-Flex.
 - e. JP Specialties, Inc.; Earthshield Type 20.
 - f. TCMiraDRI; Mirastop.
 - g. Or approved equal

2.7 VAPOR BARRIERS

- A. Sheet Vapor Barrier: ASTM E 1745, Class A with a Perm Rating less than or equal to 0.018 perms (grains / (ft² *hr *in. HG) as tested by ASTM E 96
1. Minimum thickness: 15 mil
- B. Vapor Barrier Accessories:
1. Seal Tape: Water vapor transmission rate per ASTM E96 on 0.3 perm or less.
 2. Vapor Proofing Mastic: Water vapor transmission rate per ASTM E96 of 0.3 perm or less.
 3. Pipe Boots: Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

2.8 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Use at all exposed interior concrete slabs.
1. Available Products:
 - a. Burke by Edoco; Titan Hard.
 - b. ChemMasters; Chemisil Plus.
 - c. Dayton Superior Corporation; Day-Chem Sure Hard.
 - d. Euclid Chemical Company (The); Euco Diamond Hard.
 - e. Kaufman Products, Inc.; SureHard.
 - f. L&M Construction Chemicals, Inc.; Seal Hard.
 - g. Meadows, W. R., Inc.; Liqui-Hard.
 - h. Metalcrete Industries; Floorsaver.
 - i. Symons Corporation, a Dayton Superior Company; Buff Hard.
 - j. Vexcon Chemicals, Inc.; Vexcon StarSeal PS.
 - k. Or approved equal.

2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Available Products:
 - a. Axim Concrete Technologies; Cimfilm.
 - b. Burke by Edoco; BurkeFilm.
 - c. ChemMasters; Spray-Film.
 - d. Dayton Superior Corporation; Sure Film.
 - e. Euclid Chemical Company (The); Eucobar.
 - f. Kaufman Products, Inc.; Vapor Aid.
 - g. Lambert Corporation; Lambco Skin.
 - h. MBT Protection and Repair, Div. of ChemRex; Confilm.
 - i. Meadows, W. R., Inc.; Sealtight Evapre.
 - j. Metalcrete Industries; Waterhold.
 - k. Sika Corporation, Inc.; SikaFilm.
 - l. Symons Corporation, a Dayton Superior Company; Finishing Aid.
 - m. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
 - n. Or approved equal.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Available Products:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. Burke by Edoco; Aqua Resin Cure.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - e. Euclid Chemical Company (The); Kurez DR VOX.
 - f. Kaufman Products, Inc.; Thinfilm 420.
 - g. L&M Construction Chemicals, Inc.; L&M Cure R.
 - h. Meadows, W. R., Inc.; 1100 Clear.
 - i. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
 - j. Tamms Industries, Inc.; Horncure WB 30.
 - k. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
 - l. Or approved equal.
- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. Available Products:
 - a. Burke by Edoco; Cureseal 1315 WB.
 - b. ChemMasters; Polyseal WB.

- c. Euclid Chemical Company (The); Super Diamond Clear VOX.
- d. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
- e. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
- f. Meadows, W. R., Inc.; Vocomp-30.
- g. Metalcrete Industries; Metcure 30.
- h. Symons Corporation, a Dayton Superior Company; Cure & Seal 31 Percent E.
- i. Tamms Industries, Inc.; LusterSeal WB 300.
- j. Unitex; Hydro Seal 25.
- k. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
- l. Or approved equal.

2.10 EPOXY GROUT FOR EQUIPMENT MOUNTING

- A. Epoxy Grout for Equipment Mounting: Epoxy grout for equipment mounting shall be a non-cementitious, resin based, multi-component formulation. Epoxy grout shall be flowable, with shrinkage minimized to achieve minimum 98% effective bearing area.
 - 1. Available Products:
 - a. Masterflow 648 CP Plus; Masterbuilders.
 - b. Sikadur 42; Sika Corporation.
 - c. E3-G; Euclid Chemical Company.
 - d. Or approved equal.

2.11 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- B. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. High-Strength Epoxy Doweling System: Epoxy doweling system shall consist of an injectable two-part epoxy complying with the requirements of ASTM C881-90, Type IV, Grade 3, Class B and C except gel times. Epoxy doweling system shall be tested in accordance with ICC Acceptance Criteria 308 demonstrating compliance with the performance features of ACI 355.2. The epoxy doweling system shall be installed according to manufacturer's instructions. Design was based on the Hilti HAS threaded rods with HIT-HY 200 Safe Set System (ICC ESR-3187). Anchorage design is proprietary by product and is dependent on many variables including epoxy strength, steel strength, rod size, concrete thickness, embedment depth, bolt spacing, and

concrete edge distances. Dewberry reserves the right to reject the submitted product or modify the anchorage design if a different product is submitted than that used for design.

1. Available Products:
 - a. Hilti HIT-HY 200 Epoxy Adhesive Anchoring System (ICC ESR-4868)
 - b. ITW Red Head EPCON G5 Adhesive Anchoring System (ICC ESR-1137)
 - c. Simpson Strong-Tie SET-3G Epoxy Adhesive Anchors (ICC ESR-4057)

- E. Expansion Wedge Anchors: Expansion Wedge Anchors shall consist of threaded stud bolt body and integral wedge expander, nut, and washer complying with the requirements of Federal Specification A-A-1923A, Type 4. Expansion wedge anchors shall be tested in accordance with ICC Acceptance Criteria 193 demonstrating compliance with the performance features of ACI 355.2. Anchors shall be made of stainless steel in accordance with AISI grade 304. Design was based on the Hilti Kwik Bolt TZ2 (ICC ESR-4266). Anchorage design is proprietary by product and is dependent on many variables including bolt strength, bolt diameter, concrete thickness, embedment depth, bolt spacing, and concrete edge distances. Dewberry reserves the right to reject the submitted product or modify the anchorage design if a different product is submitted than that used for design.

1. Available Products:
 - a. Hilti Kwik Bolt TZ2 Expansion Anchor Safe Set System Carbon and Stainless Steel Anchors (ICC ESR-4266)
 - b. ITW Red Head TRUBOLT+ Wedge Anchors [3/8"-5/8" diameters only] (ICC ESR-2427)
 - c. Simpson STRONG-BOLT 2 Wedge Anchor (ICC ESR-3037)

2.12 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash: 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.14 CONCRETE MIXTURES FOR STRUCTURAL ELEMENTS

- A. Exterior Concrete Aprons, Stairs, Pipe Support Foundations, Sidewalks and Bollard Foundations: Normal-weight concrete.
 1. Minimum Compressive Strength: 4,500 psi at 28 days.
 2. Maximum W/C Ratio: 0.42.
 3. Slump Limit: 4 inches, plus or minus 1 inch. 8 inches (plus or minus 1 inch) for concrete with verified slump of 1 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
- B. Blower Building Footings, Piers, Slab-on-Grade, and Equipment Pads: Normal-weight concrete.
 1. Minimum Compressive Strength: 4,000 psi at 28 days.
 2. Maximum W/C Ratio: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.

4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size. Do not allow air content of troweled interior finished floors to exceed 3 percent.
- C. Aeration Basin, Influent Splitter Box, Effluent Reactor Splitter Box, and RAS Blending Chamber: Normal-weight concrete.
1. Minimum Compressive Strength: 5,000 psi at 28 days.
 2. Maximum W/C Ratio: 0.40.
 3. Slump Limit: 5 inches, plus or minus 1 inch. 8 inches (plus or minus 1 inch) for concrete with verified slump of 1 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Not Permitted.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
1. Class A, 1/8 inch for smooth-formed finished surfaces.
 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.

- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Structural Engineer of Record.

3.4 VAPOR-BARRIER INSTALLATION

- A. Sheet Vapor Barriers: Place, protect, and repair sheet vapor barrier according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Barriers: Place, protect, and repair bituminous vapor barrier according to manufacturer's written instructions.

3.5 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer of Record.
 - 1. Unless indicated otherwise on the drawings or approved by the Designer, the unit of operation shall not exceed 30 feet in any horizontal direction. Concrete shall be placed

continuously so the unit will be monolithic in construction. At least 7 days shall elapse between the casting of adjoining units unless approved by the Designer.

2. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
8. Provide waterstops in construction joints as indicated. Install waterstops to form a continuous diaphragm in each joint. Support and protect exposed waterstops during progress of work. Field fabricate joints in waterstops according to manufacturer's printed instructions.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE BONDING

A. General: Before depositing new concrete on or against concrete which has set, the existing surfaces shall be thoroughly roughened in a manner to uniformly expose the bonding aggregate. The existing surface shall be cleaned of all laitance, foreign matter, and loose particles.

- B. Apply epoxy adhesive bonding agent to roughened concrete surface per the epoxy adhesive manufacturer's instructions. Handle, store, and mix the epoxy adhesive agent carefully and in compliance with manufacturer's instructions. Place fresh concrete on bonding agent within allowable time limit set by manufacturer's instructions.

3.8 HIGH STRENGTH GROUT FOR EQUIPMENT BASES

- A. Equipment Base and Bearing Plates: Clean concrete bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates on wedges, shims, or setting nuts as required.
 - 2. Install anchor rods as required by equipment manufacturer.
 - 3. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

3.9 WATERSTOP INSTALLATION

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.10 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Structural Engineer of Record.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to

consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.11 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.12 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of

trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view.
 2. Finish and measure interior floor surfaces so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot-long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Structural Engineer of Record before application.

3.13 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 5. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 6. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.14 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing

operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - b. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.15 LIQUID FLOOR TREATMENT APPLICATION

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than 14 days' old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.16 GROUT FOR SHAPING BOTTOM OF STRUCTURES

- A. Where "Shaping Grout" is indicated for shaping or sloping the bottom of basins, tanks, ditches, and flumes, the "Shaping Grout" shall be a concrete mix containing no coarse aggregate and shall have a minimum 28 day compressive strength of 4,000 psi. Contractor shall proportion, design, and submit "Shaping Grout" mix design for review consistent with the requirements in Section 2 of these specifications.
- B. Concrete surfaces to receive grout for shaping or sloping structure bottoms shall be prepared for bonding in accordance with requirements in Section 3.7 of these specifications. "Shaping Grout" shall be placed as shown on the drawings with a troweled finish, unless noted otherwise.

3.17 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.18 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Structural Engineer of Record. Remove and replace concrete that cannot be repaired and patched to Structural Engineer of Record's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Structural Engineer of Record.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Structural Engineer of Record's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Structural Engineer of Record's approval.

3.19 TESTING FOR WATER-TIGHTNESS

- A. All concrete structures designed to hold or convey water, sewage, or sludge shall be tested for water-tightness by filling with water to levels approximating what will be attained during operation and measuring the drop in level due to leakage, if any. These tests shall be made under the direction of the Designer. Water supplied from the utility system shall be paid for by the Contractor. Structures to be tested for water-tightness include the Aeration Basin, Influent Splitter Box, Effluent Reactor Splitter Box, and RAS Blending Chamber.
- B. The water shall be held under each condition long enough to satisfy the Engineer that the structures are watertight. The total loss of water level in any structure shall not exceed 1/2 inch depth in 24 hours. Leakage shall be located and stopped and the structure again tested until this requirement is met.
- C. Regardless of the rate of leakage, there shall be no visible leakage from any concrete structure. The concrete structure shall be tested for leakage prior to placing backfill around the structure.

3.20 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports per the Statement of Special Inspections.
- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 - 6. Compression Test Specimens: ASTM C 31.

- a. Cast and laboratory cure four 6x12 or five 4x8 cylinder specimens for each composite sample.
 - b. One cylinder size shall be used throughout the project.
 - c. Each cylinder shall be weighed and the weight recorded directly prior to performing the compression test.
7. Compressive-Strength Tests: ASTM C 39; test one laboratory-cured specimen at 7 days and two 6x12 or three 4x8 specimens at 28 days, and retain one specimen for later testing at 56 days if 28 day strength falls below the required specified strength.
- a. Test one field-cured specimen at 7 days and two 6x12 or three 4x8 specimens at 28 days, and retain one specimen for later testing at 56 days if 28 day strength falls below the required specified strength.
 - b. A compressive-strength test shall be the average compressive strength from a set of two 6x12 or three 4x8 specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Structural Engineer of Record, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Structural Engineer of Record but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Structural Engineer of Record. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Structural Engineer of Record.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.21 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 034200 – PRECAST POST-TENSIONED CONCRETE TANKS – RECTANGULAR (ACI 350)

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. This Section includes the performance criteria, materials, design, production, and erection of rectangular precast post-tensioned concrete tanks for the entire project. The work performed under this Section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the rectangular precast post-tensioned concrete tanks shown on the Contract Drawings.
- B. Work includes, but is not limited to:
 - 1. North Aeration Basin
- C. Related Sections include the following:
 - 1. Division 32 “Earthwork” for preparing the subgrade to support the tanks and for backfilling requirements.
 - 2. Section 033100 “Cast-in-Place Concrete for Precast Post-tensioned Concrete Tank Base Slabs” for concrete for the base slab.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide rectangular precast post-tensioned concrete tanks capable of withstanding the following minimum design loads within limits and under conditions indicated:
 - 1. Internal Fluid Loads: 65 pcf
 - 2. Superimposed Dead Loads:
 - a. Piping Loads: 60 lb/ft
 - b. Shaping Grout Per Civil Drawings
 - 3. Live Loads:
 - a. Platforms: Per General Structural Notes (Sheet S-001) of Bid Drawings
 - 4. Roof Loads: N/A
 - 5. Basic Ground Snow Load: Per General Structural Notes (Sheet S-001) of Bid Drawings
 - 6. Backfill Loads:
 - a. Moist Backfill Unit Weight: Per Report of Subsurface Exploration

- b. At-Rest Equivalent Fluid Pressure against Tank Walls: Per Report of Subsurface Exploration
 - 7. Surcharge Loads: 100 Pounds Per Square Foot (psf)
 - 8. Design Groundwater Elevation: Per Report of Subsurface Exploration
 - 9. Design Flood Elevation: Elevation 522.0’.
 - 10. Seismic Loads:
 - a. Importance Factor: Per General Structural Notes (Sheet S-001) of Bid Drawings
 - b. Risk Category: Per General Structural Notes (Sheet S-001) of Bid Drawings
 - c. Soil Site Classification: Per Report of Subsurface Exploration
 - d. Mapped Spectral Response Coefficients:
 - 1) S_S : Per General Structural Notes (Sheet S-001) of Bid Drawings
 - 2) S_1 : Per General Structural Notes (Sheet S-001) of Bid Drawings
- B. General Tank Design Criteria:
- 1. Wall thickness shall be as required by ACI 350.
 - 2. Backfill shall not be used to offset fluid loads.
 - 3. Comply with ACI 350 requirements including, but not limited to:
 - a. Load factors.
 - b. Limits on stresses at transfer of prestress and under service load.
 - c. Minimum bonded reinforcement.
 - d. Concrete cover over reinforcement.
 - 4. The tank walls shall be post-tensioned in accordance with ACI 350.
 - a. Tank walls shall have horizontal post-tensioned tendons to provide residual compression stress.
 - b. Minimum residual compression shall be 125 psi after allowance for all prestress losses.
 - 5. The tank structure shall be designed to resist low to medium strength residential wastewater.
 - 6. The tank structure shall be designed for normal environmental exposure.
 - 7. Design rectangular precast post-tensioned concrete tanks to allow for fabrication and construction tolerances, and to accommodate deflection, shrinkage and creep of primary tank structure. Maintain structural precast concrete deflections within limits of ACI 350.
 - 8. Flotation safety factors:
 - a. When design groundwater or flood elevation exceeds the top of tank elevation and only using dead load to resist flotation, minimum factor of safety shall be 1.25.
 - b. When design groundwater or flood elevation is below the top of the tank, or when using soil to help resist buoyancy, minimum factor of safety shall be 1.33.
 - 1) Maximum allowable soil wedge angle from vertical: 27 degrees.
- C. Base Slab Design Criteria:
- 1. Design the base slab to resist all imposed loads within the allowable bearing capacity listed below.
 - a. Allowable Bearing Capacity: Per Report of Subsurface Exploration
 - b. Subgrade Modulus: Per Report of Subsurface Exploration
 - c. Refer to Geotechnical Engineering Report by Froehling & Robertson, Inc. dated March 17, 2023 for additional foundation design recommendations (F&R Project No. 66B-0009).

2. Minimum reinforcement in each orthogonal direction shall be in accordance with ACI 350.
3. Frost depth: 24 inches.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Material test reports shall show compliance with the required standards and be less than one year old.
- B. Design Mixtures: For each concrete mixture. Include minimum required compressive strength and field experience records or trial mix data.
- C. Shop (Erection) Drawings:
 1. Indicate stone requirements for pressure relief valves.
 2. Indicate configuration, thickness, dimensions and details of cast-in-place concrete base slab.
 3. Indicate size, spacing and details of all necessary base slab reinforcing.
 4. Indicate plan views, elevations, sections, and details necessary to install the tank.
 5. Indicate locations of all post-tensioned tendons.
 6. Indicate tendon stressing sequence and force, and theoretical elongations for all post-tensioned tendons.
 7. Include and locate all pipe penetrations. Indicate all penetration styles.
 8. Coordinate and indicate openings required by other trades.
 9. Indicate location of each precast concrete member by same identification mark placed on unit.
 10. Indicate relationship of structural precast concrete members to adjacent materials.
 11. Indicate locations and details of joint treatment.
 12. Indicate shim sizes and grout requirements.
 13. Indicate bearing pad sizes and materials.
- D. Comprehensive engineering design signed and sealed by a qualified professional engineer responsible for its preparation licensed in the State of North Carolina.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Tank Supplier and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names and addresses, names and addresses of engineers and owners, and other information specified.
- B. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements.
 1. Cementitious materials.
 2. Aggregates.
 3. Reinforcing materials and post-tensioning strands.
 4. Admixtures.
 5. Bearing pads.

6. Other components specified in Contract Documents with applicable standards.
- C. Provide handling procedures, erection sequences, and temporary bracing as required for special conditions.
 - D. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Tank Supplier Qualifications: A firm that complies with the following requirements and is experienced in producing rectangular precast post-tensioned concrete tanks that have a record of successful in-service performance.
 1. Assumes responsibility for engineering rectangular precast post-tensioned concrete tanks to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 2. Precast Tank Engineer Qualifications: A professional engineer licensed 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 designs and installations of rectangular precast post-tensioned concrete tanks.
 3. Participates in PCI's Plant Certification program and is designated a PCI-certified plant for Group C, Category C3.
 - a. Certification shall be maintained throughout the production of the precast concrete units. Production shall immediately stop if at any time the fabricator's certification is revoked, regardless of the status of completion of contracted work. Production will not be allowed to re-start until the necessary corrections are made and certification has been re-established. In the event certification cannot be re-established in a timely manner to avoid project delays, the fabricator, at no additional cost, will contract out the remainder of the units to be manufactured at a PCI certified plant.
 4. Has sufficient production capacity to produce required members to meet the project schedule.
- B. Tank Supplier: Subject to compliance with requirements, provide rectangular precast post-tensioned concrete tanks by Dutchland, Inc. located in Gap, Pennsylvania, or pre-approved equal.
- C. Alternate Tank Supplier Pre-approval Qualifications: Alternate Tank Suppliers wishing to become pre-approved shall comply with the Tank Supplier Qualifications listed above, and the following requirements.
 1. The firm shall have a minimum of 25 consecutive years in designing, producing and installing tanks of similar arrangement, size and complexity using the precast post-tensioned concrete system.
 2. The firm shall document the successful installation and performance of a minimum of ten structures of equal or greater size and certify compliance of those structures will all applicable provisions of ACI 350 for a precast post-tensioned concrete structure.

3. The firm shall employ a full-time engineer on staff who meets the Precast Tank Engineer Qualifications listed above and who has served as the engineer in responsible charge of at least ten structures of equal or greater size.
 4. The firm shall submit with its bid a summary sheet documenting compliance with these qualifications.
 5. The firm shall submit with its bid a reference sheet listing contact names and telephone numbers of at least ten structures of equal or greater size built by the firm.
 6. All firms seeking prequalification shall document a first pass leak test history of no less than 90 percent of all completed water holding basins passing the leak test on the first test over a twelve-month period.
- D. Post-Tensioning Manufacturer Qualifications: Fabricating plant certified by PTI according to procedures set forth in PTI's "Manual for Certification of Plants Producing Unbonded Single Strand Tendons."
- E. Post-Tensioning Installer Qualifications: A qualified installer whose full-time Project superintendent has successfully completed PTI's Level 1 Unbonded PT - Field Installation course.
1. Superintendent must receive training from post-tensioning supplier in the operation of stressing equipment to be used on Project.
- F. Post-Tensioning Inspector Qualifications: Personnel performing field inspections and measuring elongations shall have successfully completed PTI's Level 2 Unbonded PT - Inspector course.
- G. Design Standards: Comply with ACI 350, "Code Requirements for Environmental Concrete Structures" and the design recommendations of PCI MNL 120, "PCI Design Handbook – Precast and Prestressed Concrete," applicable to types of structural precast concrete members indicated.
- H. Quality-Control Standard: For manufacturing procedures and testing requirements and quality control recommendations for types of members required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Concrete Products."
1. Comply with dimensional tolerances of PCI MNL 135, "Tolerance Manual for Precast and Prestressed Concrete Construction."
- I. Plant Quality Control Manager Qualifications: The plant quality control manager shall be currently certified as a PCI Level 2 Plant Quality Control Technician.
- J. Plant Manager Qualifications: The plant manager shall be currently certified as a PCI Level 2 Plant Quality Control Technician.
- K. Referenced Standards:
1. AASHTO M 251, "Standard Specification for Plain and Laminated Elastomeric Bridge Bearings"
 2. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials"
 3. ACI 301, "Specifications for Structural Concrete"

4. ACI 318, "Building Code Requirements for Structural Concrete"
5. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures"
6. ACI 350.1, "Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures"
7. ACI 350.3, "Seismic Design of Liquid-Containing Concrete Structures"
8. ACI 350.4R, "Design Considerations for Environmental Engineering Concrete Structures"
9. ACI 350.5, "Specifications for Environmental Concrete Structures"
10. ACI 423.7, "Specification for Unbonded Single-Strand Tendon Materials and Commentary"
11. ASCE 7, "Minimum Design Loads for Buildings and Other Structures"
12. ASTM A 36, "Standard Specification for Carbon Structural Steel"
13. ASTM A 108, "Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished"
14. ASTM A 123, "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products"
15. ASTM A 276, "Standard Specification for Stainless Steel Bars and Shapes"
16. ASTM A 416, "Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete"
17. ASTM A 615, "Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement"
18. ASTM A 666, "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar"
19. ASTM A 706, "Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement"
20. ASTM A 775, "Standard Specification for Epoxy-Coated Steel Reinforcing Bars"
21. ASTM A 780, "Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings"
22. ASTM A 934, "Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars"
23. ASTM A 1064, "Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete"
24. ASTM C 31, "Standard Practice for Making and Curing Concrete Test Specimens in the Field"
25. ASTM C 33, "Standard Specification for Concrete Aggregates"
26. ASTM C 39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens"
27. ASTM C 42, "Standard Test Method for Obtaining and Testing Drilled Cores and sawed Beams of Concrete"
28. ASTM C 94, "Standard Specification for Ready-Mixed Concrete"
29. ASTM C 143, "Standard Test Method for Slump of Hydraulic-Cement Concrete"
30. ASTM C 150, "Standard Specification for Portland Cement"
31. ASTM C 172, "Standard Practice for Sampling Freshly Mixed Concrete"
32. ASTM C 231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method"
33. ASTM C 260, "Standard Specification for Air-Entraining Admixtures for Concrete"
34. ASTM C 295, "Standard Guide for Petrographic Examination of Aggregates for Concrete"
35. ASTM C 494, "Standard Specification for Chemical Admixtures for Concrete"
36. ASTM C 595, "Standard Specification for Blended Hydraulic Cements"

37. ASTM C 618, “Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete”
 38. ASTM C 881, “Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete”
 39. ASTM C 920, “Standard Specification for Elastomeric Joint Sealants”
 40. ASTM C 989, “Standard Specification for Slag Cement for Use in Concrete and Mortars”
 41. ASTM C 1012, “Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution”
 42. ASTM C 1067, “Standard Practice for Conducting a Ruggedness Evaluation or Screening Program for Test Methods for Construction Materials”
 43. ASTM C 1107, “Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)”
 44. ASTM C 1116, “Standard Specification for Fiber-Reinforced Concrete”
 45. ASTM C 1157, “Standard Performance Specification for Hydraulic Cement”
 46. ASTM C 1218, “Standard Test Method for Water-Soluble Chloride in Mortar and Concrete”
 47. ASTM C 1240, “Standard Specification for Silica Fume Used in Cementitious Mixtures”
 48. ASTM C 1260, “Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)”
 49. ASTM C 1567, “Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)”
 50. ASTM C 1610, “Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique”
 51. ASTM C 1611, “Standard Test Method for Slump Flow of Self-Consolidating Concrete”
 52. ASTM C 1621, “Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring”
 53. ASTM C 1778, “Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete”
 54. ASTM D 412, “Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension”
 55. ASTM D 2240, “Standard Test Method for Rubber Property-Durometer Hardness”
 56. ASTM F 593, “Standard Specification for Stainless Steel Bolts, Hex Cap Screw, and Studs”
 57. AWS D1.4, “Structural Welding Code – Reinforcing Steel”
 58. PCI MNL-116, “Manual for Quality Control for Plants and Production of Structural Concrete Products”
 59. PCI MNL-120, “PCI Design Handbook – Precast and Prestressed Concrete”
 60. PCI MNL-135, “Tolerance Manual for Precast and Prestressed Concrete Construction”
 61. PTI TAB.1, “Post-Tensioning Manual”
 62. PTI M10.2, “Specification for Unbonded Single Strand Tendons”
 63. PTI M10.3, “Field Procedures Manual for Unbonded Single Strand Tendons”
 64. PTI M55.1, “Specification for Grouting of Post-Tensioned Structures”
- L. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 “Project Management and Coordination.”

- M. Tank designs that rely on bolted or welded connections, or ship-lap joints, for primary, fluid-retaining walls shall not be allowed.
- N. Shotcrete shall not be allowed.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle post-tensioning materials according to PTI's "Field Procedures Manual for Unbonded Single Strand Tendons."
- B. Deliver all precast concrete members in such quantities and at such times to assure compliance with the agreed upon project schedule and setting sequence to ensure continuity of installation.
- C. Handle and transport precast concrete members in a manner to avoid excessive stresses that could cause cracking or other damage.
- D. Store precast concrete members with adequate dunnage and bracing, and protect units to prevent contact with soil, staining, and to control cracking, distortion, warping or other physical damage.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain post-tensioning materials and equipment from single source.

2.2 FORM MATERIALS

- A. Forms: Rigid, dimensionally stable, nonabsorptive material, warp and buckle free, that will provide precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required surface finishes.
 - 1. Form-Release Agent: Commercially produced form-release agent that will not bond with, stain or affect hardening of precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.3 NON-PRESTRESSED REINFORCING STEEL

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.
- C. Welded Wire Reinforcement: ASTM A 1064, plain or deformed, flat sheet.
- D. Supports: Use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.4 BONDED PRESTRESSING TENDONS

- A. Bonded Prestressing Strand: ASTM A 416, Grade 270, 7-wire, low-relaxation, 0.6-inch-diameter strand.
- B. Anchorage Device and Coupler Assembly: Assembly of strand, wedges, and anchorage device or coupler complying with static and fatigue testing requirements and capable of developing 95 percent of actual breaking strength of strand.

2.5 UNBONDED PRESTRESSING TENDONS

- C. ACI Publications: Comply with ACI 423.7, "Specification for Unbonded Single Strand Tendon Materials and Commentary."
- D. Prestressing Strand: ASTM A 416, Grade 270, 7-wire, low-relaxation, 0.6-inch-diameter strand with corrosion inhibitor conforming to ACI 423.7, with polypropylene tendon sheathing.
- E. Post-Tensioning Coating: Compound with friction-reducing, moisture-displacing, and corrosion-inhibiting properties; chemically stable and nonreactive with prestressing steel, nonprestressed reinforcement, sheathing material, and concrete.
- F. Tendon Sheathing:
 - 1. Virgin high-density polyethylene or polypropylene with a minimum thickness of 50 mils.
 - 2. Continuous over the length of tendon to provide watertight encapsulation of strand.
- G. Anchorage Device and Coupler Assembly: Assembly of strand, wedges, and anchorage device or coupler complying with static and fatigue testing requirements and capable of developing 95 percent of actual breaking strength of strand.
 - 1. Anchorage devices and coupler assemblies shall be fully encapsulated with either plastic or epoxy coating.
- H. Encapsulation System: Watertight encapsulation of prestressing strand consisting of the following:
 - 1. Wedge-Cavity Caps: Attached to anchorages with a positive mechanical connection and filled with post-tensioning coating.
 - 2. Sleeves: Attached to anchorage device with positive mechanical connection; overlapped a minimum of 4 inches with sheathing and filled with post-tensioning coating.
 - 3. The encapsulation system shall meet the hydrostatic pressure testing requirements of ACI 423.7, except with a hydrostatic pressure of 10 psi, instead of the specified 1.25 psi.

2.5 ACCESSORIES

- A. Sheathing Repair Tape: Elastic, self-adhesive, moisture-proof tape with minimum width of 2 inches (50 mm), in contrasting color to tendon sheathing; nonreactive with sheathing, coating, or prestressing steel.

2.6 CONCRETE MATERIALS

A. Hydraulic Cement:

- a. Portland Cement: ASTM C 150, Type II or Type I/II.
- b. Blended Cement: ASTM C 595 with (MS) designation for moderate sulfate resistance, excluding Type IS ≥ 70). Blended cements that include ASTM C 1157 cements shall not be permitted.
- c. Concrete mixtures shall include either fly ash or slag as shown below, but within the limits stipulated in 2.12.A, unless the proposed combination of cementitious materials has been tested in accordance with ASTM C 1012 and resulted in expansion of not more than 0.10 percent at 6 months.
 - i. At least 15 percent fly ash replacement by mass, or
 - ii. At least 50 percent slag replacement by mass.
- d. Different types of cement shall not be mixed or used alternately without specific written approval by the Precast Tank Engineer. Different brands of cement may be used when authorized in writing by the Precast Tank Engineer. A resubmittal will be required if different brands are proposed during the Project.

B. Supplementary Cementitious Materials

1. Fly Ash: ASTM C 618, Class F with alkali content ($\%Na_2O_{eq}$) less than 3.0%.
2. Slag: ASTM C 989, Grade 100 or 120, ground granulated blast furnace slag.
3. Silica Fume: ASTM C 1240.

C. Fine and Coarse Aggregates: ASTM C33, 3/4-inch maximum size.

- a. All aggregates shall be evaluated in accordance with ASTM C 1778 for potential alkali-silica reactivity (ASR). All aggregates shall be considered reactive unless they have been examined in accordance with ASTM C 295 and found to be non-reactive.
- b. Concrete mixtures using potentially reactive aggregates, except as permitted by 2.3.C.c, shall include either fly ash or slag as shown below, but within the limits stipulated in 2.4.C.
 - i. At least 25 percent fly ash replacement by mass where Portland cement alkali content is less than 1.00%, or at least 35 percent fly ash replacement by mass where Portland cement alkali content is 1.00 to 1.25%, or
 - ii. At least 50 percent slag replacement by mass where Portland cement alkali content is less than 1.00%, or at least 65 percent slag replacement by mass where Portland cement alkali content is 1.00% to 1.25%.
 - iii. Portland cement alkali loading shall not exceed 3.0 lb/yd³ (LBA). Alkali loading shall be calculated as shown below:
 1. $LBA = \text{Portland cement content (lbs)} \times \text{alkali content } (\% Na_2O_{eq}) / 100.$
- c. Aggregates meeting the requirements below may be considered non-reactive.
 - i. ASTM C 1260, Potential Alkali Reactivity of Aggregates (Mortar-Bar Method). Average expansion of less than 0.10 percent at 16 days after casting.
 - ii. ASTM C 1567, Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated Mortar-Bar Method). Average expansion of less than 0.10 percent at 16 days after casting.
- d. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

- D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- E. Air Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. Water-Reducing and Accelerating Admixture ASTM C494/C 494M, Type E.
 - 5. High Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type A and F.
 - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 7. Plasticizing Admixture for Flowable Concrete: ASTM C 1017/C 1017M.

2.7 STEEL EMBEDDED MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M
- B. Carbon-Steel Headed Studs: ASTM A 108, Grades 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with the minimum mechanical properties of PCI MNL 116, Table 3.2.3.
- C. Deformed-Steel Wire or Bar Anchors: ASTM A 1064 or ASTM A 706.
- D. Zinc-Coated Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123, after fabrication.
 - 1. Galvanizing Repair Paint: Zinc paint with dry film containing not less than 94 percent zinc dust by weight and complying with DOD-P-21035B or SSPC-Paint 20.

2.8 STAINLESS-STEEL EMBEDDED MATERIALS

- A. Stainless-Steel Plate: ASTM A 666, Type 304, Type 316, or Type 201, of grade suitable for application.
- B. Stainless-Steel Bolts and Studs: ASTM F 593, alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.
- C. Stainless-Steel Headed Studs: ASTM A 276, with minimum mechanical properties for studs as indicated under MNL 116, Table 3.2.3.

2.9 BEARING PADS AND OTHER ACCESSORIES

- A. Provide one of the following bearing pads for structural precast concrete members as recommended by tank supplier for application:

RECTANGULAR PRECAST POST-TENSIONED TANK (ACI 350)
CITY OF EDEN NORTH AERATION BASIN REPLACEMENT

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer according to ASTM D 2240, minimum tensile strength 2250 psi per ASTM D 412.
 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D2240. Capable of supporting a compressive stress of 3000 psi with no cracking, splitting or delaminating in the internal portions of the pad.
 3. High-Density Plastic: Multimonomer, nonleaching, plastic strip capable of supporting loads with no visible overall expansion.
- B. Erection Accessories: Provide steel plates and brackets, clips, hangers, high density plastic shims, and other accessories required to install precast concrete members.

2.10 GROUT MATERIALS

- A. Grout for Bonded Tendons: Provide cement grout for bonded tendons as indicated below:
1. Maximum Water-Cementitious Materials Ratio: 0.43
 2. Limit use of fly ash to 15 percent replacement of portland cement by weight.
 3. Limit use of slag to 20 percent replacement of portland cement by weight.
 4. Add High-Range, Water-Reducing admixture on-site as necessary for placement.
 5. Provide admixtures to prevent bleeding and grout settlement. Material shall be added to the mix on-site.
 - a. Acceptable Products: Sika Intraplast-N[®], or equal.
 6. Grout shall not contain water-soluble chloride ions in excess of 0.06 percent by weight of cementitious materials.
- B. Nonshrink Grout: Premixed, prepackaged, non-metallic, shrink-resistant grout complying with ASTM C 1107, Grade C. Grout shall not contain chlorides.
1. Acceptable Products:
 - a. SikaGrout 212[®], or equal.
 - b. SikaGrout 328[®], or equal.

2.11 PATCHING MATERIALS

- A. One-component, polymer-modified, premixed patching material containing selected silica aggregates and portland cement, suitable for vertical and overhead applications. Do not use material containing chlorides or other chemicals known to be deleterious to prestressing steel or material that is reactive with prestressing steel, anchorage device material, or concrete.
1. Acceptable Products:
 - a. ProSpec[®] BlendCrete, or equal.

2.12 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of concrete required.
1. The inclusion of either fly ash or slag in the concrete mix is mandatory.

2. Where fly ash is used:
 - i. The minimum fly ash content shall be 15 percent replacement of cementitious material by weight, and the maximum content shall be 35%.
 - ii. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.
 3. Where slag is used:
 - i. The minimum slag content shall be 15 percent replacement of cementitious material by weight, and the maximum content shall be 65%.
 - ii. Additional slag shall not be included in concrete mixed with Type IS or IP cement.
 4. The inclusion of both fly ash and slag shall not be permitted without specific written approval by the Precast Tank Engineer.
 5. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 350 when tested in accordance with ASTM C 1218.
 6. Limit use of silica fume to 10 percent replacement of Portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at Tank Supplier's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 350 or PCI MNL 116 when tested in accordance with ASTM C 1218/C 1218M.
- D. Normal-weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete.
- E. Furnish precast concrete as indicated below:
1. Compressive Strength (28 Days): 5,000 psi minimum.
 2. Maximum Water-Cementitious Materials Ratio: 0.40.
 3. Slump Flow: 24 inches, ± 4 inches
 4. Minimum cementitious content: 610 pounds per cubic yard
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6%, $\pm 1-1/2\%$.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mixture Adjustments: Concrete mixture design adjustments may be made if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.13 FORM FABRICATION

- A. Form: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes, and for

prestressing and detensioning operations. Coat contact surfaces of forms with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

- B. Maintain forms to provide completed structural precast concrete members of shapes, lines, and dimensions within fabrication tolerances specified.
 - 1. Edge and Corner Treatment: Uniformly chamfered or as built-in on standard forms.

2.14 FABRICATION

- A. Cast-in Plates, Inserts, Angles, and Other Hardware: Fabricate hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during precasting operations. Locate hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy coated reinforcing exceeds limits specified in ASTM A 775, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Locate and support reinforcement by plastic tipped or corrosion resistant metal or plastic chairs, runners, bolsters, spacers, hangers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.
 - 3. Provide cover requirements in accordance with ACI 350. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete.
 - 4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces in accordance with ACI 350 and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- C. Reinforce structural precast concrete members to resist handling, transportation, and erection stresses, and specified in-place loads, whichever governs.
- D. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- E. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete members.
- F. Place self-consolidating concrete with minimal vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
- G. Comply with PCI MNL 116 procedures for hot and cold-weather concrete placement.

- H. Identify pickup points of precast concrete members and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast concrete member on a surface that will not show in finished structure.
- I. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure members until compressive strength is high enough to ensure that stripping does not have an effect on the performance of final product.

2.15 WATERSTOPS

- A. Flexible PVC Waterstops: Corp of Engineers CRD-C 572 for embedding in concrete construction joints to prevent the passage of fluids through joints. Factory-fabricate corners, intersections and directional changes.
 - 1. Profile: Ribbed without center bulb.
 - 2. Dimensions: 9 inches by 3/8-inch-thick, non-tapered.
 - 3. Acceptable Products:
 - a. Greenstreak PVC Waterstop #646, or equal.
- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free, hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete.
 - 1. Acceptable Products:
 - a. Greenstreak Hydrotite® CJ-1030-4M, or equal.
- C. Self-Expanding Extrudable Waterstops: Extrudable, swelling, bentonite-free, one-part polyurethane.
 - 1. Acceptable Products:
 - a. SikaSwell® S-2, or equal

2.16 RELATED MATERIALS

- A. Joint/Crack Filler: ASTM C 920, Type S, Grade NS, Class 35 one-part polyurethane, elastomeric sealant, for sealing precast panel joints and minor cracks.
 - 1. Acceptable Products:
 - a. Sikaflex®-1a, or equal
- B. Sealant/Adhesive Primer: Specially formulated primer to promote adhesion of sealants and adhesives to concrete.
 - 1. Acceptable Products:
 - a. Sikaflex® 429/202, or equal
- C. Joint Sealant, Epoxy: High-build, two-part, protective, solvent-free epoxy.
 - 1. Acceptable Products:
 - a. Sikagard® 62, or equal
- D. Joint Sealant, Urethane: Liquid-applied, elastomeric, urethane.
 - 1. Acceptable Products:

- a. CIM 1000, or equal
- E. Epoxy Injection Adhesive: Two-part, moisture-tolerant, epoxy injection adhesive.
 - 1. Acceptable Products:
 - a. Sikadur® 52, or equal
- F. Chemical Grout: Expanding, polyurethane, chemical grout.
 - 1. Acceptable Products:
 - a. SikaFix® HH+, or equal
 - b. SikaFix® HH Hydrophilic, or equal

2.17 FABRICATION TOLERANCES

- A. Fabricate structural precast concrete members of shapes, lines and dimensions indicated, so each finished member complies with PCI MNL 135 product tolerances as well as position tolerances for cast-in items.

2.18 FINISHES

- A. Form Finish:
 - 1. Standard Grade: Normal plant-run finish produced in forms that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are acceptable. Fill air holes greater than 1/4 inch in width that occur in high concentration (more than one per 2 square inches). Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Allowable joint offset limited to 1/8 inch.
- B. Smooth steel-trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float and trowel to a smooth, uniform finish.

2.19 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements. If using self-consolidating concrete also test and inspect according to ASTM C 1610, ASTM 1611, and ASTM C 1621.
- B. Strength of precast concrete members will be considered deficient if units fail to comply with ACI 350 concrete strength requirements.
- C. Testing: If there is evidence that strength of precast concrete members may be deficient or may not comply with ACI 350 requirements, fabricator shall employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42 and ACI 350.
 - 1. Test results shall be reported in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports shall include the following:
 - a. Project identification name and number.

- b. Date when tests were performed.
 - c. Name of Tank Supplier.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete member(s) represented by core tests; design compressive strength; type of failure; actual compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- D. Patching: If core test results are satisfactory and precast concrete members comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture or repair material, and finish to match adjacent precast concrete surfaces.
- E. Acceptability. Structural precast concrete members that do not comply with acceptability requirements in PCI MNL 116, including concrete strength, and manufacturing tolerances, are unacceptable. Chipped, spalled or cracked members may be repaired. Replace unacceptable units with precast concrete members that comply with requirements.

PART 3 – EXECUTION

3.1 PREPARATION

- A. General Contractor shall prepare subgrade in accordance with Div 32 “Earthwork.”

3.2 EXAMINATION

- A. The Contractors’s Geotechnical Engineer shall inspect and approve the subgrade supporting the tank.
- B. Unsatisfactory conditions shall be corrected to the satisfaction of the Owner’s Geotechnical Engineer.
- C. General Contractor shall notify Tank Supplier in writing that supporting subgrade has been approved by the Contractor’s Geotechnical Engineer.
- D. Proceed with base slab construction only after unsatisfactory conditions have been corrected.
- E. The stone sub-base shall be prepared, leveled, and graded to within \pm one inch of stone grade, as indicated on the approved Tank Supplier’s Shop (Erection) drawings.
- F. Excavation shall include a minimum of four feet in plan beyond the perimeter of the approved exterior wall line.
- G. Site access roads:
 - 1. Shall be provided and maintained by the General Contractor throughout the installation of the base slab and precast tank structure.

2. Shall be cleared, leveled, stoned, and free of mud to provide 14-feet of vertical clearance and 14-feet of horizontal clearance.
3. Shall be capable of handling 80,000 pounds GVWR.
4. Shall support live loaded trucks operating under their own power.
5. Shall allow drop-deck, spread axle combinations with 53-ft trailers. This includes a 60-foot-long sweep radius for corners and egress/regress to roadways.

H. Crane and concrete pump pads:

1. Shall be provided and maintained by the General Contractor.
2. Shall be cleared, leveled, stoned, and free of mud.
3. Tank Supplier shall communicate the required locations and sizes of the pads with the General Contractor.

3.3 CAST-IN-PLACE CONCRETE BASE SLAB

- A. Install the base slab in accordance with Section 033100 "Cast-in-Place Concrete for Precast Post-tensioned Concrete Tanks."

3.4 ERECTION

- A. Erect structural precast concrete level, plumb and square within the specified allowable erection tolerances. Provide temporary bracing as required to maintain position, stability, and alignment of members until permanent connections are completed.
1. Install temporary plastic spacing shims as necessary as precast concrete members are being erected.
 2. Use patching material to fill voids within recessed lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.
- B. Install post-tensioning tendons as soon as practical.
- C. Grouting or Dry-Packing Connections and Joints: Indicate joints to be grouted and any critical grouting sequences on Shop (Erection) Drawings. Grout open spaces at keyways, connections and joints where required or indicated with non-shrink, non-metallic grout. Retain flowable grout in place until it gains sufficient strength to support itself. Fill joints completely without seepage to other surfaces. Alternatively, pack spaces with stiff dry pack grout material, tamping until voids are filled. Promptly remove grout material from exposed surfaces before it hardens.
- D. Field cutting of precast concrete members is not permitted without approval of the Precast Tank Engineer.

3.5 ERECTION TOLERANCES

- A. Erect structural precast concrete members level, plumb, square and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.

3.6 TENDON INSTALLATION

- A. Inspect prestressing strand for damage before installing tendons.
- B. Inspect sheathing for damage before installing tendons. Repair damaged areas by restoring post-tensioning coating and repairing or replacing tendon sheathing.
 - 1. Ensure that sheathing is watertight and there are no air voids.
 - 2. Follow tape repair procedures in PTI's "Field Procedures Manual for Unbonded Single Strand Tendons."
- C. Immediately remove and replace tendons that have damaged strand.

3.7 TENDON STRESSING

- A. Stressing jacks and gauges shall be individually identified and calibrated to known standards at intervals not exceeding six months. Exercise care in handling stressing equipment to ensure that proper calibration is maintained.
- B. Stress tendons only under supervision of a qualified post-tensioning superintendent.
- C. Tendon stressing shall not begin until grout strength in the joints has attained at least 2,500 psi compressive strength.
- D. Tendon stressing shall be performed in the sequence indicated on the Shop (Erection) Drawings.
- E. Mark and measure elongations according to PTI's "Field Procedures Manual for Unbonded Single Strand Tendons." Measure elongations to closest 1/8-inch.
- F. Tendon elongations shall be recorded and compared to the theoretical elongations indicated on the Shop (Erection) Drawings. Prestressing will be considered acceptable if gage pressures shown on stressing record correspond to required stressing force and theoretical and measured elongations agree.
- G. In the event that measured elongations exceed the tolerances indicated on the Shop (Erection) Drawings, the Precast Tank Engineer shall be notified for resolution.

3.8 TENDON FINISHING

- A. Strand tails may be cut once prestressing has been deemed acceptable.
- B. Do not cut strand tails or cover anchorages of tendons where elongations exceed tolerances until all discrepancies have been resolved to the satisfaction of the Precast Tank Engineer.
- C. Cut strand tails as soon as possible after approval of elongations.
- D. The tendon tails shall be cut using hydraulic shears.

- E. The strand length protruding beyond the wedges after cutting of the tendon tail shall be between 0.5-inch and 0.75-inch.
- F. Wedge-cavity caps shall be installed within one working day after cutting tendon tails.
- G. Patch stressing pockets within one day of cutting strand tail. Clean inside surface of pocket to remove laitance or post-tensioning coating before installing patch material. Finish patch material flush with adjacent concrete.
- H. If stressing pockets are not able to be filled within ten days after tendon tail cutting, then temporary protection shall be provided.

3.9 GROUTING OF BONDED TENDONS

- A. Execute grouting within 10 days after approval of tendon elongations. If grouting will not be performed within this time period, provide weather protection for the jacking access pockets.
- B. Pump grout through ports into the ducts under pressure.
- C. Temperature of concrete walls at time of grouting shall be above 35° F and shall be maintained above 35° F until field-cured 2-inch grout cubes reach a minimum of 800 psi.
- D. Grout temperatures shall not be above 90° F during mixing and pumping.
- E. Patch jacking access pockets.

3.10 FIELD QUALITY CONTROL

- F. Place no concrete for the base slab until the subgrade has been inspected and approved by the Contractor's Geotechnical Engineer.
- G. Testing: Owner will engage accredited independent testing and inspecting agency to perform field tests and prepare reports.
 - 1. Testing agency will report test results promptly and in writing to Contractor, Engineer of Record and Tank Supplier.
- H. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

3.11 PROTECTION OF PRESTRESSED REINFORCEMENT

- A. Do not expose tendons to electric ground currents, welding sparks, or temperatures that would degrade components.
- B. Prevent water from entering tendons during installation and stressing.

- C. Provide weather protection to stressing-end anchorages if strand tails are not cut within 10 days of stressing the tendons.

3.12 REPAIRS

- A. Repairs will be permitted provided structural adequacy, serviceability and durability of members are not impaired.
- B. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- C. Repair base slab shrinkage cracks as required for watertightness. Rout a ¼-inch vee-notch along the crack and fill the crack with epoxy injection adhesive.
- D. Surface chips or spalls shall be cleaned and then patched with patching material.
- E. Misaligned grout ports or connection ports in walkways may be repaired by either enlarging the existing port, or drilling a new one, as required. Coordinate with the Precast Tank Engineer to avoid internal reinforcing and hardware.
- F. Damage that occurs during the shipping, installation or construction process shall be brought to the attention of the Precast Tank Engineer for resolution.
- G. Additional repairs, if necessary, shall be performed as directed by the Precast Tank Engineer.
- H. Remove and replace damaged structural precast concrete members when repairs do not comply with specified requirements.

3.13 CLEANING

- A. Clean grout and any other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete members after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect adjacent work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

3.14 WATER TIGHTNESS TESTING

- A. Each cell of multi-cell tanks shall be considered a single containment structure and shall be tested individually, unless otherwise specified.

- B. The General Contractor shall commence tightness testing within five business days of notification that the structure is ready for testing.
- C. Testing shall be performed using the hydrostatic tightness test, which consists of two parts. Part 2 may be waived if approved by the Project Engineer-of-Record.
 - 1. Part 1 shall be a qualitative criterion.
 - 2. Part 2 shall be a quantitative criterion expressed as a maximum allowable volume loss of 0.05 percent per 24-hour period.
- D. No backfill may be placed against the walls or on the wall footings of the containment structures to be tested, unless otherwise specified.
- E. The initial filling of a new containment structure shall not exceed four feet per hour. Filling shall be continued until the water surface is at the design maximum liquid level, or either one inch below any fixed overflow level in covered containment structures or four inches in open containment structures, whichever is lower.
- F. Water for the initial filling shall be provided by the General Contractor. Use potable water unless otherwise specified.
- G. Part 1 – Qualitative criteria
 - 1. If any water is observed on the containment structure exterior wall surfaces where moisture can be picked up on a dry hand, the containment structure shall be considered to have failed Part 1 of the hydrostatic test.
 - 2. Wet areas on top of the wall footing shall not be cause to fail Part 1 unless the water can be observed to be flowing.
 - 3. Although Part 2 of the test may begin prior to completion of repairs for Part 1, all defects causing the failure of Part 1 shall be repaired before acceptance of the containment structure.
 - 4. The standard repair procedure for areas failing Part 1 is to inject chemical grout into the affected area. Consult with the Precast Tank Engineer before commencing any such repairs.
- H. Part 2 – Quantitative criteria
 - 1. Part 2 of the hydrostatic tightness test shall not be scheduled for a period when the forecast is for a difference of more than 35°F between the ambient temperature readings at the times of the initial and final level measurements of the water surface. The test shall also not be scheduled when the weather forecast indicates the water surface could freeze before the test is completed.
 - 2. The vertical distance to the water surface shall be measured to within 1/16 inch from a fixed point on the containment structure above the water surface. The initial measurement shall not be taken until at least 24 hours after the tank is completely filled. Measurements shall be recorded at 24-hour intervals.
 - 3. The test period shall be the theoretical time required to lower the water surface 3/8 inch, assuming a loss of water at the maximum allowable rate. However, the test period shall not be longer than five days.
 - 4. In uncovered containment structures, evaporation and precipitation shall be measured.

5. At the end of the test period, the water surface shall be recorded to within 1/16 inch at the location of the original measurements. The water temperature and precipitation measurements shall be recorded.
6. The change in water volume in the containment structure shall be calculated and corrected, if necessary, for evaporation, precipitation, and temperature. If the loss exceeds the required criterion, the containment shall be considered to have failed Part 2 of the test.

I. Retesting

1. A restart of the test shall be required when test measurements become unreliable due to unusual precipitation or other external factors.
2. It shall be permitted to immediately retest a containment structure failing Part 2 of the hydrostatic test when Part 1 is passed. If the containment structure fails the second test or if not immediately retested after the first test failure, the interior of the containment structure shall be observed for probable problem areas by the Tank Supplier. The containment structure shall only be retested after the probable problem areas are repaired.
3. Containment structures shall be retested until they meet the required Part 1 and Part 2 criteria. Repairs shall be made before each retest.

- J. The containment structure shall be deemed substantially complete upon successful completion of tightness testing. All final payments, including retainage, for all structural elements related to the precast, post-tensioned concrete tank, including the foundation system and cast-in-place base slab, shall be made at this time. This clause supersedes any conflicting clauses in the contract documents.

3.15 SPECIAL WARRANTY

- A. The Tank Supplier shall provide a two-year structural warranty to the Owner. The warranty shall at minimum include the following items:

1. The Tank Supplier shall provide a corporate guarantee not covered by any form of insurance or bond as a warranty for the precast post-tensioned concrete tank that warrants the tank is free from structural defect due to faulty design, workmanship, or structural materials.
2. The Tank Supplier shall warrant the structural aspects of the tank for a period of two years from the substantial completion date of the precast post-tensioned concrete tank.
3. The Owner must report in a timely manner any claim to the warranty in writing to the tank manufacturer within the effective coverage dates of the warranty.
4. The Tank Supplier shall furnish, without charge to the Owner, all necessary labor and materials required to repair all structural defects subject to this warranty with a maximum cost of repair not exceeding the Tank Supplier's contract value of the tank and under the condition that the Tank Supplier has been paid in full for the project.

- B. Specific Exclusions from Warranty:

1. Maintenance items (sealants, coatings, equipment, plumbing, etc.), all non-structural items.
2. Consequential damages, punitive damages, incidental costs, bodily injury, death, and damage to the property other than the tank.
3. Emptying of tanks, inspection of tanks, processing of the water/wastewater, drying or cleaning of the tanks, filling of tanks, etc. complete in preparation for, and completion of repairs.

4. Defects or issues caused by accident, abuse, misuse, storage or processing of corrosive liquids, improper maintenance, negligence, modifications, additions, or deletions not made by tank manufacturer, improper or defective application, acts of God, force majeure, untimely action by Owner to minimize damage or losses, unstable or improperly designed or constructed soil/subgrade, or defects caused by work supplied by any party other than the Tank Supplier.
 5. A loss or defect that is covered by insurance.
- C. All materials and labor for work performed by the Tank Supplier which is not covered under the standard two-year limited structural warranty shall be warranted for a period of one (1) year from substantial completion of the tank per the Contract Documents.

3.16 BACKFILL

- A. General Contractor shall place and compact backfill in accordance with Section 02200 "Earthwork."
- B. Do not commence backfilling around the tank until the tank has been examined and approved by the Engineer of Record.
- C. The General Contractor shall be responsible to protect the tank from damage by construction activity, equipment and vehicles. Damaged structures shall be repaired or replaced to the satisfaction of the Tank Supplier.
- D. When backfilling against the tank, place backfill material in equal lifts and to similar elevations on opposite sides of structures in order to equalize opposing horizontal pressures, except where required for final grading.
- E. The excavation shall be kept free of water by the General Contractor at all times.

END OF SECTION 03420

SECTION 033100 - CAST-IN-PLACE CONCRETE FOR PRECAST POST-TENSIONED CONCRETE TANK BASE SLABS

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. This Section includes form materials, reinforcement, accessories, cast-in-place concrete, and slab finishing and curing for the base slabs of the precast post-tensioned concrete tanks for the entire project. The work performed under this Section includes all labor, material, equipment, related services, and supervision required for the mixing, placing and finishing of cast-in-place concrete.
- B. Related Sections include the following:
 - 1. Div 32 for “Earthwork” for preparing the subgrade to support the tanks and for backfilling requirements.
 - 2. Section 034200 “Precast Post-tensioned Concrete Tanks – Rectangular (ACI 350)”

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Material test reports shall show compliance with the required standards and be less than one year old.
- B. Design Mixtures: For each concrete mixture. Include minimum required compressive strength and field experience records or trial mix data.

1.4 QUALITY ASSURANCE

- A. Construct and erect concrete formwork and accessories in accordance with ACI 301, ACI 347 and ACI 350.
- B. Perform concrete reinforcing work in accordance with ACI 301 and ACI 350.
- C. Perform cast-in-place concrete work in accordance with ACI 301 and ACI 350.
- D. Conform to ACI 305R when concreting during hot weather.
- E. Conform to ACI 306R when concreting during cold weather.
- F. Referenced Standards:

1. ACI 117, “Standard Specifications for Tolerances for Concrete Construction and Materials”
2. ACI 301, “Specifications for Structural Concrete”
3. ACI 305R, “Guide to Hot Weather Concreting”
4. ACI 306R, “Guide to Cold Weather Concreting”
5. ACI 350, “Code Requirements for Environmental Engineering Concrete Structures”
6. ACI 350.5, “Specifications for Environmental Concrete Structures”
7. ASTM A 615, “Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement”
8. ASTM A 775, “Standard Specification for Epoxy-Coated Steel Reinforcing Bars”
9. ASTM A 934, “Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars”
10. ASTM A 1064, “Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete”
11. ASTM C 31, “Standard Practice for Making and Curing Concrete Test Specimens in the Field”
12. ASTM C 33, “Standard Specification for Concrete Aggregates”
13. ASTM C 39, “Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens”
14. ASTM C 94, “Standard Specification for Ready-Mixed Concrete”
15. ASTM C 143, “Standard Test Method for Slump of Hydraulic-Cement Concrete”
16. ASTM C 150, “Standard Specification for Portland Cement”
17. ASTM C 172, “Standard Practice for Sampling Freshly Mixed Concrete”
18. ASTM C 231, “Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method”
19. ASTM C 260, “Standard Specification for Air-Entraining Admixtures for Concrete”
20. ASTM C 295, “Standard Guide for Petrographic Examination of Aggregates for Concrete”
21. ASTM C 494, “Standard Specification for Chemical Admixtures for Concrete”
22. ASTM C 595, “Standard Specification for Blended Hydraulic Cements”
23. ASTM C 618, “Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete”
24. ASTM C 881, “Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete”
25. ASTM C 920, “Standard Specification for Elastomeric Joint Sealants”
26. ASTM C 989, “Standard Specification for Slag Cement for Use in Concrete and Mortars”
27. ASTM C 1012, “Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution”
28. ASTM C 1067, “Standard Practice for Conducting a Ruggedness Evaluation or Screening Program for Test Methods for Construction Materials”
29. ASTM C 1116, “Standard Specification for Fiber-Reinforced Concrete”
30. ASTM C 1157, “Standard Performance Specification for Hydraulic Cement”
31. ASTM C 1218, “Standard Test Method for Water-Soluble Chloride in Mortar and Concrete”
32. ASTM C 1260, “Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)”

33. ASTM C 1567, “Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
34. ASTM C 1778, “Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete”
35. ASTM D 4397, “Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications”
36. CRSI, “Manual of Standard Practice”

PART 2 – PRODUCTS

2.1 FORM MATERIALS AND ACCESSORIES

- A. Form Materials: At discretion of Tank Supplier.
- B. Formed Construction Joints: Keyed joints as indicated on the tank Shop (Erection) drawings provided by the Tank Supplier. Provide holes in formwork to receive reinforcing across the joint.
- C. Vapor Retarder: ASTM D 4397, 6 mil thick, clear polyethylene film.

2.2 NON-PRESTRESSED REINFORCING STEEL

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Welded Wire Reinforcement: ASTM A 1064, plain or deformed, flat sheet.
- C. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for support of reinforcing.
- D. Fabricate concrete reinforcement in accordance with ACI 301, ACI 350 and CRSI Manual of Standard Practice.

2.3 CONCRETE MATERIALS

- A. Hydraulic Cement:
 - a. Portland Cement: ASTM C 150, Type II or Type I/II.
 - b. Blended Cement: ASTM C 595 with (MS) designation for moderate sulfate resistance, excluding Type IS ≥ 70). Blended cements that include ASTM C 1157 cements shall not be permitted.
 - c. Concrete mixtures shall include either fly ash or slag as shown below, but within the limits stipulated in 2.4.C, unless the proposed combination of cementitious materials has been tested in accordance with ASTM C 1012 and resulted in expansion of not more than 0.10 percent at 6 months.
 - i. At least 15 percent fly ash replacement by mass, or
 - ii. At least 50 percent slag replacement by mass.
 - d. Different types of cement shall not be mixed or used alternately without specific written approval by the Precast Tank Engineer. Different brands of cement may be used when

authorized in writing by the Precast Tank Engineer. A resubmittal will be required if different brands are proposed during the Project.

B. Supplementary Cementitious Materials

1. Fly Ash: ASTM C 618, Class F with alkali content (%Na₂O_{eq}) less than 3.0%.
2. Slag: ASTM C 989, Grade 100 or 120, ground granulated blast furnace slag.

C. Fine and Coarse Aggregates: ASTM C33, 1-inch maximum size.

- a. All aggregates shall be evaluated in accordance with ASTM C 1778 for potential alkali-silica reactivity (ASR). All aggregates shall be considered reactive unless they have been examined in accordance with ASTM C 295 and found to be non-reactive.
- b. Concrete mixtures using potentially reactive aggregates, except as permitted by 2.3.C.c, shall include either fly ash or slag as shown below, but within the limits stipulated in 2.4.C.
 - i. At least 25 percent fly ash replacement by mass where Portland cement alkali content is less than 1.00%, or at least 35 percent fly ash replacement by mass where Portland cement alkali content is 1.00 to 1.25%, or
 - ii. At least 50 percent slag replacement by mass where Portland cement alkali content is less than 1.00%, or at least 65 percent slag replacement by mass where Portland cement alkali content is 1.00% to 1.25%.
 - iii. Portland cement alkali loading shall not exceed 3.0 lb/yd³ (LBA). Alkali loading shall be calculated as shown below:
 1. $LBA = \text{Portland cement content (lbs)} \times \text{alkali content (\% Na}_2\text{O}_{eq}) / 100.$
- c. Aggregates meeting the requirements below may be considered non-reactive.
 - i. ASTM C 1260, Potential Alkali Reactivity of Aggregates (Mortar-Bar Method). Average expansion of less than 0.10 percent at 16 days after casting.
 - ii. ASTM C 1567, Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated Mortar-Bar Method). Average expansion of less than 0.10 percent at 16 days after casting.

D. Concrete Reinforcing Fibers: ASTM C 1116, high-strength industrial-grade fibers.

E. Water: Potable; free from deleterious material that may affect setting or strength of concrete.

F. Air Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. Water-Reducing and Accelerating Admixture ASTM C494, Type E.
5. High Range, Water-Reducing Admixture: ASTM C 494, Type A and F.

6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.

2.4 CONCRETE MIXTURES

- A. Mix and deliver concrete in accordance with ASTM C 94, Option C.
- B. Select proportions for normal weight concrete in accordance with ACI 301, Method 1 or Method 2.
- C. Prepare design mixtures for each type of concrete required.
 - 1. The inclusion of either fly ash or slag in the concrete mix is mandatory.
 - 2. Where fly ash is used:
 - i. The minimum fly ash content shall be 15 percent replacement of cementitious material by weight, and the maximum content shall be 35%.
 - ii. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.
 - 3. Where slag is used:
 - i. The minimum slag content shall be 15 percent replacement of cementitious material by weight, and the maximum content shall be 65%.
 - ii. Additional slag shall not be included in concrete mixed with Type IS or IP cement.
 - 4. The inclusion of both fly ash and slag shall not be permitted without specific written approval by the Precast Tank Engineer.
 - 5. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 350 when tested in accordance with ASTM C 1218.
- D. Furnish concrete as indicated below:
 - 1. Compressive Strength (28 Days): 4,500 psi minimum
 - 2. Maximum Water-Cementitious Materials Ratio: 0.42
 - 3. Slump: 7 inches, ± 1 inch utilizing high-range, water-reducing admixture.
 - 4. Minimum cementitious content: 564 pounds per cubic yard
- E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6%, $\pm 1-1/2\%$.
- F. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- G. Do not use calcium chloride or admixtures containing calcium chloride.

2.5 WATERSTOPS

- A. Flexible PVC Waterstops: Corp of Engineers CRD-C 572 for embedding in concrete construction joints to prevent the passage of fluids through joints. Factory-fabricate corners, intersections and directional changes.
 - 1. Profile: Ribbed without center bulb.
 - 2. Dimensions: 6 inches by 3/8-inch-thick, non-tapered.
 - 3. Acceptable Products:
 - a. Greenstreak PVC Waterstop #679, or equal.

- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free, hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete.
 - 1. Acceptable Products:
 - a. Greenstreak Hydrotite® CJ-1030-4M, or equal.

- C. Self-Expanding Extrudable Waterstops: Extrudable, swelling, bentonite-free, one-part polyurethane.
 - 1. Acceptable Products:
 - a. SikaSwell® S-2, or equal

2.6 RELATED MATERIALS

- A. Crack Filler: ASTM C 881, two-part, moisture-tolerant, very-low-viscosity, epoxy injection adhesive for filling cracks.
 - 1. Acceptable Products:
 - a. Sikadur® 52, or equal

- B. Crack Sealer: ASTM C 920, Type S, Grade NS, Class 35 one-part polyurethane, elastomeric sealant, for sealing cracks.
 - 1. Acceptable Products:
 - a. Sikaflex®-1a, or equal

PART 3 – EXECUTION

3.1 PREPARATION

- A. Proceed with base slab construction only after unsatisfactory conditions have been corrected in accordance with Section 034200, “Precast Post-tensioned Concrete Tanks.”

3.2 FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements.

- B. Provide bracing to ensure stability of formwork.

3.3 EMBEDDED COMPONENTS AND OPENINGS

RECTANGULAR PRECAST POST-TENSIONED TANK BASE SLAB (ACI 350)
CITY OF EDEN NORTH AERATION BASIN REPLACEMENT

- A. Coordinate work of other sections in forming and setting openings, slots, keyways, sleeves, bolts, anchors, pipe sleeves and other embedded components.
- B. Install concrete accessories straight, level and plumb.
- C. Install water stops continuous without displacing reinforcing. Heat seal joints watertight.
- D. Place construction joint forms in accordance with base slab pouring sequence.

3.4 REINFORCEMENT PLACEMENT

- A. Place reinforcement, supported and secured against displacement.
- B. Ensure reinforcing is clean, free of loose scale, dirt or other foreign coatings.
- C. Space reinforcement bars with minimum clear spacing in accordance with ACI 350, but not less than 1-1/2 inches.
- D. Place reinforcement bars and maintain cover in accordance with tolerances listed in ACI 117 and ACI 350.

3.5 PLACING CONCRETE

- A. Install vapor retarder under base slab as indicated on the tank Shop (Erection) drawings provided by the Tank Supplier.
- B. Ensure reinforcement, embedded components and formwork is not displaced during concrete placement.
- C. Deposit concrete as closely as practicable to final position. Prevent segregation of mix.
- D. Place concrete continuously between predetermined construction joints. Subsequent placements shall use the same concrete mix as the initial placement.
- E. Consolidate concrete.
- F. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.
- G. Screed base slab level. Maintain slab flatness meeting the Conventional floor surface classification as measured using the Manual Straightedge Method per ACI 117, Table 4.8.6.1, unless indicated otherwise on the tank Shop (Erection) drawings provided by the Tank Supplier.

3.6 FINISHING

- A. Steel-trowel finish unformed surfaces.
- B. In areas with floor drains, maintain slab level at walls and slope uniformly to drains.

3.7 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 - 1. Concrete, except high-early strength concrete, shall be maintained above 50° F and in a moist condition for at least the first three days after placement.
 - 2. When concrete could be exposed to more than one freezing and thawing cycle during construction, protect concrete from freezing until concrete strength of 3,500 psi is achieved. Strength shall be verified using field-cured cylinders.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.8 FIELD QUALITY CONTROL

- A. Place no concrete for the base slab until the subgrade has been inspected and approved by the Contractor's Geotechnical Engineer in writing.
- B. Perform field inspection and testing in accordance with ACI 301 and Statement of Special Inspections
- C. Testing: Owner will engage accredited independent testing and inspecting agency to perform field tests and prepare reports.
 - 1. Testing agency will report test results promptly and in writing to Contractor, Engineer of Record and Tank Supplier.
- D. Strength Test Samples:
 - 1. Sampling Procedures: ASTM C 172
 - 2. Cylinder Molding and Curing Procedures: ASTM C 31, cylinder specimens, standard cured.
 - a. When there are early-age strength requirements, strength shall be evaluated using field-cured cylinders.
 - 3. Sample concrete and make one set of five 4" x 8" cylinders for every 50 cubic yards or less of each class of concrete placed each day and for every 5,000 square feet of surface area.
 - a. Make additional sets of three 4" x 8" cylinders at the discretion of the Tank Supplier when required to verify early-age strength.
- E. Field Testing:

1. Slump Test Method: ASTM C 143
2. Air Content Test Method: ASTM C 231
3. Temperature Test Method: ASTM C 1067
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

F. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39
2. Evaluation and Acceptance of Concrete: In accordance with ACI 350.
3. Test three 4" x 8" cylinders at 28 days.
4. Retain two cylinders for 56 days for testing when requested by Engineer.
5. Dispose of remaining cylinders when testing is not required.

3.9 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replace defective concrete. Repairs will be permitted provided structural adequacy, serviceability and durability of concrete elements comply with requirements of this section.

END OF SECTION 033100

SECTION 051200 - STRUCTURAL STEEL FRAMING

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. Structural steel.
- 2. Grout.

- B. Related Requirements:

- 1. Section 133419 "Metal Building Systems" for structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Show fabrication of structural-steel components.

- 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
- 2. Include embedment Drawings.
- 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
- 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

SECTION 051200 - STRUCTURAL STEEL FRAMING

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. Structural steel.
- 2. Grout.

- B. Related Requirements:

- 1. Section 133419 "Metal Building Systems" for structural steel used for Pre-engineered Metal Building.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Show fabrication of structural-steel components.

- 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
- 2. Include embedment Drawings.
- 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
- 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.
- B. Welding certificates.
- C. Mill test reports for structural steel, including chemical and physical properties.
- D. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 3. Nonshrink grout.
- E. Source quality-control reports.
- F. Field quality-control and special inspection reports.
- G. Domestically sourced in the United States: Written Certification the structural steel has been 100% milled and 100% fabricated in the United States only with domestically sourced materials.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: The fabricator must meet one of the two following requirements.
 - 1. A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
 - 2. A qualified fabricator with a minimum of 5 years experience in fabricating structural steel similar to that indicated for this project and with a record of successful in-service performance, and one of the two options below:
 - a. An independent auditor certification of their quality control program in accordance with NCSBC Section 1704.2.
 - b. The fabricator shall retain, at no cost to the owner, a qualified 3rd-party inspector to oversee an inspection process and quality control plan as directed by the engineer of record and in accordance with NCSBC Section 1704.2. The inspector shall submit a summary letter and all supporting documentation to the engineer of record for approval. The letter shall be signed and sealed with an engineering seal for the same state where the project is located and must be approved by the engineer of record prior to fabrication.
- B. Installer Qualifications: The installer must meet one of the two following requirements.
 - 1. A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
 - 2. A qualified installer with a minimum of 5 years experience in installing structural steel similar to that indicated for this project and with a record of successful in-service performance.

- a. Provide three project references with Owner contact information with the bid.
 - b. Provide a copy of the installers Policy for Quality and Policy for Safety with the bid.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Comply with applicable provisions of the following specifications and documents:
- 1. AISC 303.
 - 2. AISC 360.
 - 3. AISC's "Specification for the Design of Steel Hollow Structural Sections."
 - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
- 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
- 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992, Grade 50.
- B. Channels, Angles, M, S-Shapes: ASTM A 36.
- C. Plate and Bar: ASTM A 36.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C (Fy=50 ksi), structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating.
- B. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Straight .
 - 2. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A 36 carbon steel.
 - 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 5. Finish: Hot-dip zinc coating, ASTM A 153, Class C.
- C. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
 - 1. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 4. Finish: Hot-dip zinc coating, ASTM A 153, Class C.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

- A. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."
- B. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.6 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123. Apply to all exposed exterior structural steel and where indicated.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.

4. Radiographic Inspection: ASTM E 94.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

3.5 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a Special Inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections: See Statement of Special Inspections.
- C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1.
 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
- B. All field welds shall receive three coats of galvanizing repair paint.

END OF SECTION 051200

SECTION 05521 - PIPE AND TUBE RAILINGS

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. Aluminum pipe and tube railings.

1.3 COORDINATION

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of connecting members at intersections.

- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer registered in the state where the project is located responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2, "Structural Welding Code - Aluminum."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 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. Aluminum Pipe and Tube Railings:
 - a. ATR Technologies, Inc.
 - b. Blum, Julius & Co., Inc.
 - c. Braun, J. G., Company; a division of the Wagner Companies.
 - d. CraneVeyor Corp.
 - e. Hollaender Manufacturing Company.

- f. Kee Industrial Products, Inc.
- g. Moultrie Manufacturing Company.
- h. Pisor Industries, Inc.
- i. Sterling Dula Architectural Products, Inc.; Div. of Kane Manufacturing.
- j. Superior Aluminum Products, Inc.
- k. Thompson Fabricating, LLC.
- l. Tri Tech, Inc.
- m. Tubular Specialties Manufacturing, Inc.
- n. Tuttle Railing Systems; Div. of Tuttle Aluminum & Bronze, Inc.
- o. Wagner, R & B, Inc.; a division of the Wagner Companies.
- p. Or approved equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Unless indicated otherwise, design railings, including comprehensive engineering analysis by a qualified professional engineer currently registered in the State of North Carolina, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
- C. Structural Performance: Railings, including attachment to structure, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lb/ ft. applied in any direction.
 - b. Concentrated load of 200 lb applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lb applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Tubing: ASTM B 221, Alloy 6063-T5/T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- G. Castings: ASTM B 26, Alloy A356.0-T6.

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Aluminum Railings: Type 304 or Type 316 stainless-steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 2. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical epoxy anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed

in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded or non-welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- K. Form changes in direction as follows:
1. By bending or by inserting prefabricated elbow fittings.
- L. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- M. Close exposed ends of railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- Q. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- R. For removable railing posts, fabricate slip-fit sockets from stainless-steel pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- S. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.9 ALUMINUM FINISHES

- A. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.3 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
- D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.4 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.
- C. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 1. Use type of bracket with predrilled hole for exposed bolt anchorage.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.5 ADJUSTING AND CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

3.6 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 099600 - HIGH-PERFORMANCE 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 on the following substrates:
 - 1. Exterior Substrates:
 - a. All new exposed and vaulted pipes, valves (excluding stems), bracket supports, pipe supports, and miscellaneous ferrous metals.
 - 2. Interior Substrates:
 - a. All new exposed pipe, valves (excluding stems) brackets supports, pipe supports, and miscellaneous ferrous metals.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of coating system.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.

1.4 QUALITY ASSURANCE

- A. Painting Contractor shall have a minimum of three (3) years proven satisfactory experience and shall show proof before commencement of work that he will maintain a qualified crew of painters throughout the duration of the work. When requested, Painting Contractor shall provide a list of the last two comparable exterior repainting jobs, including name, location, specifying authority/project manager, start/completion dates, and value of the work.
- B. Master Painters Institute (MPI) Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Product List".

2. Preparation and Workmanship: Comply with requirements in “MPI Architectural Painting Specification Manual” for products and coating systems indicated.

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 (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.
- D. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

PART 2 - PRODUCTS

2.1 MANUFACTURER’S NAMES

- A. Shortened versions (shown in parentheses of the following manufacturers names are used in other Part 2 articles):
 1. PPG Industries, Inc. (Pittsburg Paints)
 2. Sherwin-Williams Co. (Sherwin-Williams)
 3. Tnemec Company, Inc.
 4. Duron, Inc.
 5. Benjamin Moore & Co.
 6. Or approved equal

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Optically Activated Pigments
 1. For immersion surfaces, Opt-Check optically activated pigment (OAP) technology is RECOMMENDED for rapid holiday detection in accordance with SSPC-TU 11.
- B. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
- C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint material containers not displaying manufacturer's product identification labels will not be acceptable.
- D. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 3. Flat Topcoat Paints: VOC content of not more than 50 g/L.
 4. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
 5. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
- E. Colors: As specified in 3.6 and 3.7 of this section. Where not specified shall be selected by Owner from the Manufacturer's full range.

2.3 COATING SYSTEMS FOR CARBON STEEL – PIPE, EQUIPMENT AND MISCELLANEOUS

- A. Exterior Exposed (Non-Immersion)
1. System Type: Epoxy/Epoxy/Urethane.
 2. Surface Preparation: SSPC-SP 6 with a surface profile of 2.0 to 3.0 mils.
 3. Primer: Two – component catalyzed epoxy. DFT 3.0 to 5.0 mils.
 4. Intermediate Coat: Two – component catalyzed epoxy. DFT 3.0 to 5.0 mils.
 5. Finish Coat: Two – component aliphatic polyurethane. DFT 2.0 to 4.0 mils.
 6. Total DFT: 8.0 to 14.0 mils.
 7. Finish Color: As defined in Paragraph 2.2.E.
- B. Immersion (Wastewater)
1. System Type: Epoxy flake filled/epoxy flake filled
 2. Surface Preparation: SSPC-SP 10.
 3. OPTIONAL Shop Primer: Copoxy. DFT 3.0 to 5.0 mils.
 4. Primer: Two – component glass flake reinforced amine epoxy. DFT 8.0 to 12.0 mils.
 5. Finish Coat: Two – component glass flake reinforced amine epoxy. DFT 8.0 to 12.0 mils.
 6. Total DFT: 16.0 to 24.0 mils, excluding optional shop primer.
 7. Finish Color: As defined in Paragraph 2.2.E.

2.4 COATING SYSTEM FOR DUCTILE OR CAST IRON – PIPE, PUMPS, AND VALVES

- A. Exterior Exposed (Non-Immersion)

1. System Type: Epoxy/Epoxy/Urethane.
2. Surface Preparation: NAPF 500-03-04 with the exception that ALL rust and mold coating be removed. Only tightly adherent annealing oxides may remain.
3. Primer: Two – component catalyzed epoxy. DFT 3.0 to 5.0 mils.
4. Intermediate Coat: Two – component catalyzed epoxy. DFT 3.0 to 5.0 mils.
5. Finish Coat: Two – component aliphatic polyurethane. DFT 2.0 to 4.0 mils.
6. Total DFT: 8.0 to 14.0 mils.
7. Finish Color: As defined in Paragraph 2.2.E.

B. Immersion (Wastewater)

1. System Type: Epoxy/Epoxy/Epoxy
2. Surface Preparation: NAPF 500-03-04 with the exception that ALL rust and mold coating be removed. Only tightly adherent annealing oxides may remain.
3. Primer: Two component glass flake reinforced amine epoxy. DFT 8.0 to 12.0 mils.
4. Finish Coat: Two component glass flake reinforced amine epoxy. DFT 8.0 to 12.0 mils.
5. Total DFT: 16.0 to 24.0 mils.
6. Finish Color: As defined in Paragraph 2.2.E.

2.5 COATING SYSTEM FOR IMMERSION CONCRETE SURFACES

A. Protective Lining shall be comprised of 1) epoxy resurfacer, 2) spray-applied, fiber-reinforced epoxy liner (base coat) and 3) epoxy glaze (top coat).

1. Epoxy Resurfacer: Epoxy-polymer modified cementitious resurfacer (thin overlay) applied to new or existing manhole to a depth of ¼-inch (6.35 mm). Repair new or existing materials to fill all bugholes, surface imperfections and provide a uniform, level substrate for application of the protective lining; and
2. 100% aggregate reinforced epoxy mortar (base coat) to provide a chemical, permeation, and abrasion resistant protective lining against physical and chemical attack phenomena typically associated with municipal wastewater headspace conditions; and
3. Epoxy glaze coat (top coat) to provide enhanced chemical, permeation, and abrasion resistance.

B. Contractor shall provide all accessory components such as polysulfide sealants and curing compounds as recommended by the manufacturer for maximum protective lining adhesion to substrate, and long-term service performance.

C. Epoxy Cementitious Resurfacer (for rehabilitation of existing structures only)

1. Shall be Tnemec Series 218 MortarClad, Sauereisen No. 208 Restokrete Epoxy Modified Resurfacer or equal.
2. Installation Requirements:
 - a. Minimum Thickness: 1/16 inches
 - b. Maximum Thickness: 1/4 inches
3. Shall be an epoxy modified cementitious mortar. Shall be a high-performance, aggregate reinforced material for surfacing, patching, and filling voids and bugholes in concrete and brick substrates. Shall be compatible with specified topcoat system.

D. 100% Aggregate Reinforced Epoxy Mortar

1. Shall be Tnemec Series 434 Perma-Shield H₂S, Sauereisen No. 210T Trowelable Sewergard Epoxy or equal.
2. Installation Requirements:
 - a. Thickness: 125 mils DFT
3. Shall be a modified aliphatic amine epoxy mortar. Shall be a 100% solids, hybrid epoxy mortar designed for severe wastewater immersion and fume environments. Specifically formulated to withstand high levels of hydrogen sulfide gas (H₂S), sulfuric acid (H₂SO₄), as well as other gases common to sewer exposures. Aggregate reinforcement shall provide additional resistance to abrasions and impacts. Shall be compatible with specified topcoat system.

E. Epoxy Glaze Coat

1. Shall be Tnemec Series 435 Perma-Glaze, Sauereisen No. 210GL Sewergard Gard or equal.
2. Installation Requirements:
 - a. Thickness: 20 mils DFT
3. Shall be a modified polyamide epoxy. Shall be a versatile, thick film, 100% solids, abrasion-resistance lining specifically designed for wastewater immersion and fume environments. Shall provide low permeation to H₂S gas, protects against MIC, and provides chemical resistance to severe wastewater environments. Shall be compatible with intermediate coating system.

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.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Clean substrates of materials 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.
- B. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods as shown in Part 2 above.
- C. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- D. Ductile or Cast-Iron Substrates: NAPF 500-03-04 with the exception that ALL rust and mold coating be removed. Only tightly adherent annealing oxides may remain.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 1. Use applicators and techniques suited for coating and substrate indicated.
 2. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. 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.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Contractor shall 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 these specifications and coating manufacturer's written recommendations, Contractor shall apply additional coats as needed to provide dry film thickness that complies with these specifications and the coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Exposed pipes, valves (excluding stems), bracket supports, pipe supports, and all others shall be coated with the appropriate coating system designated above for immersion and non-immersion services for carbon steel and cast or ductile iron as applicable.
- B. Color Code Schedule: Color code shall be as specified below:

Sewer (Sanitary or Other)	Dark Gray	GR28 Fossil
Nonpotable Water	Aqua	GB36 Aqua Sky

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Metal Decking: Apply high performance coating as specified in Part 2 on underside of metal decking located in the new chlorination building.
- B. Exposed pipes, valves (excluding stems), bracket supports, pipe supports, and all others shall be coated with the appropriate coating system designated above for immersion and non-immersion services for carbon steel and cast or ductile iron as applicable.
- C. Color Code Schedule: Color code shall be as specified below:

Sewer (Sanitary or Other)	Dark Gray	GR28 Fossil
Nonpotable Water	Aqua	GB36 Aqua Sky

3.8 EPOXY CEMENTITIOUS RESURFACER

- A. This product is only intended for rehabilitation of existing structures. Skip this step for
- B. The work consists of troweling, spray applying and/or centrifugally spin-casting a cementitious based liner to the inside of the existing manhole. The necessary equipment and application methods to apply the cementitious based liner material shall be only as recommended and approved by the material Manufacturer.
- C. Material shall be mixed with water in accordance with Manufacturer’s specifications. Once mixed to proper consistency, the materials shall be pumped via a rotor-stator style progressive

cavity pump through a material plaster hose for delivery to the appropriate and/or selected application device. The equipment shall be as recommended by the manufacturer, matched for the material being applied.

D. Spray Application of Cementitious Material:

1. All material shall be applied and finished, by the Contractor, using equipment specified by the Manufacturer.
 - a. Material hose shall be coupled to a low-velocity spray application nozzle. Pumping of the material shall commence and the mortar shall be atomized by the introduction of air at the nozzle, creating a low-velocity spray pattern for material application.
 - b. Spraying shall be performed by starting at the manhole invert and progressing up the wall to the corbel and chimney area.
 - c. Material shall be applied to a specified uniform minimum thickness as required by the Manufacturer and as necessary for proper curing and application. Material shall be applied to the bench area in such a manner as to provide for proper drainage.
 - d. Material shall be troweled smooth to compact material into voids. A brush or broom finish may be applied when a top coating is desired.

E. Spin Casting Application of the Cementitious Material:

1. All material shall be applied and finished by the Contractor using equipment specified by the Manufacturer.
 - a. Material hose shall be coupled to a high-speed rotating applicator device. The rotating casting applicator shall then be positioned within the center of the manhole at either the top of the manhole chimney or the lowest point elevation corresponding to the junction of the manhole bench and walls.
 - b. The high-speed rotating applicator shall then be initialized and pumping of the material shall commence. As the mortar begins to be centrifugally cast evenly around the interior of the manhole, the rotating applicator head shall be raised and/or lowered at a controlled retrieval speed conducive to providing a uniform material thickness on the manhole walls.
 - c. Controlled multiple passes are then made until the specified minimum finished thickness is attained. If the procedure is interrupted for any reason, simply stop the retrieval of the applicator head until flows are recommended.
 - d. Material thickness may be verified at any point with a depth gauge and shall be no less than a uniform ½-inch. If additional material is required at any level, the rotating applicator head shall be placed at that level and application shall recommence until the area is thickened.
 - e. Material shall be applied only when manhole is in a saturated surface dry state, with no visible water dripping or running over the manhole walls.
 - f. The low-velocity spray nozzle and the centrifugal spin casting head may be used in conjunction to facilitate uniform application of the mortar material to irregularities in the contour of the manhole walls and bench areas.
 - g. Troweling of materials shall begin immediately following the spray application. Initial troweling shall be in an upward motion, to compress the material into voids and solidify manhole wall. A brush or broom finish may be applied if top coating is desired.
 - h. Curing will take place once the manhole cover has been replaced. It is important that the manhole cover is replaced no more than 10-20 minutes after troweling is complete to avoid moisture loss in the material due to sunlight and winds.

- i. Material shall not be applied during freezing weather conditions. Material shall not be placed when the ambient temperature is 37 degrees Fahrenheit and falling or when the temperature is anticipated to fall below 32 degrees Fahrenheit during the following 24-hour period.

F. Testing and Acceptance:

- 1. Visual inspection – verify no infiltration, cracks, or loose material.
- 2. Cementitious Material Physical Property Testing

3.9 100% AGGREGATE REINFORCE EPOXY MORTAR

A. General:

- 1. New Portland cement concrete structures shall have cured a minimum of 28 days since manufacture prior to commencing coating installation or as recommended by the Manufacturer.
- 2. Any active flows shall be dammed, plugged, or diverted as required to ensure all liquids are maintained below or away from the surfaces to be coated.
- 3. Temperature of the surface to be coated should be maintained between 40 degrees Fahrenheit and 120 degrees Fahrenheit or as recommended by the Manufacturer.
- 4. Specified surfaces should be shielded to avoid exposure to direct sunlight or other intense heat source. Where varying surface temperatures do exist, coating application shall be scheduled when the temperature is falling and not rising or as recommended by the Manufacturer.
- 5. Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive coating and notify Owner, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

B. Surface Preparation:

- 1. Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be entirely removed.
- 2. Concrete and/or mortar damaged by corrosion, chemical attack or other means of degradation shall be removed so that only sound substrate remains.
- 3. Choice of surface preparation method(s) should be based upon the condition of the structure and concrete or masonry surface, potential contaminants present, access to perform work, and required cleanliness and profile of the prepared surface to receive the specified polymer coating product, as recommended by the Manufacturer.
- 4. Surface preparation methods or combination of methods that may be used include high pressure water cleaning, high pressure water jetting, abrasive blasting and others as described in NACE No. 6/SSPC SP-13. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound clean neutralized surface with sufficient profile to promote an acceptable bond with the specified polymer coating.
- 5. Infiltration shall be stopped by using a material which is compatible with the repair products and is suitable for top-coating with the epoxy coating product. The Manufacturer shall verify the product compatibility, in writing, to the Owner.
- 6. For manholes - Manhole Chimney Joint and Casting: The area between the manhole and the manhole ring and the manhole casting shall be a termination point of the specified epoxy coating product.

C. Application of Repair and Resurfacing Products:

1. Resurfacing products shall be used to repair, smooth or rebuild surfaces with rough profiles to provide a concrete or masonry substrate suitable for the polymer coating product to be applied. These products shall be installed to minimum thickness as recommended with the Manufacturer's published guidelines. Should structural rebuild be necessary, these products shall be installed to a thickness as specified in the Contract Documents.
 - a. Repair and resurfacing products shall be handled, mixed, installed and cured in accordance with Manufacturer's recommendations.
 - b. All repaired or resurfaced surfaces shall be inspected for cleanliness and suitability to receive the coating product(s). Additional surface preparation may be required prior to coating application.

D. Application of Polymer Coating Product:

1. Application procedures shall conform to the recommendations of the epoxy coating product manufacturer, including environmental controls, product handling, mixing, application equipment and methods.
2. Spray equipment shall be specifically designed to accurately ratio, apply the polymer coating product, shall be in proper working order and shall be as recommended by the product Manufacturer.
3. Contractors qualified in accordance with this specification shall perform all aspects of polymer coating product installation.
4. Prepared surfaces shall be coated by spray application of the coating product(s) described herein to a minimum as recommended by the Manufacturer to meet the requirement of this specification.
5. Subsequent top coating or additional coats of the polymer coating product shall occur within the product's recoat time. Additional surface preparation procedures will be required if this recoat time is exceeded. The polymer Manufacturer's recoat time for the specific application, based on temperature and project conditions, shall be strictly followed by the Applicator.
6. The polymer coating product shall mechanically bond with adjoining construction materials throughout the manhole structure to effectively seal and protect concrete or masonry substrates from infiltration and attack by corrosive elements. Procedures and materials necessary to effect this bond shall be as recommended by the polymer coating product Manufacturer. No hollow spots will be accepted.
7. Contractor shall submit manufacturer's recommended method for terminating a coating or lining in a manhole for review and approval.
8. If required by the Manufacturer's requirements, sewage flow shall be stopped, bypassed, or diverted for application of the polymer coating product to the invert and interface with pipe materials.

E. Testing and Acceptance:

1. Visual Inspection – Installed coating system shall be completely free of pinholes and hollow spots/voids and other defects that will reduce the life expectancy of the applied system.
2. Film thickness measurements – (either wet or dry) Coating thickness shall be the minimum value as specified in the Contract Documents.
3. Holiday Detection Test (Spark Testing), to identify pinholes, thin material and any defects that will affect the life of the installed system.
4. Adhesion Testing – To verify that the system has consistently mechanically bonded to the host structure.

3.10 QUALITY ASSURANCE AND TESTING

A. General

1. The Contractor shall test the installed coating system components as specified by this specification. 10% of all installed coating systems shall be tested using a testing procedure as further delineated below. If more than 5% of the tested coating systems fail the test, an additional 10% of the manhole coating systems shall be selected for further testing. This process continues until the coating systems tested meet the requirements of this specification, to the satisfaction of the Owner.

B. Chain of Custody

1. The Contractor shall perform all testing/sample collection in the presence of the Inspector. The Contractor shall transmit samples to a third-party testing laboratory. A chain of custody for all samples shall be maintained by the Contractor and be available on site at all times.

C. Testing Requirements

1. Visual Inspection
 - a. All manholes shall be visually inspected by the Inspector. Any leakage into the manhole in areas where coating systems were installed by the Contractor shall be identified.
 - b. The Contractor shall provide samples for testing to the Inspector for the actual installed coating system. Samples shall be provided, at a minimum from one location per every ten (10) manholes coated.
2. Cementitious Material Property Testing
 - a. Where specified one (1) 2" x 2" sample cube shall be taken for every 50 bags of material used. Samples shall be sprayed from nozzle, identified in the presence of the Inspector, and sent to an independent test laboratory for compression strength testing as described in ASTM C-109.
3. Film Thickness Measurements
 - a. Where applicable and specified during application, a wet film thickness gauge, meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used. Measurements shall be taken, in the presence of the Inspector, documented and attested to by Contractor for submission to Owner.
4. Holiday Detection Test
 - a. Where specified Holiday Detection shall be performed for all coating systems installed in corrosive environments.
 - b. After the epoxy coating product has set in accordance with Manufacturer's instructions, all surfaces shall be inspected for holidays with high-voltage holiday detection equipment. Reference NACE RPO 188-99 for performing holiday detection.
 - c. All detected holidays shall be marked and repaired by abrading coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional coating can be hand applied to the repair area.
 - d. All touch-up/repair procedures shall follow the coating Manufacturer's recommendations.
 - e. Documentation on areas tested, results and repairs made shall be provided to the Owner, in writing, by Contractor.
5. Adhesion Testing

- a. Where specified a minimum of 10% of the manholes coated shall be tested for adhesion/bond of the coating to the subsurface. Testing shall be conducted in accordance with ASTM D4541, ASTM D7234, or NACE SP018. Inspector shall select the manholes to be tested.
- b. A minimum of three (3) – 50 mm dollies shall be affixed to the coated surface at the cone area, mid-section and at the bottom of the structure or in areas suspect from non-destructive evaluation and testing. The adhesive used to attach the dollies to the coating shall be rapid setting with tensile strengths in excess of the coating product and permitted to cure in accordance with Manufacturer's recommendations. The coating and dollies shall be adequately prepared to receive the adhesive.
- c. Failure of the dolly adhesive shall be deemed a non-test and require retesting. Prior to performing the pull test, the coating shall be scored to the substrate by mechanical means without disturbing the dolly or bond within the test area.
- d. Two of the three adhesion pulls shall exceed 300 psi or concrete failure with more than 50% of the subsurface adhered to the coating.
- e. Should a structure fail to achieve two successful pulls as described above, additional testing shall be performed at the discretion of the Inspector. Any areas detected to have inadequate bond strength shall be evaluated by the Owner.
- f. Further bond tests may be performed in that area to determine the extent of the potentially deficient bonded area and repairs shall be made by the Contractor.

END OF SECTION 099600

SECTION 110000 – GENERAL REQUIREMENTS FOR EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Scope: This section specifies general requirements applicable to all mechanical equipment specified in Divisions 40, 41, 43, 44, and 46. The Contractor is responsible for ensuring all mechanical equipment meets the requirements of this section in addition to the specific requirements of the individual equipment specification section. Where the requirements of this section are in conflict with the requirements of an individual equipment specification section, the individual equipment specification shall take precedence. The Contractor shall be responsible for coordinating the installation of the equipment.
- B. Equipment Lists: Equipment lists, presented in these specifications and as specified on the drawings, are included for the convenience of the Contractor and are not complete listings of all equipment, devices and material to be provided under this contract. The Contractor agrees to prepare his own material and equipment takeoff lists as necessary to meet the requirements of this project manual.

1.02 QUALITY ASSURANCE

- A. Arrangement: The arrangement of equipment shown on the Drawings is based upon information available to the Owner at the time of design and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements. Structural supports, foundations, connected piping, valves, and electrical conduit specified may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations.
- B. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ABMA Std 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B1.1	Unified Inch Screw Threads
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)

- C. Unit Responsibility: Where specified in individual equipment specification sections, the Contractor shall assign unit responsibility to, and obtain each system from, the supplier of the primary or driven equipment. The supplier shall provide all components of the system to enhance compatibility, ease of construction and efficient maintenance. The responsible manufacturer shall

coordinate selection and design of all system components such that all equipment is compatible and operates properly to achieve the performance requirements specified. Assignment of unit responsibility shall in no way relieve the Contractor of his responsibility to the Owner for performance of all systems as provided elsewhere in the Contract Documents.

- D. Warranty: All equipment and systems specified in Divisions 40, 41, 43, 44, and 46 shall be warranted against defects in materials and workmanship for a period beginning from date of purchase and extending through the correction period specified in Section C800 Supplementary Conditions. During the warranty period, the equipment will be repaired or replaced at no cost to the Owner.
- E. The equipment manufacturer shall coordinate with suppliers of related equipment specified elsewhere in the Contract Documents to ensure proper operation and interface between system components.

1.03 SUBMITTALS

- A. Provide the following submittals, as applicable, for each unique equipment item and unique set of performance requirements in accordance with Section 01 33 00. Items 1 through 10 listed below must be submitted, reviewed by the engineer, and accepted prior to shipping of equipment.
 - 1. Manufacturer’s data including complete manufacturer model number, materials of construction, equipment configuration, details of installation, equipment weight, and equipment coatings.
 - 2. Dimensioned fabrication drawings showing the entire assembly. This shall include a materials list, sizes, piping connections, ASTM designations where appropriate, thicknesses, construction, and description of all major components.
 - 3. A copy of the Contract Document control diagrams and process and instrumentation diagrams, with addenda updates that apply to the equipment, marked to show specific changes necessary for the supplied equipment. If no changes are required, the Drawing(s) shall be marked “no changes required.”
 - 4. A copy of the individual equipment specification section with addenda updates that apply to the equipment specification section, with each paragraph check marked to show specification compliance or marked to show deviations.
 - 5. Electrical data and control and wiring diagrams, including a bill of materials, elementary control diagrams, connection diagrams, dimensioned panel layout drawings, and manufacturer’s catalog data for all system components.
 - 6. Pump performance or equipment headloss curves and data, marked to indicate the operating limits recommended for stable operation between which the equipment may be operated without surge, cavitation, or vibration. The performance curves shall indicate each condition point specified showing head, power, efficiency, and NPSH required on the ordinate plotted against capacity on the abscissa. The performance curves shall indicate performance over the entire operating range of the pump from shutoff to maximum capacity for full and reduced speeds.
 - 7. Certified factory test data as specified where required in the individual equipment specification. One pump of each type (if pumps are identical test only one), 15 horsepower and greater, shall be tested for performance at the factory to determine head vs. capacity, efficiencies, and kilowatt draw required for the points that are

specified. All tests shall be run in accordance with the latest edition of the American Institute Standards. If any deviation from the testing is found the pump shall be rejected. Provide certification of factory tests verifying design requirements. Testing shall also include the following:

- a. Hydrostatic test with data recorded.
 - b. Hydraulic test with minimum of 5 readings between shutoff head and 25 percent above design capacity, recorded on data sheets as defined by the Hydraulic Institute, signed, dated and certified.
 - c. Certified pump curves showing head/flow, bhp, efficiency, NPSH curves.
 - d. Certification that the pump horsepower demand will not exceed the rated motor horsepower beyond the 1.2 service rating at any point on the curve.
 - e. Impeller, motor rating and electrical connections shall be checked for compliance to specific requirements.
 - f. Submersible Pumps shall include the following additional items:
 - 1) Motor and cable insulation test for moisture content of insulation defects.
 - 2) After submerged test run of 30 minutes under 6 feet of water, item f shall be re-tested.
- 8. Warranty information as specified in Paragraph 1.02.D and Section 01 33 00.
 - 9. Equipment Record Form as specified in Section 01 33 00.
 - 10. Motor Data Form as specified in Section 11 05 13.
 - 11. Submit operation and maintenance manuals as specified in Section 01 78 23, accompanied by an O&M Manual Transmittal Form.
 - 12. Proposed on-site testing and start-up procedures in step-by-step detail in accordance with Section 01 91 13. Submittal of all test reports.
 - 13. Certificate of Installation, Inspection and Start-up Services form as specified in Section 01 91 13.
 - 14. Manufacturer's Certification of Instructional Services form as specified in Section 01 79 00.

PART 2 PRODUCTS

2.01 FLANGES AND PIPE THREADS

- A. Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125 for maximum normal operating pressures of 150 psi or ANSI B16.1, Class 250 for maximum normal operating pressures of 300 psi, unless otherwise specified. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.
- B. Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.

- C. Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.02 BEARINGS

- A. Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of ABMA standards for Load Ratings and Fatigue Life for Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L-10 rating life of 50,000 hours. The rating life shall be determined using the maximum equipment operating speed.
- B. Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.
- C. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C (140 degrees F) and shall be equipped with a filler pipe and an external level indicator gage.
- D. All bearings accessible to touch and located within 7 feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, fixed ladders or other access structures shall either incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 degrees C (149 degrees F) or less for continuous operation at bearing rated load and a 50 degrees C ambient temperature or appropriate shielding shall be provided that will prevent inadvertent human contact.

2.03 V-BELT ASSEMBLIES

- A. Unless otherwise specified, V-belt assemblies shall be Dodge Dyna-V belts with matching Dyna-V sheaves and Dodge Taper-lock bushings, Wood's Ultra V-belts with matching Ultra-V sheaves and Wood's Sure-Grip bushings, or equal.
- B. Sheaves and bushings shall be statically balanced. Additionally, sheaves and bushings which operate at a peripheral speed of more than 5500 feet per minute shall be dynamically balanced. Sheaves shall be separately mounted on their bushings by means of three pull-up grub or cap tightening screws. Bushings shall be key seated to the drive shaft.
- C. Belts shall be selected for not less than 150 percent of rated driver horsepower and, where two sheaves sizes are specified shall be capable of operating with either set of sheaves. Belts shall be of the antistatic type where explosion-proof equipment is specified.

2.04 PUMP SHAFT SEALS

- A. General: Where mechanical seals are specified, seals shall be self-contained cartridge type single or double mechanical seals as specified in individual equipment sections. Unless specified otherwise, mechanical seals shall conform to the requirements set forth in this paragraph.

B. Mechanical Seals

1. SINGLE CARTRIDGE SEAL: balanced o-ring, multi-spring design with self-aligning faces, one piece investment cast gland with flush, quench and drain ports, 316 SS construction, carbon vs. silicon carbide faces, carbon restriction bushing in atmospheric side of gland. Single mechanical seals shall be AESSEAL SCUSI or CURC as recommended by the manufacturer on a pump by pump basis; seals by other manufacturers will not be accepted.
2. DOUBLE CARTRIDGE SEAL: double balanced o-ring, multi-spring design with self-aligning faces inboard and outboard, one-piece investment cast gland, connection built-in to gland for inlet and outlet of barrier fluid, carbon vs. silicon carbide inboard faces, carbon vs. chrome oxide outboard faces. Double mechanical seals shall be AESSEAL CDSA; seals by other manufacturers will not be accepted.
3. Pumps used for hazardous chemicals and or abrasive fluids shall be equipped with double mechanical seals with built-in barrier fluid ports unless otherwise specified or requested by Owner.
4. For submersible pumps use AESSEAL T05 component seal or manufacturers equivalent, double mechanical seals for abrasives and single mechanical seals for clean water.

C. Shaft Packing

1. Where shaft packing is specified, stuffing boxes shall be tapped to permit introduction of seal liquid and shall hold a minimum of five rows of packing. Stuffing boxes shall be face attached. Stuffing box and shaft shall be suitable for field installation, without machining or other modifications, of the mechanical seal specified in subparagraph 2.04.B for the applicable pump and operating conditions.
2. Unless otherwise specified, lantern rings shall be bronze or Teflon, packing shall be die-molded packing rings of non-asbestos material suitable for the intended service and as recommended by the manufacturer, and glands shall be bronze, two piece split construction. Lantern rings shall be of two-piece construction and shall be provided with tapped holes to facilitate removal. Lantern rings shall be drilled and tapped 1/4 NC-20. Threaded lantern ring removal tools shall be provided with spare parts for each pump.

D. Seal Water Regulating and Monitoring System

1. Seal water monitoring system shall be a complete unified component capable of controlling all necessary aspects of the seal water system for pumps or equipment utilizing a packing gland type, single mechanical type, or double mechanical type shaft seal. Complete monitoring system shall include the single component control unit, mounting stand or bracket and associated hardware, and all necessary hoses, quick couplings, check valves, hose nipples, and hose couplings required for a complete and functioning system.
2. The base of the control unit shall be constructed of 7/8" thick, 316 stainless steel to accommodate fittings. Seal connections shall be 1/4" NPT for shaft sizes up to 2" diameter and pumped fluid temperature < 120 deg F. For shafts > 2" diameter or pumped fluid temperatures > 120 deg F, unit shall have min. 3/8" connections. Unit shall include a push button test and clean system for the flow meter which can be activated while unit is in operation. Unit shall utilize orifice shaped valves to allow larger particles of dirt and debris to pass through without stopping the flow or plugging the unit. Pressure gauge

shall be glycerin filled. Unit shall come equipped with an inductive low-flow alarm sensor that utilizes an AC signal (20-250 VAC) to communicate to the process control system.

3. Complete seal water monitoring system as specified shall be John Crane Safeunit Model SFP or SFD, or approved equal. Unit shall be provided with connections as follows or per manufacturer's written instructions:
 - a. Packing gland or single seal flush type seal water system
 - 1) John Crane Safeunit Model SFP
 - 2) 1 connection – service water supply to unit
 - 3) 1 connection – seal water supply from unit to the shaft seal
 - b. Double mechanical type seal water system
 - 1) John Crane Safeunit Model SFD
 - 2) 1 connection – service water supply to unit
 - 3) 1 connection – seal water supply from unit to shaft seal
 - 4) 1 connection – seal water return from shaft seal to unit
 - 5) 1 connection – drain line from unit

2.05 COUPLINGS

- A. Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taperlock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.
- B. Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas-Rex, Falk Steel Flex, or approved equal couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

2.06 GUARDS

- A. Exposed moving parts shall be provided with guards which meet the requirements of OSHA. Guards shall be fabricated of 14-gage steel, 1/2-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

2.07 CAUTION SIGNS

- A. Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION - AUTOMATIC EQUIPMENT MAY START AT ANY TIME". Signs shall be as specified in Section 10 14 00. Signs shall be installed near guarded moving parts.

2.08 GAGE TAPS, TEST PLUGS, AND GAGES

- A. Gage taps shall be provided on the suction and discharge sides of pumps, blowers, compressors, and as shown in the Drawings. Pressure and vacuum gages shall be provided where specified.

2.09 NAMEPLATES

- A. A manufacturer's nameplate shall be provided for each piece of equipment and shall identify the manufacturer's name and address, and the specific style and/or model of the equipment provided.
- B. Project identification nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible location with stainless steel screws or drive pins.
- C. Project identification nameplates for pumps shall indicate rated head and flow, pump operating speed (rpm), and impeller diameter.

2.10 LUBRICANTS

- A. The Contractor shall provide for each item of mechanical equipment a supply of the lubricant required for the commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the Owner's current lubricant supplier. The Contractor shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment, the Contractor shall provide the Owner with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

2.11 ANCHOR BOLTS

- A. Anchor bolts shall be designed for lateral forces for both pullout and shear. Anchor bolts shall be 304 stainless steel and comply with the requirements of Section 05 05 19.

2.12 SPARE PARTS

- A. Spare parts, wherever required by detailed specification sections, shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds

and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a suitable box, identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the exterior of the box.

PART 3 EXECUTION

3.01 GENERAL

- A. The manufacturer shall assume responsibility for packaging to prevent transit and handling damage.
- B. Store, install, and start-up each specified equipment system, including accessories, where shown on the Drawings, as specified herein, and as recommended by the equipment manufacturer's written instructions. Bring any discrepancies immediately to the attention of the Engineer.
- C. Final coatings, where required, shall be in accordance with Section 09 90 00.

3.02 INSTALLATION AND FIELD TESTING

- A. All certification of factory tests and materials shall be submitted and approved by the Engineer before shipping equipment.
- B. The Contractor shall install the equipment and make any and all necessary modifications and/or adjustments required to obtain satisfactory operation. Accurately place anchor bolts for skid attachment to floor using dimensions as per the manufacturer installation data and as specified in Section 05 05 19.
- C. Provide lubrication and lubrication fittings before operating as per manufacturer's recommendations. Extend fitting to allow easy access and without having to remove covers or guards.
- D. Provide factory certified service technician to inspect the installation, unless otherwise specified.
- E. All equipment shall be field tested after installation in accordance with Section 01 91 13, the Contract Documents, the requirements of this section, and the requirements of the individual equipment specification to demonstrate satisfactory operation and performance, without causing excessive noise, cavitation, vibration, leakage, overheating, or other operational deficiencies. Field testing shall be performed under the supervision of an experienced field representative of the manufacturer, who shall supervise the testing and shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.
- F. Start-up: Start-up, check and operate equipment over the entire operational range and speed range.
- G. Pump systems. Pumps systems shall be tested for compliance with the following:
 - 1. Vibration shall be within amplitude limits recommended in the Hydraulic Institute Standards and shall be recorded at a minimum of four pumping conditions defined by the engineer.

2. Pump performance shall be documented by obtaining concurrent readings, showing motor voltage, amperage, pump suction head, and pump discharge head for at least 4 pumping conditions. Each power lead to the motor shall be checked for proper current balance. All instrumentation necessary to conduct the testing shall be provided by the Contractor.
 - H. The installation and initial operation of all components shall be certified on the Certificate of Installation, Inspection and Start-up Services form as specified in Section 01 91 13.
 - I. Electrical and controls testing shall conform to the requirements of Section 01 91 13 and Divisions 26 and 40.
- 3.03 TRAINING
- A. Unless otherwise specified, training addressing the theory of operation, testing, troubleshooting, and maintenance of equipment item and system shall be provided. Training shall be conducted in accordance with Section 01 79 00 and shall be certified on Manufacturer's Certificate of Instructional Services in Section 01 79 00. Minimum training duration shall be as specified in the individual equipment specification.

END OF SECTION

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes metal building systems that consist of integrated sets of mutually dependent components including structural framing, roof panels, wall panels, soffit panels, canopies, and accessories.
- B. See Division 3 Section "Cast-in-Place Concrete" for concrete foundations, slabs, and anchor-bolt installation.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Engineer metal building systems according to procedures in MBMA's "Metal Building Systems Manual".
 - 2. Design Loads: As indicated on Drawings and as required by the 2018 North Carolina State Building Code.
 - 3. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:
 - a. Purlins and Rafters: Vertical deflection of 1/180 of the span.
 - b. Girts: Horizontal deflection of 1/180 of the span where supporting metal wall panels. Horizontal deflection of 1/600 of the span where providing horizontal support for brick veneer exterior walls.
 - c. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - 4. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than the following:
 - a. Lateral Drift: Maximum of 1/240 of the building height.
- B. Seismic Performance: Design and engineer metal building systems capable of withstanding the effects of earthquake motions determined according to the 2018 North Carolina State Building Code.
- C. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 90.

1.3 SUBMITTALS

- A. Product Data: For each type of metal building system component indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. For installed products indicated to comply with design loads, include shop drawings and structural analysis data signed and sealed by the Professional Engineer licensed by the State of North Carolina who is responsible for their preparation.
 2. Anchor-Bolt Plans: Submit anchor-bolt plans before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. See structural drawings for project requirements related to anchor bolt diameter, layout, spacing, and grade. Anchor bolts design shall meet the criteria shown in the structural drawings unless written approval for variances is provided by the foundation engineer of record. Indicate column reactions at each location. Column reaction submittal shall define all loads (dead, collateral, roof live, snow, wind, earthquake) and all subsets of each, including which subsets act simultaneously (Example: Snow Drift Load acts simultaneously with Balanced Snow Load). Elevations of all building frames shall either employ the column grid designations defined on the structural drawings or shall indicate from which direction the building elevation is being viewed. Failure to provide all information required to identify at which columns each set of reactions occurs and which loads act concurrently shall be grounds for submittal rejection.
 3. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 4. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
- C. Samples: For each type of building component and for each color and texture required.
- D. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
1. Name and location of Project.
 2. Order number.
 3. Name of manufacturer.
 4. Name of Contractor.
 5. Building dimensions including width, length, height, and roof slope.
 6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 7. Governing building code and year of edition.
 8. Design loads and load combinations.

9. Building-use category.
10. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.

- E. Welding certificates.
- F. Erector Certificate: Signed by manufacturer certifying that erector complies with requirements.
- G. Manufacturer certificate.

1.4 QUALITY ASSURANCE

- A. Erector Qualifications: An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- B. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.
 1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- D. Structural Steel: Comply with AISC's "Specification for Structural Steel Buildings--Allowable Stress Design, Plastic Design," or AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings," for design requirements and allowable stresses.
- E. Cold-Formed Steel: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members," or AISI's "Load and Resistance Factor Design Specification for Steel Structural Members," for design requirements and allowable stresses.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness and with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.6 PROJECT CONDITIONS

- A. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

1.7 COORDINATION

- A. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

1.8 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Watertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard non-prorated warranty in which manufacturer agrees to repair or replace standing-seam, metal roof panel assemblies that fail to remain watertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alliance Steel, Inc.
 - 2. American Buildings Company.
 - 3. American Steel Building Company, Inc.; Division of NCI Building Systems, LLP.
 - 4. Behlen Mfg. Co.
 - 5. Butler Manufacturing Company.
 - 6. Ceco Building Systems; Division of Robertson-Ceco Corporation.
 - 7. Crown Metal Buildings, Inc.
 - 8. Garco Building Systems.
 - 9. Gulf States Manufacturers, Inc.
 - 10. Mesco Metal Buildings; Division of NCI Building Systems, LLP.
 - 11. Metallic Metal Building Company; Division of NCI Building Systems, LLP.
 - 12. Package Industries, Inc.
 - 13. Southern Structures, Inc.
 - 14. Spirco Manufacturing; Division of Metal Building Products, Inc.

15. Star Building Systems; Division of Robertson-Ceco Corporation.
16. SteeloX Systems Inc.
17. United Structures of America, Inc.
18. VP Buildings, Inc.; a United Dominion Company.

2.2 STRUCTURAL-FRAMING MATERIALS

- A. W-Shapes: ASTM A 992; ASTM A 572, Grade 50 or 55; or ASTM A 529, Grade 50 or 55.
- B. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36; ASTM A 572, Grade 50 or 55; or ASTM A 529, Grade 50 or 55.
- C. Plate and Bar: ASTM A 36; ASTM A 572, Grade 50 or 55; or ASTM A 529, Grade 50 or 55.
- D. Steel Pipe: ASTM A 53, Type E or S, Grade B.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.
- F. Structural-Steel Sheet: Hot-rolled, ASTM A 1011, Structural Steel (SS), Grades 30 through 55, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70; or cold-rolled, ASTM A 1008, Structural Steel (SS), Grades 25 through 80, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70.
- G. Metallic-Coated Steel Sheet: ASTM A 653, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G60 coating designation; mill phosphatized.
- H. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G90 coating designation.
 2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Structural Steel (SS), Grade 50 or 80; with Class AZ50 coating.
- I. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
- J. High-Strength Bolts, Nuts, and Washers: ASTM 325 or ASTM A 490, Type 1, heavy hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.
- K. Unheaded Anchor Rods: ASTM F 1554, Grade 36; ASTM A 572, Grade 50; or ASTM A 307, Grade A.
 1. Configuration: Straight.
 2. Nuts: ASTM A 563 heavy hex carbon steel.
 3. Plate Washers: ASTM A 36 carbon steel.
 4. Washers: ASTM F 436 hardened carbon steel.

L. Headed Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight.
2. Nuts: ASTM A 563 heavy hex carbon steel.
3. Plate Washers: ASTM A 36 carbon steel.
4. Washers: ASTM F 436 hardened carbon steel.

M. Threaded Rods: ASTM A 193; ASTM A 572, Grade 50; or ASTM A 307, Grade A.

1. Nuts: ASTM A 563 heavy hex carbon steel.
2. Washers: ASTM F 436 hardened carbon steel.

N. Primer: SSPC-Paint 15, Type I, red oxide.

2.3 MATERIALS FOR FIELD-ASSEMBLED METAL PANELS

A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 50 or 80; with Class AZ50 coating designation.
2. Surface: Smooth, flat finish.
3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings:
 - a. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturers' written instructions, except as modified below:
 - 1) Humidity Resistance: 2000 hours.
 - 2) Salt-Spray Resistance: 1000 hours.
 - b. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored backer finish, consisting of prime coat and wash coat with a total minimum dry film thickness of 0.5 mil.

2.4 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL PANELS

A. Metal Building Insulation: ASTM C 991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch- wide, continuous, vapor-tight edge tabs; and with a flame-spread index of 25 or less.

- B. Vapor-Retarder Facing: ASTM C 1136, with permeance not greater than 0.02 perm when tested according to ASTM E 96, Desiccant Method.
 - 1. Composition: Vinyl film facing.
- C. Retainer Strips: 0.019-inch- thick, formed, galvanized steel or PVC retainer clips colored to match insulation facing.
- D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.5 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - 1. Fasteners for Metal Roof and Wall Panels: Self-drilling Type 410 stainless-steel or self-tapping Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal panels.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- D. Metal Panel Sealants:
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing.
 - 2. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane, polysulfide, or silicone-rubber sealant.

2.6 FABRICATION, GENERAL

- A. Tolerances: Comply with MBMA's "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."
- B. Metal Panels: Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.7 STRUCTURAL FRAMING

- A. General:

1. Primary Framing: Shop fabricate framing components to indicated size and section with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 - a. Make shop connections by welding or by using high-strength bolts.
 - b. Join flanges to webs of built-up members by a continuous submerged arc-welding process.
 - c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - d. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary structural members with specified primer after fabrication.

2. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 - a. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary structural members with specified primer after fabrication.

- B. Primary Framing: Manufacturer's standard structural primary framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing. Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 1. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
 2. Frame Configuration: Single gable.
 3. Exterior Column Type: Tapered, designed with pinned bases.
 4. Rafter Type: Uniform depth or Tapered.

- C. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
 1. End-Wall along column line 'D': Full-Load, Rigid Clear Span Frame designed to accommodate future expansion as indicated on the drawings. End-wall column shall be removable for future expansion and shall be designed as a vertical wind girt.
 2. End-Wall along column line 'A': Half-Load, Rigid Clear Span Frame designed as permanent end wall. End-wall column is permanent and need not be designed to be removable.

- D. Secondary Framing: Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet prepainted with coil coating, unless otherwise indicated, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from minimum 0.0598-inch-thick steel sheet, built-up steel plates, or structural-steel shapes; minimum 2-1/2-inch wide flanges.
 - a. Depth: As required to comply with system performance requirements.
 2. Girts: C- or Z-shaped sections; fabricated from minimum 0.0598-inch-thick steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange and with minimum 2-1/2-inch- wide flanges.
 - a. Depth: 8-1/2 inches.
 3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from 0.0598-inch-thick steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.
 4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary frame flanges.
 5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 6. Base or Sill Angles: Minimum 3-by-2-by-0.0598-inch zinc-coated (galvanized) steel sheet.
 7. Purlin and Girt Clips: Minimum 0.0598-inch-thick, steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from minimum 0.0598-inch-thick, zinc-coated (galvanized) steel sheet.
 9. Framing for Openings: Channel shapes; fabricated from minimum 0.0598-inch- thick, cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.
 10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- E. Bracing: Provide adjustable wind bracing as follows:
1. Rods: ASTM A 36/A 36M; ASTM A 572, Grade 50; or ASTM A 529/A 529M, Grade 50; minimum 1/2-inch-diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
 2. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 3. Bracing: Provide wind bracing using either method specified above, at manufacturer's option.
- F. Bolts: Provide plain finish bolts for structural-framing components that are primed or finish painted. Provide zinc-plated or hot-dipped galvanized bolts for structural-framing components that are galvanized.
- G. Factory-Primed Finish: Apply specified primer immediately after cleaning and pretreating.
1. Prime primary, secondary, and end-wall structural-framing members to a minimum dry film thickness of 1 mil.
 - a. Prime secondary steel framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2. Prime galvanized members with specified primer, after phosphoric acid pretreatment.

2.8 METAL ROOF PANELS

- A. Vertical-Rib, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
 1. Material: Aluminum-zinc alloy-coated steel sheet, 0.0209 inch thick.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Clips: Manufacturer's standard, floating type to accommodate thermal movement; fabricated from aluminum-zinc alloy-coated steel, or stainless-steel sheet.
 3. Joint Type: Mechanically seamed, folded as standard with manufacturer.
 4. Panel Coverage: 16 inches.
 5. Panel Height: 2 inches.

2.9 FIELD-ASSEMBLED METAL WALL PANELS

- A. Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and flush surface; with flush joint between panels; with 1-inch- wide flange for attaching interior finish; designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.
alternative: Exposed-Fastener, Tapered-Rib, Metal Wall Panels
 1. Material: Aluminum-zinc alloy-coated steel sheet, 0.0269 inch thick.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Panel Coverage: 36 inches.
 3. Panel Height: 2 inches. Would be 1.25" if exposed fastener

2.10 TRANSLUCENT PANELS

- A. Fire-Test-Response Characteristics: Provide panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 1. Flame Spread: 25 or less.
 2. Smoke Developed: 450 or less.
- B. Uninsulated Translucent Panels: Glass-fiber-reinforced polyester, translucent plastic; complying with ASTM D 3841, Type CC1 (limited flammability), Grade 1 (weather resistant); smooth finish on both sides. Match profile of adjacent metal panels.

1. Roof Panel Weight: Not less than 8 oz./sq. ft.
 2. Light Transmittance: Not less than 55 percent according to ASTM D 1494.
 3. Metal Edge: Fabricate full length of each side of panel with metal edge for seaming into standing-seam roof panel joint.
 4. Color: White.
- C. Mastic for Translucent Panels: Nonstaining, saturated vinyl polymer as recommended by translucent panel manufacturer for sealing laps.

2.11 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels: Match profile and material of metal wall panels.
1. Finish: Match finish and color of metal wall panels.
- C. Concealed-Fastener Metal Soffit Panels: Formed with vertical panel edges and flush surface; with flush joint between panels; with 1-inch- wide flange for attaching interior finish; designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.
1. Material: Aluminum-zinc alloy-coated steel sheet, 0.0269 inch thick.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Panel Coverage: 16 inches.
 3. Panel Height: 1.5 inches.

2.12 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.

2. Clips: Manufacturer's standard, formed from stainless-steel sheet, designed to withstand negative-load requirements.
 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless-steel sheet or nylon-coated aluminum sheet.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Formed from minimum 0.0159-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.
1. Opening Trim: Minimum 0.0269-inch-thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Formed from minimum 0.0159-inch- thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters; spaced 36 inches o.c.
- F. Downspouts: Formed from 0.0159-inch- thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters; spaced 10 feet o.c.
- G. Roof Ventilators: Gravity type, complete with hardware, flashing, closures, and fittings.
1. Continuous or Sectional-Ridge Type: Factory-engineered and -fabricated, continuous unit; fabricated from minimum 0.0159-inch-thick, metallic-coated steel sheet or

aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels. Fabricated in minimum 10-foot-long sections. Provide throat size and total length indicated, complete with side baffles, ventilator assembly, end caps, splice plates, and reinforcing diaphragms.

- a. Bird Screening: Galvanized steel, 1/2-inch-square mesh, 0.041-inch wire, or aluminum, 1/2-inch-square mesh, 0.063-inch wire.
 - b. Throat Size: 9 or 12 inches, as standard with manufacturer.
- H. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating roof panel, with predrilled holes and clamps or hooks for anchoring.
- 1. Metal-Type Guard: Consisting of aluminum or stainless-steel rods or bars held in place by supports clamped to vertical ribs of standing-seam roof.
 - a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) LMCurbs; S-5! SnoFence.
 - 2) Riddell & Company, Inc.; Snobar.
 - 3) Snow Management Systems; Vermont Snowguard.
- I. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

PART 3 - EXECUTION

3.1 ERECTION

- A. Before erection proceeds survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with Erector present, for compliance with requirements and metal building system manufacturer's tolerances.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.
- C. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- D. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- E. Set structural framing accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- F. Base Plates: Clean concrete-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- G. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure.
- H. Primary Framing and End Walls: Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist cure grout for not less than seven days after placement.
1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and snug-tightened or pretensioned joints.
- I. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts.
1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 2. Locate and space wall girts to suit openings such as doors and windows.
 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- J. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
1. Tighten rod and cable bracing to avoid sag.
 2. Locate interior end-bay bracing only where indicated.
- K. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- L. Erection Tolerances: Maintain erection tolerances of structural framing within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- 3.2 METAL PANEL INSTALLATION, GENERAL
- A. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel

finishes. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.

2. Install metal panels perpendicular to structural supports, unless otherwise indicated.
3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
4. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
5. Lap metal flashing over metal panels to allow moisture to run over and off the material.

- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- C. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal panel manufacturer.

3.3 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Install ridge caps as metal roof panel work proceeds.
- B. Field-Assembled, Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
1. Install clips to supports with self-tapping fasteners.
 2. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
 3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
 5. Provide metal closures at peaks, rake edges, rake walls, and each side of ridge caps.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.4 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. When two rows of metal panels are required, lap panels 4 inches minimum.

2. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
3. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
4. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
5. Install screw fasteners in pre-drilled holes.
6. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated, or if not indicated, as necessary for waterproofing.
7. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws.
8. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

- B. Field-Assembled, Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

3.5 TRANSLUCENT PANEL INSTALLATION

- A. Translucent Panels: Attach translucent panels to structural framing with fasteners according to manufacturer's written instructions. Install panels perpendicular to supports, unless otherwise indicated. Anchor translucent panels securely in place, with provisions for thermal and structural movement.
1. Provide end laps of not less than 6 inches and side laps of not less than 1-1/2-inch corrugations for metal roof panels.
 2. Align horizontal laps with adjacent metal panels.
 3. Seal intermediate end laps and side laps of translucent panels with translucent mastic.

3.6 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.7 THERMAL INSULATION INSTALLATION FOR FIELD-ASSEMBLED METAL PANELS

- A. General: Install insulation concurrently with metal wall panel installation, in thickness indicated to cover entire wall, according to manufacturer's written instructions.
1. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths with both sets of facing tabs sealed to provide a complete vapor retarder.
 4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation with both sets of facing tabs sealed to provide a complete vapor retarder.

- B. Blanket Roof Insulation: Comply with the following installation method:
 - 1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by metal roof panels fastened to secondary framing.
 - 2. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
 - 3. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by metal wall panels fastened to secondary framing.
 - 1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.8 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 2. Install components for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection.

- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Tie downspouts to underground drainage system indicated.

- E. Continuous Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Join sections with splice plates and end-cap skirt assemblies where required to achieve indicated length. Install preformed filler strips at base to seal ventilator to metal roof panels.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.9 FIELD QUALITY CONTROL

- A. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports. Refer to the "Statement of Special Inspections" (Specification 014100) for additional tests and requirements.
- B. Tests and Inspections:
 - 1. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1.

3.10 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 133419

SECTION 220519 – 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:
 - 1. Dial-type pressure gauges.
 - 2. Gauge attachments.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gauge, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gauges to include in operation and maintenance manuals.

1.6 Warranty

- A. Products shall be guaranteed against defects in material and workmanship for a period of one (1) year from the date of installation.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:
 - 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. Ashcroft Inc.
 - b. WIKA Instrument Corporation - USA. – Pressure Gauges Stock #12162 USA Blue Book Catalog No. 125
2. Standard: NSF/ANSI 61 conforming with the lead-free plumbing
 3. Case: Sealed; 4-1/2-inch (114-mm) nominal diameter.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
 8. Pointer: Dark-colored metal.
 9. Window: Glass or plastic.
 10. Accuracy: +/- 1 full scale range.

2.2 GAUGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- B. Install valve and snubber in piping for each pressure gauge for fluids.
- C. Install pressure gauges in the following locations:
 1. Outlet of each pump.

3.2 CONNECTIONS

- A. Install gauges adjacent to equipment to allow service and maintenance of gauges and equipment.

3.3 ADJUSTING

- A. Adjust faces of gauges to proper angle for best visibility.

3.4 PRESSURE-GAUGE SCHEDULE

- A. Pressure gauges at outlet of each pump shall be the following:
1. Liquid-filled direct-mounted, plastic case.

3.5 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

- A. Scale Range: All pressure gauges shall be coordinated with new pumps and blowers according to the following:
1. Gauges for pumps shall range from 0 psi to 25% above the shut off head for the pump.
 2. Gauges for blowers shall range from 0 psi to 25% above the blower maximum design pressure.

END OF SECTION 220519

SECTION 221329.01 – 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 Specifications Sections apply to this Section.

1.2 SUMMARY

- A. This section shall include the removal of existing pumps, furnishings, and installing replacement pumps for the following:
 - 1. EQ Tank Drain Pump Station Pumps
 - 2. South Basin Transfer Pump
- B. Related Sections
 - 1. Division 40 for controlling the EQ Basin and Drain Pump Stations.
 - 2. Division 26 – Electrical for power to pump motors.

1.3 QUALITY ASSURANCE

- A. All pumping equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications, and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer specifically named herein.
- B. All equipment must strictly conform to the requirements herein. If there are any exceptions, they must be clearly listed. If the equipment is approved for use on this project and is found at any time in the future that exceptions were not listed, the engineer shall have the right to reject the equipment or require the manufacturer to modify the equipment to bring it into compliance at no increase in cost.
- C. Unit responsibility. Pumps, complete with motor, coupling, necessary guards, lift out rails, and all other specified accessories and appurtenances shall be furnished by the pump manufacturer to ensure compatibility and integrity of the individual components, and provide the specified warranty for all components.
- D. Pumps are to be engineered and manufactured under a written Quality Assurance program. The Quality Assurance program is to be in effect for at least ten years, to include a written record of periodic internal and external audits to confirm compliance with such program.
- E. Manufacturer shall have 5 installations of like or similar application with a minimum of 5 years service for this pump size. They shall also include names of the installations, contact persons, and phone numbers where they can be reached and will be included in the submittals.

- F. Certified factory hydrostatic and performance test shall be performed on each pumping unit in accordance with Hydraulic Institute Standards, latest edition. Tests shall be sufficient to determine the curves of head, input horsepower, and efficiency relative to capacity from shutoff to 150% of design flow. A minimum of six points, including shutoff, shall be taken for each test. At least one point of the six shall be taken as near as possible to each specified condition. A registered Professional Engineer at the factory shall review and certify the results of the test.

1.4 ADAPTION OF EQUIPMENT

- A. Furnish equipment readily adaptable for installation and operation in the structure shown on drawings.
- B. Assume full responsibility for alteration of planned structure to accommodate other types of equipment.
- C. Equipment which required alteration of the structure or planned equipment will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations.
- D. Provide all such alterations free of extra cost to Owner.

1.5 SUBMITTALS

- A. Shop Drawings: Complete assembly and installation drawings, together with detailed specifications and data covering materials used, drive unit, parts, devices, and other accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. The data and specifications for each shall include detailed information on the pump to include:
 - 1. Pump
 - a. Manufacturer
 - b. Type and model
 - c. RPM at rated condition
 - d. Size of suction and discharge flanges
 - e. Complete performance curves
 - f. Net weight of pump and baseplate
 - g. Base and anchor bolt details
 - 2. Motor
 - a. Manufacturer
 - b. Type, model, and enclosure
 - c. Rated size of motor, hp and service factor
 - d. Temperature rise and insulation rating
 - e. Full load rotative speed
 - f. Net weight
 - g. Efficiency at full, $\frac{3}{4}$ and $\frac{1}{2}$ load
 - h. Full load current
 - i. Locked rotor current
 - j. Overall dimensions and base details
 - k. Power factor at no load and at full load

- B. Operation and Maintenance Manuals: Complete with manufacturer's instructions for equipment installation, equipment function, start-up procedures, operation, preventative maintenance, servicing, and troubleshooting.

1.6 WARRANTY

- A. The equipment shall be warranted for a period of one (1) year from substantial completion or 18 months from date of delivery whichever comes first. The warranty shall be against defects in workmanship and materials under normal use, operation, and service. If the equipment should fail during the warranty period due to a defective part, it shall be replaced, and the units restored at no expense to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The manufacturers named herein this specification is to establish a minimum standard of quality, reliability, and process performance.

2.2 NORTH BASIN SUMP PUMPS

- A. The duplex submersible pumps shall be manufactured by:
 - 1. ABS-Sulzer
 - 2. Grundfos
 - 3. KSB
 - 4. Or approved equal
- B. Pump shall be rated 50 hp, 480 volts, 3 phase, 60 hertz, operate at 1180 rpm, and handle a 3-inch solid. Pump shall meet the following operating conditions:
 - 1. Primary Operating Condition: 2200 gpm, 50 ft. TDH, minimum 80% efficiency.
- C. Construction - Each pump shall be of the sealed submersible type, incorporating the following features:
 - 1. Pump Case: Cast Iron, ASTM A48, Class 35B
 - 2. Motor Housing: Cast Iron, ASTM A48, Class 35B
 - 3. Impeller: Cast Iron, ASTM A48, Class 35B
 - 4. Intermediate Housing (Backplate): Cast Iron, ASTM A48, Class 35B
 - 5. Discharge Base Elbow: Cast Iron, ASTM A48, Class 35B
 - 6. Pump/Motor Shaft: Carbon Steel, C 45 N with replaceable ASTM A276 Type 420 shaft protection sleeve or entire shaft to be ASTM A276 Type 420 stainless steel with an ASTM A276 Type 420 shaft protection sleeve.
 - 7. Shaft Sleeve: Stainless Steel, ASTM A276 Type 420
 - 8. Wear Ring, case: Cast Iron, ASTM A48, minimum 200 Brinell
 - 9. Wear Ring, impeller (enclosed impellers only): Stainless Steel, AISI329, 350 Brinell
 - 10. O-Rings: Nitrile Rubber (NBR)
 - 11. Fasteners (including impeller fastener): Stainless Steel, ASTM A276 Type 316Ti.
 - 12. Lower Seal Faces: Silicon Carbide/Silicon Carbide

13. Upper Seal Faces: Silicon Carbide stationary/Carbon rotating
14. Guide rails/cables and mounting brackets: Stainless Steel, ASTM A276 Type 316 (cables shall be nylon coated)
15. Lifting Chain or cable: Stainless Steel, ASTM A276 Type 316
16. Oil-all uses (seal lubrication, etc.): Ecologically safe, paraffin or mineral base
17. Power/Control Cable Jacket: Chloroprene with non-wicking fillers

D. Motor and Shaft

Provide common pump/motor shaft of sufficient size to transmit full driver output with a maximum deflection of 0.002 inches measured at the lower mechanical seal. Machine the shaft of carbon steel or stainless steel and isolate the shaft from the pumped media with a replaceable Type 420 stainless steel shaft sleeve under the lower mechanical seal. Pump shafts without shaft sleeves are not acceptable due to higher maintenance costs associated with repairing shafts / rotor assemblies that are left unprotected.

E. Shaft Seal

Provide two totally independent mechanical shaft seals, installed in tandem, each with its own independent single spring system acting in a common direction. Install the upper seal in an oil-filled chamber with drain and inspection plug (with positive anti-leak seal) for easy access from external to the pump. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced. Provide seals which are non-proprietary in design, with replacements available from a source other than the pump manufacturer or its distributors. Do not provide seals with the following characteristics: conventional double mechanical seals with single or multiple springs acting in opposed direction; cartridge-type mechanical seals; seals incorporating coolant circulating impellers, seals with face materials other than those specified.

F. Bearings

Furnish upper and lower bearings, single row (preferred) or double row as needed to provide a B10 life of, at minimum, 100,000 hours at all anticipated axial and radial loadings. Provide sealed/shielded (permanently lubricated) bearings. If open-type (non-shielded) bearings are used, provide re-lubrication ports with positive anti-leak plugs for periodic addition of lubrication from external to the pump.

G. Impeller and Wear Rings

Provide non-clog type impeller, capable of passing at minimum a 3" spherical solid. Statically and dynamically balance the impeller. On enclosed impeller designs, provide hard metal wear rings of material and Brinell hardness specified, to ensure maximum pump/impeller life and continuing high efficiencies. Impellers must incorporate back vanes which reduce axial loads and propel solids away from the seal area. Do not use soft metals (i.e., bronze, 304 or 316 stainless) or elastomers as wear ring material as these are incompatible with the grit contaminate expected in the pumpage.

H. Pump shall be equipped with a new stainless-steel guide rail of height to match the height of the wet well.

I. Temperature Protection

Furnish temperature monitoring devices in motor windings for use in conjunction with and supplemental to external motor overload protection. Arrange controls to shut down pump should any of the monitors detect high temperature and automatically reset once motor temperature returns to normal. Set temperature monitors at levels recommended by pump manufacturer.

J. Seal Leak Detection

Provide a detector in the motor's stator cavity which allows a control panel mounted relay to indicate leakage into the motor. Electronic probes which depend on sensing resistance value changes in seal oil will not be acceptable as seal leak indicators.

K. Motor Sensor Monitoring Relay

The pump supplier shall furnish all relays required for monitoring all motor sensors. The relays shall be installed by others in the motor control panel and properly wired in accordance with pump manufacturer's instructions. Relays shall mount in standard 12-pin socket bases (provided) and shall operate on available control voltage of 24-240 VAC. If relays require an input voltage that is not available in the motor control panel an adequate transformer (with fused input) shall be provided by the pump supplier. Relays shall have a power consumption of no more than 2.8 watt and shall be UL approved. Relays shall be modular in design, with each relay monitoring no more than two motor sensor functions.

Each relay module shall include a dual color (red/green) LED to indicate the status of each monitored sensor. Green will indicate "status OK"; red will indicate a failure or alarm condition. A self-corrected fault will allow the relay output contacts to reset and cause the LED to change from a steady alarm indication to a flashing signal. The LED shall continue to flash until locally cleared, providing the operator an indication of a potential intermittent fault. Each relay shall also include a power-on LED and both "test" and "reset" pushbuttons.

An independent fail-safe (switch on power loss) form-C output contact shall be included for each monitored sensor to provide a normally-open / normally-closed dry contact to initiate a remote alarm device or shut down the motor. Contacts shall be rated for 5 amps at 120 volts.

2.3 SOUTH BASIN TRANSFER PUMP – SELF PRIMING SUCTION LIFT

A. Manufacturers

1. The South Basin Suction Lift Transfer Pump shall be manufactured by:
 - a. Gorman-Rupp
 - b. Goulds
 - c. Or approved equal
2. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.
3. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in

construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.

4. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.
5. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

B. Unitary Responsibility

1. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

C. Performance Criteria

1. The pump manufacturer must be ISO 9001 revision certified, with scope of registration including design control and service after sales activities.
2. The pump manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices, technological advances, promoting environmental awareness and continual improvement.

3. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have 10" suction connection, and 10" discharge connection. Each pump shall be selected to perform under following operating conditions:

a.	Simplex	<u>One (1) pump</u>
b.	Capacity (GPM)	<u>2000</u>
c.	Total Dynamic Head (FT)	<u>31</u>
d.	NPSHr (FT)	<u>7.83</u>

4. Site power furnished to pump station shall be 3 phase, 60 hertz, 480 volts, maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

D. Manufacturer

E. Unit Base

1. The unit base shall comprise a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than 1/4" thick. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

F. Pump Design

1. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.
2. The pump manufacturer must be ISO 9001 revision certified, with scope of registration including design control and service after sales activities.
3. Materials and Construction Features
 - a. Pump casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:
 - b. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
 - c. Fill port cover plate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, a clamp bar screw must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.
 - d. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
 - e. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.
 - f. Suction Head shall be Class 30 cast iron. Its design must incorporate following maintenance features:
 - g. The suction head will be secured to the pump casing by using hex head cap screws and lock washers. Access to the impeller and mechanical seal shall be accomplished by removing the suction head.
 - h. Removal of any blockages in the impeller shall be accomplished by removing the suction head, or through a cleanout cover on the suction head. In consideration of safety, two clamp bar screws must provide slow release of pressure on two clamp bars securing the cleanout cover. A cork gasket shall provide a leak-free seal between the cleanout cover and suction head casing.
 - i. Removal of the suction check valve shall be accomplished through the removable cleanout cover on the suction head.
 - j. In consideration for safety, a pressure relief valve shall be supplied in the suction head. The relief valve shall open at 75-200 PSI.
 - k. A replaceable ductile iron wear plate shall be secured up against the pump casing by the suction head. Measurement of the clearance between this wearplate and impeller shall be accomplished through the cleanout cover plate.
4. Continuous Vane Impeller with Eradicator Self-Cleaning Wear plate
 - a. The nature of the conveyed medium poses significant challenges to the continuous operation of the pump. Of particular concern is the clogging of the impeller by debris in the pumped medium including but not limited to long rags, fibers, and like debris which are able to wrap around the impeller vanes, stick to the center of the vanes or hub, or lodge within the spaces between the impeller and the housing.
 - b. The pump impeller shall be a continuous vane extending from one edge of the impeller through the central portion of the impeller to the other edge. The impeller height shall increase continuously from the outer radius of to the central region of the impeller.
 - c. The matching wear plate shall have one or more notches and/or recesses provided along a common diameter of the wear plate to disturb and dislodge any solids which might otherwise remain on the impeller in dynamic operation. Clusters of notches and/or recesses may also be provided.

- d. Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:
- 1) Seal plate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.
 - 2) The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
 - 3) The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
 - 4) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
 - 5) Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lock screw and conical washer.
 - 6) Impeller shaft shall be AISI 17-4 pH stainless steel.
 - 7) Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
 - 8) Shaft seal shall be cartridge oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the seal plate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.
 - 9) Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same cap screws as used for retaining rotating assembly.
 - 10) Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means.
 - 11) Clearances shall be maintained by using external shims between the casing ring of the rotation assembly and the pump casing itself. Shims will be of various sizes to allow precise adjustment of this clearance. The clearance can be measured by removing the cleanout cover on the suction head.
 - 12) Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

- 13) Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the cleanout cover on the suction head without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.
 - 14) Removal of the rotating assembly will be accomplished through the front or the back of the pump casing.
5. Serviceability
 - a. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.
 - b. No special tools shall be required for replacement of any components within the pump.
6. Drain Kit
 - a. Pumps to be supplied with a drain kit for ease of maintenance. The kit to contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel gate valve and aluminum male quick connect fitting.
7. Spare Parts Kit
 - a. The following minimum spare parts shall be furnished with the pump station:
 - 1) One spare pump mechanical seal (complete with shaft sleeve).
 - 2) One cover plate O-Ring.
 - 3) One rotating assembly O-Ring.
 - 4) One set of impeller clearance adjustment shims.
8. Volute Casing Heaters
 - a. Pump shall be provided with a thermostat mounted to the exterior of the volute casing, and a 900 watt 115 volt electric heater inserted into the interior of the volute by means of a dedicated port. The heater shall be energized at 43+/-3 degrees F to provide heat to the casing and eliminate the possibility of freezing. Heater probes that must be installed through a pump drain port shall not be acceptable.

PART 3 - EXECUTION

3.1 EQUIPMENT REMOVAL

- A. Remove the existing pumps being replaced and deliver to the Owner at designated area.

3.2 INSTALLATION

- A. The installation shall be installed in accordance with manufactures recommendation. Vibration limits shall be governed by HI standards for centrifugal pumps. Proper installation shall include proper concrete pads, no pipe strain, and proper piping practices established by HI standards. Any deficiencies found during startup or warranty period shall be corrected by the contractor at no additional charge to Owner.
- B. Install the pumps following the manufacturer’s printed instructions paying particular attention to:
 - 1. Leveling pump connection base plates.
 - 2. Aligning flanges or connecting piping.
 - 3. Connecting base plate securely to concrete pad.
- C. Grout for setting and leveling base plates shall be equal parts sand and Portland cement mixed with sufficient water to ensure that grout will flow under and solidly bed the plates. Forms shall be used where required to contain and stabilize the grout.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section “Grounding and Bonding for Electrical Systems.”
- B. Connect wiring according to Division 26 Section “Low-Voltage Electrical Power Conductors and Cables.”

3.4 FIELD REPRESENTATIVES SERVICES

- A. Provide services of an experienced, competent, and authorized representative of manufacturer or supplier of equipment to visit the site of work and inspect, check, adjust if necessary, approve equipment installation, and perform equipment startup/performance testing.
- B. Assure that equipment supplier’s representative is present when equipment is placed in operation.
- C. Verify that equipment supplier’s representative revisits job site as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory in the opinion of the Engineer.
- D. Furnish to Owner, through Engineer, a written report prepared by equipment supplier certifying that equipment:
 - 1. Has been properly installed.
 - 2. Is free from any undue stress.
 - 3. Has been operated under design conditions and that it operated satisfactorily.
- E. The equipment supplier shall provide a factory representative for the following:
 - 1. Up to one (1) eight (8) hour day for each equipment installation, inspection, certification, start-up, corrective adjustment and to instruct the operating personnel.

2. Up to one (1) eight (8) hour day for each pump completing testing and conclude with training for plant personnel.

3.5 ACCEPTANCE TESTS

- A. Furnish labor, piping, equipment, and material for conducting the tests.
- B. Testing
 1. Each pump shall be visually inspected to confirm that it is built in accordance with the specifications as to HP, voltage, phase, and hertz.
- C. Perform pump running test on each pump in the presence of Engineer demonstrating its ability to operate without vibration or overheating and deliver its rated capacity under specified conditions. Specifically the following items shall be measured at five (5) points over the entire operating range:
 1. Discharge pressure
 2. Flow rate
 3. Motor speed
 4. Amperage draw
- D. Correct all defects or replace defective equipment revealed by or noted during tests. Make necessary adjustments at the time of tests at the expense of contractor.
- E. Repeat tests if necessary, to obtain results acceptable to engineer.

END OF SECTION 221329.01

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. General: This section specifies several categories of provisions for electrical work, including:
 - 1. Certain adaptive expansions of requirements specified in General Conditions.
 - 2. General performance requirements within the whole electrical system.
 - 3. General work to be performed as electrical work, because of its close association.
- B. Drawings: Examine all drawings relating to the project. Include all work, materials, and equipment mentioned or shown as being provided under this division. Refer to all Drawings and details in coordinating and completing the work. Study all Drawings to determine any conflicts with ordinances and statutes. Report any discrepancies, conflicts, or omissions; accomplish work required for conformance and/or completion.
- C. Specifications: Examine all specification divisions relating to the project. Include all work, materials, and equipment mentioned as being provided under this division. Study all specifications to determine any conflicts with ordinances and statutes. Report any discrepancies, conflicts, or omissions; accomplish work require for conformance and/or completion.
- D. General Outline: The facilities and systems of the electrical work can be described (but not by way of limitation) as follows:
 - 1. Coordination and installation of new electrical equipment to the existing electrical distribution.
 - 2. Motor starters/controllers and control/protection work as indicated.
 - 3. Lighting systems.
 - 4. Controls and instrumentation systems as indicated.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 260800 – COMMISIONING OF ELECTRICAL SYSTEMS
- D. Section 260533.23 – SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS
- E. Section 260533.16 – BOXES FOR ELECTRICAL SYSTEMS
- F. Section 262726 – WIRING DEVICES

1.3 REFERENCES

ANSI Standards	American National Standards Institute
ASTM Standards	American Society of Testing Materials
IEEE Standards	Institute of Electrical and Electronic Engineers
ICEA Standards	Insulated Cable Engineers Association
NECA Standards	National Electrical Contractors Association
NEMA Standards	National Electrical Manufacturers Association
NFPA 70	National Electrical Code (NEC)
OSHA Standards	Occupational Safety and Health Act
UL Standards	Underwriters' Laboratories
NFPA 820	Standard for Fire Protection and Wastewater Treatment and Collection Facilities

1.4 ACTION SUBMITTALS

- A. General: Electrical compliance submittals shall be prepared and submitted in accordance with the Conditions of Contract, General Conditions, and this specification section. The types of submittals required for electrical work are defined herein. Refer to each Division 26 specification section for detailed requirements for submittal content. Administrative submittals are specified elsewhere in the Contract Documents.
- B. Content: Electrical compliance submittals shall include the following information.
 - 1. Each specification section shall be submitted separately for approval. All equipment included in the submittal shall be listed. Combined section submittals are not acceptable.
 - 2. Shop Drawings: Project shop drawings and other data prepared specifically for fulfillment of the project requirements. Shop drawings include fabrication, physical size, dimensioned layout, wiring diagrams, coordination and similar drawings and diagrams, and include performance data associated therewith, including weights, capacities, speeds, outputs, consumptions, efficiencies, voltages, amperages, cycles, phases, noise levels, operating ranges, and similar information. Installation manuals shall be furnished in the shop drawing submittals.
 - 3. Manufacturer's Data: Manufacturer's most current standard printed product information, including (as applicable) promotional brochures, product specifications, installation instructions and diagrams, statements of compliance with standards, performance charts or curves, and similar information concerning the standard portions of the manufacturer's products.

4. **Certifications:** Written statements, either standard printed forms or specifically prepared text, executed specifically for the project application by an authorized officer of the contracting firm, manufacturer, or other firm as designated, certifying (to the best of his knowledge) to compliance with the requirements as specified.
5. **Specification Conformance:** Each electrical submittal shall include a copy of the applicable specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (in the margin adjacent to the beginning of the paragraph) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

- C. **Submittal Presentation:** Submittal data shall be assembled in folders or three-ring binders. Each folder or binder shall contain a cover sheet, indexed by item and cross-referenced to the appropriate specification paragraph. If the General Conditions permit it, equivalent electronic submittals are acceptable. Catalog cuts shall be edited to show only the items, model numbers, and information that applies to the equipment being furnished. All component and subassembly data sheets shall also be provided.
- D. **Partial, incomplete or illegible submittals** will be returned to the Contractor without review for re-submittal.

1.5 INFORMATION SUBMITTALS

A. Instruction Manuals:

1. **General:** Submittals shall be in accordance with Conditions of Contract and the General Conditions, Specification Sections and the requirements of this specification section. Instruction Manuals shall be submitted complete prior to commencing any training; partial or incomplete data shall not be accepted.
2. **Original Literature:** Two (2) copies of the Instruction Manuals shall be provided with manufacturer's original published literature; copies or reproductions of any kind shall not be accepted for these two manuals.
3. **Electronic Copy:** One (1) electronic copy of all Instruction Manuals shall be provided in portable document format (.PDF). Two (2) electronic copies shall be provided on Compact Discs to the Owner.
4. **Content:** Instruction Manuals shall include the following information.

- a. **Contact Information:** Instruction Manuals shall include the names, addresses, and telephone numbers of the manufacturer, the nearest representative of the manufacturer, and the nearest supplier of the manufacturer's equipment and parts.
- b. **Manufacturer's Product Warranties:** Manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the manufacturer, when and if the product fails within certain operational conditions and time limits. Any extended warranties or service agreements provided within this contract shall also be included.
- c. **User Manuals:** The written instructions by the manufacturer, fabricator, or installer of equipment or systems, detailing the procedures to be followed by the Owner in configuration, operation, control, and shutdown of each operating item of the equipment and each electrical system.
- d. **Maintenance Manuals:** The compiled information provided for the Owner's maintenance and troubleshooting of each system of operating equipment, including lubrication, emergency control, parts replacement, spare parts inventory recommendation, listing of tools and accessories needed for maintenance, and similar instructions.
- e. **Guarantees:** The Contractor's specific signed commitment (sometimes requiring also that other countersign) to the Owner that certain acts of restitution will be performed when and if certain portions of electrical work fail within certain operational conditions and time limits.
- f. **Certifications:** Written statements, either standard printed forms or specifically prepared text, executed specifically for the project application by an authorized officer of the contracting firm, manufacturer, or other firm as designated, certifying (to the best of his knowledge) the equipment installation, configuration, and startup is in compliance with the manufacturer's recommendations and the project requirements.
- g. **Test Reports:** The results of all specified factory and field tests shall be included with the Instruction Manuals.
- h. **Startup Reports:** Equipment manufacturer's field startup reports shall be included with the Instruction Manuals.
- i. **Configuration Data:** A written record documenting the setup and configuration of each system that is software, hardware, or firmware configurable in the field shall be included in the Instruction Manual. All configuration parameters, jumpers, switch settings, etc., shall be recorded.
- j. **As-Built Control Wiring Diagrams and Assembly Drawings:** As-built control diagrams and assembly drawings shall be provided in appropriately sized binders. Drawings shall not be folded or otherwise reduced in size for assembly in the instruction manual binder. As-built drawings shall be organized by facility or location. Electronic copies shall be included with the operation and maintenance manual files.

B. Drawings

1. Where the Contractor is required to provide information on drawings as part of the specified work, such drawings shall be prepared on 11 inch by 17 inch paper complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing. Drawings shall be prepared on a computer-aided drafting (CAD) system. All CAD drawing files shall be converted to .DWG file format and submitted on CD-ROM media. All CAD drawing files shall be updated to reflect final as-constructed conditions.

1.6 QUALITY ASSURANCE

- A. General: Refer to General Conditions for general administrative/procedural requirements related to compliance with codes and standards. Materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards, and utility company regulations. In case of difference between codes, state laws, local ordinances, industry standards, utility company regulations, and the contract documents, the most stringent shall govern.
- B. Definitions:
 1. Elementary or Schematic Diagram: A schematic (elementary) diagram shows, by means of graphic symbols, the electrical connections, and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.
 2. One-line Diagram: A one-line diagram shows by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and the components, devices or parts used therein. Physical relationships are usually disregarded.
 3. Block Diagram: A block diagram is a diagram of a system, instrument, computer, or program in which selected portions are represented by annotated boxes and interconnecting lines.
 4. Wiring or Connection Diagram: A wiring or connection diagram includes all the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly.
 5. Interconnection Diagram: Interconnection diagrams shall show all external connections between terminals of equipment and outside points, such as motors and auxiliary devices. References shall be shown to all connection diagrams that interface to the interconnection diagrams.
Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry/exit of the individual wires clearly shown. Wireless diagrams and wire lists are not acceptable. Wire identification shall be shown as actually installed.
The wire identification for each end of the same wire shall be identical. All devices and equipment shall be identified. Terminal blocks shall be shown as actually installed and identified in the equipment complete with individual terminal identification.
 6. Arrangement, Layout, or Outline Drawings: An arrangement, layout, or outline drawing is one that shows the physical space and mounting requirements of a piece of equipment. It may also indicate ventilation requirements and space provided for connections or the location to which connections are to be made.

- C. Identification of Listed Products: Electrical equipment and materials shall be listed for the purpose for which they are to be used, by an independent testing laboratory. Three such organizations are Underwriters Laboratories (UL), Canadian Standards Association (CSA), Electrical Testing Laboratories (ETL), and National Electrical Manufacturers Association (NEMA).

When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority, to undergo a special inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price.

- D. Symbols: Except as otherwise indicated, refer to the symbols legend on the Drawings for definitions of symbols used on the Drawings to show electrical work.
- E. Coordination Meetings: The Contractor shall include as Work of this section of the specifications the requirement for the following coordination meetings to be held at the project site. The primary function of the meetings shall be to ensure compliance with the requirements of the construction documents and facilitate timely performance of the contract. The Contractor shall have in attendance at each meeting a representative of the Electrical Subcontractor who is responsible for the execution of the Work of this contract. The preliminary schedule and agenda for each of the meetings shall be as described below. The specific dates for each of the meetings shall be scheduled by the Contractor and approved by the Construction Manager. The Construction Manager shall be provided with two (2) weeks minimum advanced written notice of proposed scheduled meeting dates.

1.7 PROJECT/SITE CONDITIONS

- A. Environmental Conditions: The following environmental conditions are typical for the project site. All electrical equipment and materials shall be sized and derated for the specified conditions:
 1. Elevation: 1,000 feet above mean sea level
 2. Outdoor Temperature:
 - a. Winter: -10 to 40 °F
 - b. Summer: 40 to 105 °F
 3. Indoor Air Temperature: 40 to 104 °F
- B. Area Classifications: For the purpose of delineating the basic electrical construction materials and installation requirements for this project, areas of the project have been classified on the Drawings as defined below. Electrical work within these areas shall conform to the requirements described below as well as the referenced code requirements.
 1. Dry Non-Process Areas (NEMA 12): Areas requiring general purpose, NEMA 12, construction are indoor areas typically environmentally controlled non-process areas such as electrical rooms. NEMA 1 enclosures are acceptable where NEMA 12 and NEMA 1 gasketed are not available.

2. Wet Process Areas (NEMA 4X): Areas requiring corrosion resistant, NEMA 4X, construction are all wet process areas. Wet process areas typically contain wastewater, chemicals, or sludge pumping or piping systems and are subject to spills and washdown. Wet process areas shall also include those areas containing chemicals.
 3. Outdoor Areas(NEMA 4X): Areas requiring corrosion resistant, NEMA 4X, construction are all outdoor areas. Outdoor areas are any areas located outside of a structure or not fully enclosed with four walls and a roof.
 4. Hazardous Areas (NEMA 7): Area requiring explosion proof, NEMA 7, construction are all hazardous areas. Hazardous areas typically contain exposed wastewater, chemicals, and/or sludge pumping or piping systems and are subject to spills, wash down, and combustible gas presence. Hazardous areas are prone to corrosion.
- C. Construction Materials: Construction materials required for each area classification are listed in Table 260500-A appended to the end of this specification section. Refer to the individual specification section for each component for material composition and installation practices.

1.8 HANDLING AND STORAGE

- A. Delivery: Deliver electrical materials and equipment properly packaged. Utilize factory fabricated containers or wrappings for materials and equipment which protect materials and equipment from damage. Inspect materials and equipment to ensure that no damage has occurred during shipment.
- B. Storage: Store electrical materials and equipment indoors in original packaging in areas specifically designated for equipment storage. Protect equipment and materials from construction traffic and debris.
- C. Handling: Handle electrical materials and equipment carefully to prevent physical damage to materials and equipment. Remove packaging, including the opening of crates and containers, avoiding the use of excessive hammering, and jarring which could damage the materials and equipment contained therein. Do not install damaged materials or equipment; remove from site and replace damaged materials and equipment with new.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be new and free from defects. All material and equipment of the same or a similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.

2.2 ELECTRICAL EQUIPMENT IDENTIFICATION

- A. General: Nameplates shall be made from laminated phenolic plastic. The nominal size of the nameplates shall be 3/4 inch high by 2 inches long. Nameplates shall have white backgrounds with 3/16-inch black letters. Nameplate engraving shall minimally identify the equipment or equipment served by the labeled device and shall be in complete English terminology as indicated on the Drawings. Nameplates shall be attached with epoxy-based adhesive.

- B. Legends: Descriptions given on the single line diagrams, control one-line diagrams, and panel schedules shall be used as the basis for nameplate engraving. In addition to the English description, each nameplate shall also indicate the equipment or device tag number. Additional engraving legend requirements shall be as defined below. If abbreviations are required because of space limitations, abbreviations shall be submitted to the Engineer for approval.
- C. Equipment: Nameplates shall be provided for the following equipment. Additional engraving requirements shall be as indicated in parenthesis for each equipment type.
 - 1. Panelboards, electrical cabinets, and enclosures
 - 2. Electrical switchboards
 - 3. Control panels
 - 4. Control stations (indicating equipment controlled)
 - 5. Transformers (indicating power source and equipment served)
 - 6. Disconnect switches (indicating power source and equipment controlled)
 - 7. Light switches and manual motor starters (indicating power source and equipment controlled)
 - 8. Local motor starters (indicating power source and equipment controlled)

2.3 CUTTING AND PATCHING

- A. Comply with the requirements of the General Conditions for the cutting and patching of other work to accommodate the installation of electrical work. Except as individually authorized by the Construction Manager, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

2.4 EXCAVATING FOR ELECTRICAL WORK

- A. General: The work of this article is defined to include whatever excavating and backfilling is necessary to install the electrical work. Coordinate the work with other excavating and backfilling in the same area, including dewatering, flood protection provisions, and other temporary facilities. Coordinate the work with other work in the same area, including other underground services (existing and new), landscape development, paving, and floor slabs on grade. Coordinate with weather conditions and provide temporary facilities needed for protection and proper performance of excavating and backfilling.
- B. General Standards: Except as otherwise indicated, comply with the applicable provisions of the General Conditions for electrical work, excavating, and backfilling. Refer instances of uncertain applicability to the Construction Manager for resolution before proceeding.
- C. Replacement of Other Work: Where it is necessary to remove and replace landscape work, pavement, flooring, and similar exposed finish work, engage the original installer to install the replacement work; except where work existed prior to the work of this Contract, engage only experienced and expert firms and tradespersons to replace the work.

2.5 CONCRETE FOR ELECTRICAL WORK

- A. General: The work of this article is defined to include whatever concrete work is necessary or shown specifically to install the electrical work; but excluding equipment base grouting (see applicable Division 26 sections). Coordinate the work with other work, particularly other concrete work and accessories.
 - 1. General Standards: Refer to Structural Specifications and Drawings for all concrete standards.

2.6 HOUSEKEEPING

- A. General: Electrical equipment shall be protected from dust, water and damage during the construction period. Electrical equipment including, but not limited to, motor control centers, motor controllers, panelboards, switchgear, and buses shall be wiped free of dust and dirt on the outside and kept dry.
- B. Upon completion of the work, remove all litter, waste material, unused materials, and Contractor's tools and equipment from the job site.
- C. Remove all construction debris, packing materials, shipping labels, etc., from the interior and exterior of the equipment. Thoroughly clean and remove construction markings from interior surfaces.
- D. Clean exterior surfaces of equipment of all construction debris and markings and leave the equipment in an unblemished condition.
- E. Clean all equipment filters in accordance with the manufacturer's instructions.
- F. Touch-up scratched or marred surfaces to match original finish.

2.7 TESTING

- A. The tests specified in Section 260800 – Commissioning of Electrical Systems of these specifications shall be performed prior to energizing the electrical circuits.

2.8 CLOSEOUT

- A. General: Refer to the General Conditions sections for general closeout requirements.
- B. Lubrication: Clean and lubricate operational equipment.
- C. Training: Instruct Owner's personnel thoroughly in the operation, sequencing, maintenance, and safety/emergency provisions of the electrical systems.

2.9 MAINTENANCE MATERIALS

- A. Extra stock of spare parts, materials, replacement units, accessories, adjustment devices, and similar items as designated, for the Owner's initial use in maintaining the electrical equipment and systems in continued operation. Maintenance materials shall be furnished where specified in each equipment specification.

2.10 RECORD DOCUMENTS

- A. Record documents refer to those documents maintained and annotated by the Contractor during construction, and include record drawings in accordance with the General Conditions sections, and the following additional schedules, lists, and drawings:
 - 1. Interconnection Diagrams (Part 1 of this Section).
 - 2. Original Submittal Drawings (Part 1 of this Section).

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which equipment is to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 GENERAL

- A. Coordinate equipment installation work with electrical raceway and wire/cable work, as necessary for proper interface.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.
- C. Cables larger than No. 6 AWG which hang from their vertical connections shall be supported from the structure within 2 feet of the connection.

3.3 INSTALLATION OF FREESTANDING EQUIPMENT

- A. Install equipment at the locations indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.
- B. The floor or slab upon which the freestanding equipment is installed shall be smooth and level (within 1/8 inch per three feet in any direction). Four-inch (5.4 lb/ft) structural channel sills shall be embedded in the concrete along the entire length of the equipment, front and back. The front and rear channel sills shall be set and aligned with each other and shall be level (within 1/8 inch per three feet over the entire length of the sill). The finished floor or slab shall not be higher than the channel sills. The equipment structure shall be welded to the channel sills in accordance with the manufacturer's instructions.

3.4 INSTALLATION OF WALL-MOUNTED EQUIPMENT

- A. Install equipment at the locations indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.

- B. Equipment mounting height shall be 72 inches above finished floor to top of equipment enclosure.
- C. Equipment enclosure shall be mounted on u-channel supports anchored to associated wall.
- D. Conduits shall be terminated on the sides and bottom of enclosures. Conduits shall not be installed in the top of the enclosure without approval of the Construction Manager.

3.5 GROUNDING

- A. Provide equipment grounding connections to equipment as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.6 FIELD QUALITY CONTROL

- A. Field inspection and testing of equipment shall be completed prior to energizing the equipment.
- B. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.

3.7 ADJUSTING AND CLEANING

- A. Adjust operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finish.

3.8 RUBBER MATS

- A. A three-foot-wide rubber mat shall be furnished and installed on the floor and in front of each piece of electrical equipment located indoors. The mat shall be long enough to cover the full length of each enclosure. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes or other defects detrimental to their mechanical or electrical strength. The mat shall meet OSHA requirements and the requirements of ANSI/ASTM D 178 J6-7 for Type 2, Class 2 insulating matting.

3.9 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.
- B. Anti-oxidant compound shall be used whenever there is a termination involving aluminum. Ideal Noalox or Engineer approved equivalent is acceptable.
- C. Bare aluminum is not permitted to be in direct contact with concrete or soil. Manufacturer approved protective coatings must be provided between aluminum and these materials.

TABLE 260500-A

<u>Component</u>	<u>Dry Non-Process Area (NEMA 12)</u>	<u>Wet Process Area (NEMA 4X)</u>	<u>Outdoors (NEMA 4X)</u>	<u>Hazardous Areas (NEMA 7)</u>
Rigid Conduit (exposed)	RAC	PRAC	RAC	PRAC
Rigid Conduit (concealed) ⁴	PRAC	PRAC	PRAC	PRAC
Flexible Conduit ⁵	FMC	LFMC	LFMC	LFMC
Support Systems	Galvanized Steel	Stainless Steel	Stainless Steel	Stainless Steel
Fastening Hardware and Hanger Rods ^{2,3}	Cadmium Plated Steel	Stainless Steel	Stainless Steel	Stainless Steel
Control Stations & Enclosures ^{2,3}	Steel	Stainless Steel	Stainless Steel	Stainless Steel or Cast Aluminum (Explosion Proof)
Receptacles ^{2,6}	General	WP, GFCI	WP, GFCI	WP, GFCI, Explosion Proof
Switches ²	General	WP	WP	Stainless Steel or Cast Aluminum (Explosion Proof)

Table A Notes:

1. Enclosures, device boxes, control stations, and raceway systems shall be mounted with 1/4-inch (minimum) air space between the electrical system and supporting structure.
2. Conduit terminations to control stations, enclosures, and device boxes in NEMA 4X, 7, and 12 areas shall be made through threaded hubs. Chemical Areas shall use Plastic Non-Metallic enclosures.
3. Control station and enclosure NEMA sealing ratings shall meet or exceed the rating designated by the area classification.

4. Conduit encased in concrete duct bank or beneath slab on grade shall be rigid nonmetallic conduit, raceway type PVC Schedule 40. Conduit concealed in concrete walls shall be raceway type PRAC.
5. Flexible conduit shall be utilized for final connections to equipment. Length shall be no greater than 24" and shall be fully supported per NEC.
6. All GFCI protection shall be provided by GFCI circuit breakers. GFCI receptacles are not permitted unless specifically called out by a note on the Drawings. All receptacles shall not be Tamper Resistant unless specifically called out on the Drawings.

Legend:

GRS – Galvanized Steel Conduit

RAC – Rigid Aluminum Conduit

PGRS – PVC Coated Galvanized Steel Conduit

PRAC – PVC Coated Rigid Aluminum Conduit

FMC – Flexible Metallic Conduit

LFMC – Liquid tight Flexible Metallic Conduit

WP – Weatherproof

GFCI – Ground Fault Circuit Interrupter

NM – Non-Metallic

REFER TO RACEWAYS, FITTINGS, AND SUPPORTS FOR ADDITIONAL
REQUIREMENTS AND DETAILS ON CONDUIT TYPES AND REQUIREMENTS

END OF SECTION 260500

SECTION 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, all low voltage wire and cable indicated on the Drawings and as specified herein and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of cable and wire systems shall be furnished and installed by the Contractor.
- B. The scope of this Section does not include internal wiring factory installed by electrical equipment manufacturers.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 260500– COMMON WORK RESULTS FOR ELECTRICAL
- D. Section 260533.23 – SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS
- E. Section 260533.16 – BOXES FOR ELECTRICAL SYSTEMS

1.3 REFERENCES

ICEA Standards	Insulated Cable Engineers Association
ASTM Standards	American Society of Testing Materials
UL 44	Standard for Thermoset-Insulated Wire and Cable
ISO 9000	International Organization for Standardization

1.4 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the wire and cable manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of Field Tests
 - 3. Wiring Identification Methods
- B. Each submittal shall be identified by the applicable specification section.

1.5 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.

- B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Cable pulling calculations (if required).
 - 3. Wiring identification methods and materials.
 - 4. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.6 IDENTIFICATION

- A. Each cable shall be identified as specified in Part 3, Execution, of this Specification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years. Wire and cable shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. Only one (1) manufacturer for each wire and cable type shall be permitted.
- B. The wire and cable manufacturer shall be ISO 9000 registered.

2.2 POWER WIRE AND CABLE

- A. Power cable and wire shall consist of stranded copper conductor with insulation type THHN/THWN and 600V.
- B. Conductors shall be stranded copper per ASTM-B8 and B-3, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.
- C. Multi-conductor power cable assemblies shall be UL 1277 Listed, provided with a bonding conductor, and furnished with an overall PVC jacket.

- D. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or approved equal.

2.3 CONTROL CABLE

- A. Control cable and wire shall consist of stranded copper conductor with insulation type THHN/THWN and 600V.
- B. Conductors shall be stranded copper per ASTM B-8 and B-3, and Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be No. 14 AWG.
- C. Multi-conductor control cable assemblies shall be UL 1277 Listed, provided with a bonding conductor, and furnished with an overall PVC jacket.
- D. Control cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or approved equal.

2.4 LIGHTING AND RECEPTACLE WIRE

- A. The lighting and receptacle branch circuit wire shall consist of stranded copper conductor with insulation type THHN/THWN and 600V.
- B. Conductors shall be solid copper per ASTM- B-3. Minimum size wire shall be No. 12 AWG.
- C. Lighting and receptacle wire shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or approved equal.

2.5 INSTRUMENTATION CABLE

- A. The instrumentation cable for analog signals shall be single, shielded, twisted pairs or triads with 600 volt insulation and shall have a 75°C (minimum) insulation rating.
- B. Conductors shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM-B8, Class B stranding unless otherwise specified. Minimum size wire shall be No. 16 AWG.
- C. The instrumentation cable shall be Okoseal-N Type P-OS for single pair or triad applications and Okoseal-N Type SP-OS for multiple pair or triad applications as manufactured by the Okonite Company, Belden equivalent, Southwire Company equivalent, or approved equal.

2.6 CONDUCTOR IDENTIFICATION

- A. Conductors shall be identified using a color-coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:
 - 1. 480/277V AC Power
 - a. Phase A - BROWN
 - b. Phase B - ORANGE
 - c. Phase C - YELLOW

- d. Neutral – GREY
 2. 120/208V or 120/240V AC Power
 - a. Phase A - BLACK
 - b. Phase B - RED
 - c. Phase C - BLUE
 - d. Neutral - WHITE
 3. DC Power
 - a. Positive Lead - RED
 - b. Negative Lead - BLACK
 4. DC Control
 - a. All wiring - BLUE
 5. 120VAC Control
 - a. 120 VAC control wire shall be RED except for a wire entering a motor control center compartment or control panel which is an interlock. This interlock conductor shall be color coded YELLOW.
 6. 24VAC Control
 - a. All wiring - ORANGE
 7. Equipment Grounding Conductor
 - a. All wiring - GREEN
- B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified using colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color coding requirements listed above.
- C. Conductors that are a part of multi-conductor control cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor within the cable assembly shall also be identified with a heat shrink tag with color coded background in accordance with the requirements listed in Part 3 herein. Background color shall be in accordance with the color coding requirements listed above.
- D. Conductors that are a part of multi-conductor power cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also

be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified using colored tape. Heat shrink tags and colored tape shall be in accordance with the requirements listed in Part 3 herein. Tape color and heat shrink tag background color shall be in accordance with the color coding requirements listed above.

2.7 CABLE PULLING LUBRICANTS

- A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 Plus by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or approved equal.

PART 3 - EXECUTION

3.1 POWER, CONTROL, AND LIGHTING/RECEPTACLE WIRE AND CABLE INSTALLATION

- A. The wire and cable shall be installed as specified herein and indicated on the Drawings.
- B. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for that particular type of cable.
- C. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical or approved equal.
- D. Splices shall not be allowed in the underground manhole and handhole systems. If splices are required, the Contractor shall obtain approval in writing from the Engineer prior to splicing. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or approved equal. No splicing of instrumentation cable is allowed. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits.
- E. Wire and Cable Sizes
 - 1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured from source to load does not exceed 2-1/2%.
- F. Additional Conductor Identification
 - 1. In addition to the color-coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.
 - 2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.
 - 3. All wiring shall be identified at each point of termination. This includes but is not limited to

identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.

4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the required text. The use of handwritten text for wire identification shall not be permitted.
5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.
6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.
7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or approved equal.
8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the 'FROM' and 'TO' column for that conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties, and shall be made of polyethylene as manufactured by Brady, Seton, Panduit, or approved equal.
9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

G. Wiring Supplies

1. Only electrical wiring supplies manufactured under high standards of production and meeting the approval of the Engineer shall be used.
2. Rubber insulating tape shall be in accordance with ASTM Des. D119. Friction tape shall be in accordance with ASTM Des. D69.

H. Training of Cable

1. The Contractor shall furnish all labor and material required to train cables around cable vaults within buildings and in manholes and handholes in the outdoor underground duct system. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the

cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing. Reference Raceways, Fittings, and Supports (See Referenced Sections).

2. Instrumentation cable shall be racked separate from other AC and DC wiring to maintain the required separation as follows:
 - a. 18 inches for 480/277VAC wiring
 - b. 12 inches for 208/120VAC wiring
 - c. 6 inches for 24VDC wiring

I. Conductor Terminations

1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment specification sections as applicable for additional termination requirements.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the Contractor shall terminate field wiring in an adjacent junction per the requirements of Boxes (See Referenced Sections), complete with terminal strips. Contractor shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.
3. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

J. Pulling Temperature

1. Cable shall not be flexed or pulled when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature of 40°F or less within a three (3) day period prior to pulling, the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the work day for which the cable is removed from the protected storage. Any remaining cable reels shall be returned to storage at the completion of the workday.

3.2 INSTRUMENTATION CABLE INSTALLATION

- A. The Contractor shall install all cable or conductors used for instrumentation wiring (4-20 mA DC, etc.) in conduit as specified in Raceways, Fittings, and Supports (See Referenced Sections). Only instrumentation cable as specified herein shall exclusively occupy these conduits. No other wiring for AC or discrete DC circuits shall be installed in these conduits.
- B. All shielding shall be continuous and shall be **grounded at one point only**.

- C. Where instrumentation cables are installed in panels, manholes, handholes, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.
- D. Special instrument cable shall be as specified or recommended by the manufacturer of the equipment or instruments requiring such wiring. Installation, storage, and terminations shall be per manufacturer's recommendations.

3.3 TESTING

- A. All testing shall be performed in accordance with the requirements of the General Conditions. The following tests are required:
 - 1. Shop Test
 - a. Cable and wiring shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.
 - 2. Field Tests
 - a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.
 - b. After installation, some wires and cables shall be tested for insulation levels. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:
- B. For #8 AWG and larger 600V power and control cable, apply 1,000 VDC from a Megohmmeter for one (1) minute for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Resistance shall be no less than 100 Megaohms. Insulation testing is not required for power and control cables smaller than #8 AWG.
- C. 600V instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter or approved equal. The resistance value shall be 200 Megaohms or greater.
- D. Wires and cables shall be tested before being connected to motors, devices or terminal blocks.
- E. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner.
- F. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

END OF SECTION 260519

(EXHIBIT A) TEST DATA - MEGOHMS TEST NO. _____							
Part Tested: Test Made: _____ Hours/Days: _____ After Shutdown: _____							
Grounding Time: Dry Bulb Temperature: _____ Wet Bulb Temperature: _____							
Test Voltage: _____				Equipment Temperature: _____ How Obtained: _____ Relative Humidity: _____ Absolute Humidity: _____ Dew Point: _____			
Megohmmeter: Serial Number: _____ Range: _____ Voltage: _____ Calibration Date: _____							
Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
<input type="checkbox"/> Minute				5 Minutes			
<input type="checkbox"/> Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minutes			
				Ratio			
Remarks:							

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.
- B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100-92, Powering and Grounding of Sensitive Electronic Equipment. Conflicts shall be promptly brought to the attention of the Engineer.
- C. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL
- D. Section 260533.23 – SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

1.3 REFERENCES

UL 467	Grounding and Bonding Equipment
IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE 1100-92	Powering and Grounding of Sensitive Electronic Equipment
NETA ATS	Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

1.4 ACTION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and as specified herein.
- B. Shop Drawings - Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
 - 1. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
 - 2. Shop drawings shall include but not be limited to:

- a. Product data sheets.
- b. Drawings and written description of how the Contractor intends to furnish and install the grounding system.
- c. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

- C. Manufacturer's Certification - Certify that products meet or exceed specified requirements.
- D. Identified by applicable specification section.

1.5 INFORMATION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Prior to start-up, submit manufacturer's operation and maintenance manuals and recommended spare parts list, including but not limited to:
 1. Manufacturer's equipment warranty.
 2. Copies of Submittals.
 3. Functional descriptions, operating instructions, calibration and adjustment, recommended maintenance, safety.
 4. Contact information for local representative and supplier.
- C. Results of certified field tests.

1.6 HANDLING AND STORAGE

- A. Equipment shall be carefully transported, stored, handled, and set in place in a manner that will prevent damage, misalignment, and distortion to the components.
- B. Follow manufacturer's recommendations regarding handling and storage at all times prior to installation of the equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.2 GROUND RODS, RING, AND GRID

- A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod. Ground rods shall be UL 467 listed. The ground rods shall be manufactured by Erico Products, Blackburn, or equal.
- B. Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.
- C. The ground connection shall be made at the main service equipment and shall be extended to the grounding system surrounding the structure. The grounding shall also be connected to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection. Where a Cathodic Protection system is used on equipment, the grounding of this equipment shall meet the Cathodic Protection system Manufacturer's installation requirements. Refer to the Cathodic Protection system specifications for additional requirements.
- D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.3 FITTINGS

- A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 listed.

2.4 EQUIPMENT GROUNDING CONDUCTORS

- A. An insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the underground conductors in the raceway and shall be green in color. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.5 EQUIPMENT GROUNDS

- A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

2.6 EXOTHERMIC WELDS

- A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

2.7 EXISTING GROUNDING SYSTEMS

- A. The Contractor shall connect the new ground ring to any existing grounding rings or conductors if found. Unless noted on Drawings, the presence of an existing grounding ring does not relieve the Contractor from installing a new grounding ring as shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.
- B. Ground Grid and Ring
 - 1. A main ground grid or ring shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. The ground rods shall be interconnected by the use of copper cable exothermically welded to the rods. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtailes" shall be connected to the ground grid and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system. The copper pigtailes shall be exothermically welded to the ground grid, and connected to building reinforcement steel by hydraulic crimp.
 - 2. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.
 - 3. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
 - 4. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.
 - 5. Buried exothermic welds and ground ring shall not be backfilled until inspected by Engineer.
- C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

3.2 TESTING [AND STARTUP]

- A. All tests shall be performed in accordance with the requirements of the General Conditions. The following tests are required:

1. Witnessed Shop Tests

- a. None required.

2. Field Tests

- a. Field testing shall be done in accordance with the requirements specified in the General Conditions, and NETA Acceptance Testing Specifications, latest edition.
- b. Fall of potential tests shall be performed on the ground grid per IEEE81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.
- c. Continuity tests for the grounding electrode conductor shall also be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

END OF SECTION 260526

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SECTION 260533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The scope of work under this Section includes furnishing and installing all pull boxes, junction boxes, and outlet boxes.
- B. Requirements for other boxes and enclosures are not included in this Section. Reference each specific Division 26 equipment Section for requirements related to that equipment’s respective enclosure.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL
- D. Section 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- E. Section 260533.23 – SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS
- F. Section 262726 – WIRING DEVICES

1.3 REFERENCES

UL 514A	Metallic Outlet Boxes
UL 514C	Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers
UL 50	Enclosures for Electrical Equipment, Non-environmental Considerations
UL 50E	Enclosures for Electrical Equipment, Environmental Considerations
UL 1203	Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations
NEMA 250	Enclosures for Electrical Equipment

1.4 ACTION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and as specified herein.
- B. Product Datasheets
- C. Layout Drawings for all boxes larger than standard receptacle boxes.
- D. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall

be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.5 INFORMATION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Prior to start-up, submit manufacturer's operation and maintenance manuals and recommended spare parts list, including but not limited to:
 - 1. Manufacturer's equipment warranty.
 - 2. Copies of Submittals
 - 3. Functional descriptions, operating instructions, calibration and adjustment, recommended maintenance, safety
 - 4. Contact information for local representative and supplier

1.6 HANDLING AND STORAGE

- A. Follow manufacturer's recommendations regarding handling and storage at all times prior to placing the devices in service.

PART 2 - PRODUCTS

2.1 PULL AND JUNCTION BOXES

- A. General
 - 1. All pull and junction boxes shall be UL listed and labeled.
 - 2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.
 - 3. Pull and junction boxes mounted embedded in concrete shall be UL listed for embedment.
 - 4. Where metallic boxes are used, they shall be of all welded construction. Tack welded boxes are not acceptable.
- B. Pull Boxes
 - 1. All pull boxes shall be provided with a matching gasketed cover. For covers with dimensions of 24 inches by 24 inches or less, the cover shall be held in place by machine screws. Other screw types are not acceptable. For covers with dimensions greater than 24 inches by 24 inches, the cover shall be hinged and held in place by screw-operated clamp mechanisms. Hinge pins shall be removable. Clamp mechanism material of construction shall match that of the associated box.

2. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.
3. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.
4. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC Control wiring
 - c. DC Control wiring
 - d. Instrumentation wiring
 - e. Network wiring

C. Junction Boxes

1. Junction boxes used for lighting and receptacle circuits only shall be provided with a matching gasketed cover held in place by machine screws. Other screw types are not acceptable.
2. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with a hinged, gasketed cover. Hinge pins shall be removable. Cover shall be held in place by screw-operated clamp mechanisms. Clamp mechanism material of construction shall match that of the associated box.
3. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring
 - e. Network wiring
4. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-

on (wire nut) type connectors for wire terminations/junctions.

5. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips consisting of the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.
6. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Dry Non-process Area	NEMA 12, Painted Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

2. In hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class I, Division 2, Group D	NEMA 7

3. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs.

2.2 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Wiring Devices (See Referenced Sections) for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.

2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.
3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Dry Non-process Area	NEMA 1, Cast Iron
All Outdoor Areas	NEMA 4X, Cast Aluminum

4. In hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class I, Division 2, Group D	NEMA 7

5. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

C. Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL listed and labeled. Pre-punched single diameter conduit knockouts are acceptable; however, concentric and eccentric knockouts are not acceptable.
2. Outlet boxes mounted flush in CMU walls shall be made of galvanized, tack welded steel, and suitable for installation in masonry walls. Sectional type boxes are not acceptable for this application.
3. Outlet boxes mounted flush in gypsum walls shall be made of galvanized pressed steel. Tack welded boxes are not acceptable for this application. Sectional type boxes are not acceptable for this application.
4. Outlet boxes mounted cast into concrete shall be concrete tight and shall be made of galvanized steel or PVC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors

specifically suited for use in concrete shall be used.

3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.
4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Raceways, Fittings, and Supports (See Referenced Sections) for conduit hub requirements.
5. Pull and junction boxes may be installed flush mounted in gypsum, concrete, or CMU walls where appropriate if covers are easily removed or opened.
6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Flush mounted outlet boxes shall be arranged and located so that tile and grout lines fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.
4. Outlet boxes shall be flush mounted in finished areas and other areas where practical. Flush mounted outlet boxes shall not be installed in hazardous areas and type 1 or 2 chemical storage/transfer areas.
5. For the below-named items, mounting heights from finished floor, or finished grade to top is applicable, depending on the type of wiring device to be installed in the outlet box. Mounting heights for outlet boxes shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):
 - a. Light switches and wall mounted occupancy sensors, 48 inches
 - b. Receptacles in indoor dry process/non-process areas, 16 inches
 - c. Receptacles in indoor wet process areas and all indoor chemical storage/transfer areas, 48 inches
 - d. Receptacles in outdoor locations, 24 inches
 - e. Ceiling mounted occupancy sensors, as indicated on the Drawings
6. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

END OF SECTION 260533.16
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SECTION 260533.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Under this Section, the Contractor shall furnish and install all conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein and as required.
- B. The Drawings indicate the general location of conduits both exposed and concealed; however, the Contractor shall install these conduits in such a manner to avoid all interferences.
- C. All Contractor personnel installing PVC coated rigid conduit shall be trained as specified herein.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions - SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL

1.3 REFERENCES

NFPA 70	National Electrical Code (NEC)
UL 467	Grounding and Bonding Equipment
UL 514	Standard for Safety Conduit, Tubing, and Cable Fittings

1.4 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification section.

1.5 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Conduit identification methods and materials.

3. Evidence of training (e.g. Certificates of Completion) for all Contractor personnel that will install PVC coated rigid conduit. Training shall be as specified herein.
4. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.2 CONDUITS

- A. Unless specified otherwise herein, or indicated on the Drawings, all conduits shall be rigid, aluminum conduit. Minimum size conduit shall be 3/4 inch unless otherwise indicated on the Standard Details. Unless specified otherwise herein or indicated on the Drawings, all encased conduits shall be PVC Schedule 40, minimum size 1 inch. The Contractor, at his option, for ease of installation to accommodate saddle size, may increase the size of encased conduits to 2-inch. However, no combining of circuits/conductors will be permitted in these larger conduits.
- B. All components (fittings, couplers, connectors, etc.) of the conduit system shall be of the same or compatible material of construction. Coated conduit systems shall include factory coated fittings couplings, connectors, and other components compatible with and approved for coated conduit systems.
- C. Rigid Aluminum Conduit
 1. Aluminum conduits shall be rigid type, heavy walled as manufactured by Allied Tube and Conduit Corporation, Wheatland Tube Company, Jones & Laughlin Steel Company, or approved equal.
 2. Rigid aluminum conduit shall be manufactured of 6063 alloy in temper designation T1. Fittings shall be of the same alloy.
 3. Rigid aluminum conduit shall be listed by Underwriters' Laboratories to U.L. Standard 6A shall be manufactured to 262726 – Wiring Devices.
 4. Each length of conduit shall be shipped with a coupling on one end and a color-coded thread

protector at the other end.

D. Liquid-Tight Flexible Metal Conduit

1. Liquid-tight flexible conduit (LFMC) shall be galvanized steel, single strip, with a copper strip interwoven and suitable as a grounding means. LFMC shall be UL listed. LFMC shall have an extruded moisture and oil-proof PVC jacket. LFMC shall be Titan Type UL as manufactured by Southwire, Liguatite Type "LA" as manufactured by Electri-Flex, Anaconda Type UA as manufactured by Anamet Electrical, Inc., or approved equal.
2. PVC coated or stainless steel watertight connectors shall be used with liquid-tight flexible metal conduit on both ends. LFMC shall be used to connect all vibrating equipment installed outdoors, in wet or damp areas, and other applications as directed by the Engineer.

E. Rigid Nonmetallic Conduit

1. Rigid nonmetallic conduit shall be Schedule 40 polyvinyl chloride (PVC), 90°C, UL rated and shall conform to NEMA TC-2. Fittings and conduit bodies shall conform to NEMA TC3.
2. Rigid non-metallic conduit shall be as manufactured by Carlon, Triangle Conduit and Cable, Cantex, Inc., or approved equal.

F. PVC Coated Metallic Conduit

1. PVC coated rigid steel conduit shall be furnished and installed as specified herein and indicated on the Drawings. The product shall be rigid galvanized steel conduit covered with a bonded 40 mil (minimum) thickness PVC jacket and coated inside with urethane. The conduit shall comply with NEMA RN-1 and shall be "Plasti-Bond Red" as manufactured by Robroy Industries, "OCAL-Blue" as manufactured by Thomas & Betts, Perma-Cote Supreme by Perma-Cote Industries, Kor Kap equivalent, or approved equal.

G. Conduit Fittings

1. Fittings for all conduit types shall conform to UL 467 and UL 514 as applicable.
2. Fittings for electrical metallic tubing shall be rain-tight and concrete-tight and shall be plated steel hexagonal threaded compression type.
3. Set screw or indentor type connectors shall not be used. Fittings for conduit installed in wet locations and underground shall provide a watertight joint. Fittings for rigid conduit shall be threaded.
4. Fittings or bushings shall be installed in easily accessible locations.
5. Where exposed conduits pass across structural expansion joints, approved weatherproof telescopic type expansion fittings shall be used. Fittings shall be OZ/GEDNEY Type AX, Crouse-Hinds Type XJG, or approved equal, watertight, and permit movement up to 4 inches. Each fitting shall be equipped with approved bonding jumpers around or through each fitting.
6. Where embedded conduits pass through expansion joints, approved watertight, concrete-tight deflection/expansion fittings shall be used. Fittings shall compensate for movement of $\frac{3}{4}$ -inch

from the normal in all directions. Fittings shall be OZ/GEDNEY Type DX, Crouse-Hinds Type XD, or approved equal.

7. Conduit fittings ("condulets") shall be used on exposed conduit work for changes in direction of conduit runs and breaking around beams. "Condulets" shall be cast ferrous alloy, galvanized or cadmium plated, as manufactured by Crouse-Hinds, OZ/Gedney, Appleton Company, or approved equal. Coated fittings and boxes shall be used with coated conduit in all chemically aggressive areas or where called for on the Drawings. Covers shall be of a design suitable for the purpose intended. In damp areas, the outside condulets shall be made watertight. Install all condulets with the covers accessible. Use proper tools to assemble conduit system to prevent injury to the plastic covering. No damage to the covering shall be permitted.
8. Conduit fittings shall be cast type of non-ferrous metal or malleable iron thoroughly coated inside and outside with metallic zinc or cadmium after all machining has been completed. Cast fittings shall be provided with heavy threaded hubs to fit the conduit required. Covers shall be of the same material as the fittings to which they are attached and shall be screwed on with rubber or neoprene gaskets between the covers and fittings. Cast fittings 1-1/2 inches and above shall be of the "mogul" type.
9. PVC coated fittings shall be used with PVC coated conduit. All conduit nipples, elbows, couplings, boxes, fittings, unions, expansion joints, connectors, bushing, and other components of the raceway system shall be factory coated to maintain the corrosion-resistant integrity of the conduit system. The coated conduit and its respective components shall all be provided by the same manufacturer. Coated conduit shall be used in all areas specified herein or indicated on the Drawings.
10. Conduit seals shall be Type EYS as manufactured by Crouse-Hinds, Appleton equivalent, OZ/Gedney equivalent, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Conduit shall be installed concealed unless otherwise indicated or specified. Conduit may be run exposed on walls only where concealing is not practical, or at the direction of the Engineer. No additional cost may be incurred during construction for running conduit exposed.
- B. The load applied to fasteners shall not exceed 1/4 of the proof test load. Fasteners attached to concrete ceilings shall be vibration and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joints shall not cut the main reinforcing bars. Holes not used shall be filled. Spring steel fasteners are not permitted. Conduits shall be fastened to all sheet metal boxes and cabinets with two (2) locknuts where required by the National Electrical Code to ensure adequate bonding for grounding. Where insulated bushings are used, or where bushings cannot be secured firmly to the box or enclosure, a bonding jumper shall be installed to maintain suitable grounding continuity. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by the National Electrical Code.

- C. Conduit installed in concrete floor slabs or walls shall be located so as not to affect the designed structural strength of the slabs. Conduit shall be installed within the middle one-third of the concrete slab except where necessary to not disturb the reinforcement. The outside diameter of conduit shall not exceed one-third of the slab thickness, and conduits shall be spaced no closer than three (3) diameters except at cabinet locations. Curved portions of bends shall not be visible above the finish slab. Where embedded conduits cross expansion joints, suitable expansion/deflection fittings and bonding jumpers shall be provided. Conduit larger than 1-inch trade size shall be parallel with or at right angles to the main reinforcement. When at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab. Conduits shall not be stacked more than two (2) diameters high in floor slabs. Embedded conduits shall be placed in accordance with the latest edition of ACI-318.
- D. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings. Changes in outlet locations required to serve the equipment furnished by other Contractors on the Project shall be brought to the attention of the Engineer.
- E. Conduit passing through the walls and floors of buildings below grade shall be installed with appropriate watertight fittings to prevent the entrance of ground water around the periphery of the conduits. For vertical conduit penetrations through openings in concrete floors, the fittings shall be Type FSK Floor Seals as manufactured by OZ/Gedney. For conduit penetrations through openings in concrete walls, the fittings shall be Type WSK Thruwall seals as manufactured by OZ Gedney. Conduits shall be sloped away from the buildings toward splice boxes, handholes and/or manholes to provide drainage away from the building wall.
- F. Electric Metallic Tubing (EMT) style conduit is not permitted without special approval by the Engineer.

3.2 CONDUIT

- A. Unless otherwise specified herein or indicated on the Drawings, the minimum size conduit shall be 3/4 inch for exposed work and 1 inch for conduit encased in concrete or mortar. Multiple circuits may not be combined in the same conduit without the explicit written permission to do so by the Engineer.
- B. Conduit home runs for lighting circuits are not necessarily indicated on the Drawings; however, the circuit numbers are shown. Conduit shall be furnished and installed for these lighting circuits and shall be installed as required to suit field conditions, subject to review and acceptance by the Engineer.
- C. Where exposed, maintain a minimum distance of 6 inches from parallel runs of flues or water pipes. Conduit runs shall be installed in such locations as to avoid steam or hot water pipes. A minimum separation of 12 inches shall be maintained where conduit crosses or parallels hot water or steam pipes.
- D. For floor mounted equipment, conduit may be installed overhead and dropped down, where underfloor installation is not practical. Groups of conduits shall be uniformly spaced, where straight and at turns. Conduit shall be cut with a hacksaw or an approved conduit-cutting machine and reamed after threading to remove all burrs. Securely fasten conduit to outlets, junction and

pull boxes to effect firm electrical contact. Join conduit with approved couplings. Conduits shall be freed from all obstructions. Where conduit drops down, conduit shall be secured using Unistrut.

- E. Empty conduit systems shall be furnished and installed as indicated on the Drawings and shall have pull ropes installed. The polyethylene pull ropes shall be ¼” diameter, minimum. Not less than 12 inches of slack shall be left at each end of the pull rope.
- F. Each piece of conduit installed shall be free from blisters or other defects. Each piece installed shall be cut square, taper reamed, and a coat of galvanizing and conducting compound shall be applied to the threads. Galvanizing compound shall be CRC Zinc-It or approved equal. Threads on conduits shall be painted with a conducting compound prior to making up in a fitting.
- G. Conduit threaded in the field shall be of standard sizes and lengths.
- H. All bends shall be made with standard factory conduit elbows or field bent elbows. Field bending of conduit shall be done using tools approved for the purpose. Heating of conduit to facilitate bending is prohibited. Field bends shall be not less than the same radius than a standard factory conduit elbow. Bends with kinks shall not be acceptable.
- I. The equivalent number of 90 bends in a single conduit run are limited to the following:

1. Runs in excess of 300 feet:	0
2. Runs of 300 feet to 201 feet:	1
3. Runs of 200 feet to 101 feet:	2
4. Runs of 100 feet and less:	3
- J. Unless otherwise specified herein, indicated on the Drawings, or required by the NEC, conduit shall be supported every 8 feet (minimum) and shall be installed parallel with or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right angle turns consisting of fittings or symmetrical bends. Conduits shall be supported within 1 foot of all changes in direction. Supports shall be approved pipe straps, wall brackets, hangers or ceiling trapeze.
- K. In no case shall conduit be supported or fastened to another pipe or installed to prevent the removal of other pipe for repairs. Fastenings shall be by expansion bolts on concrete; by machine screws, welded threaded studs, or spring-tension clamps on steel work. Powder actuated fasteners may only be used to make connections where the use of this equipment complies with safety regulations and for structures in Seismic Design Categories A or B, unless the fasteners are approved for seismic use. Wooden plugs inserted in masonry and the use of nails as fastening media are prohibited. Threaded C-clamps may be used on rigid steel conduit only. Conduits or pipe straps shall not be welded to steel.
- L. Aluminum conduits shall not be in contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one hole cast straps with clamp-backs to space the conduit ¼” away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come into contact with concrete, CMU, brick or mortar. All penetrations shall meet or exceed the UL design standards. Aluminum conduit shall transition to PVC coated steel conduit where entering a concrete encasement, floor or ductbank.

- M. No more than three (3) 90 degree bends will be allowed in any one conduit run. Where more bends are necessary, a conduit or pull box shall be installed. All bends in 3/4-inch conduit shall be made with a conduit bender, and all larger sizes shall have machine bends. Joints in threaded conduit shall be made up watertight with the appropriate pipe thread sealant or compound applied to male threads only; and, all field joints shall be cut square, reamed smooth, and properly threaded to receive couplings. No running threads are permitted. All conduit ends at switch and outlet boxes shall be fitted with an approved locknut and bushing forming an approved tight bond with box when screwed up tightly in place.
- N. Conduits stubbed up through concrete floors for connections to freestanding equipment and for future equipment shall be provided with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Screwdriver operated threaded flush plugs shall be installed in conduits from which no equipment connections are made.
- O. Connections from rigid conduit to motors and other vibrating equipment, limit switches, solenoid valves, level controls, and similar equipment, shall be made with short lengths of liquid-tight flexible metal conduit. These conduits shall be installed in accordance with the NEC and shall be furnished and installed with appropriate connectors with devices which will provide an excellent electrical connection between the equipment and the rigid conduit for the flow of ground current. Flexible metal conduit and liquid-tight flexible metal conduit length shall be three (3) feet, maximum.
- P. Flexible liquid-tight flexible metal conduit installed between rigid metal conduit and motor terminal box and/or any other apparatus shall have a green insulated grounding conductor running through the flexible conduit. This conductor shall be terminated to the nearest pull box, motor terminal box, or any other apparatus ground terminal. Flexible metal conduit and liquid-tight flexible metal conduit shall be grounded and bonded per NEC Articles 348 and 350, respectively.
- Q. Conduits installed within or underneath floor slabs, underground direct-buried or concrete encased conduits, and all conduits installed in areas subject to liquid inadvertently entering the conduit system shall be sealed or plugged at both ends in accordance with NEC Article 300-5(g). This requirement applies to both conduits containing conductors and "spare" conduits. Where practicable, the interior of the conduit shall be sealed as well as around the conductors by using conduit sealing bushings: Type CSB as manufactured by O/Z Gedney, or approved equal. Where the conduit fill does not allow the use of these bushings, the conduits shall be tightly caulked or plugged.
- R. Conduits passing through sleeves in interior walls and floors shall be tightly caulked.
- S. The use of two (2) locknuts, one on each side of the enclosure, and a grounding bushing shall be required at all conduit terminations where hub type fittings are not required; such as electrical rooms, control rooms, and office areas.
- T. Conduit installation shall be arranged to minimize cleaning. No horizontal runs of conduit will be permitted in brick or masonry walls.
- U. Conduits shall not penetrate the floors or walls inside liquid containment areas unless specifically accepted by the Engineer.
- V. All conduits that are buried or encased in concrete that transition from the ground to any stationary structure or equipment shall be equipped with a longitudinal expansion coupling capable of at least

four inches of expansion. Conduits with encasement that is rigidly tied to the stationary structure in accordance with the Standard Details shall not be required to have expansion couplings.

- W. Raceways shall not be installed concealed in water-bearing walls and floors.
- X. All instrumentation wire and cable for analog signals shall be installed in rigid aluminum conduit or PVC coated rigid steel conduit to suit the application. This applies to all conduit installations including exposed, concealed in concrete encasement, and all other applications.
- Y. Other conduit uses not specifically listed above shall be brought to the attention of Engineer for a decision.

3.3 FITTINGS

- A. Conduit connections shall be made with standard coupling and the ends of the conduit shall butt tightly into the couplings. Where standard coupling cannot be used, Erickson three-piece couplings shall be used. Where conduits are installed in concrete, concrete-tight three-piece couplings shall be used.
- B. Weatherproof, insulated throat "Meyers" hubs shall be used on all conduit entries to boxes and devices without integral hubs in process areas to maintain NEMA 4X integrity. The Contractor shall furnish and install "Meyers" hubs on all conduit entries into non-cast enclosures such as metallic or non-metallic control panels, control component enclosures, wireways, pull boxes, junction boxes, control stations, and similar type equipment when this type of equipment is located in process areas requiring NEMA 4X integrity. This specified requirement for "Meyers" hubs does not apply to any area of the plant facilities where NEMA 4X integrity is not required.
- C. Weatherproof, insulated throat "Meyers" hubs shall be used on all conduit entries to boxes and devices without integral hubs in process areas to maintain NEMA 4X integrity. The Contractor shall furnish and install "Meyers" hubs on all conduit entries into non-cast enclosures such as metallic or non-metallic control panels, control component enclosures, wireways, pull boxes, junction boxes, control stations, and similar type equipment when this type of equipment is located in process areas requiring NEMA 4X integrity. This specified requirement for "Meyers" hubs does not apply to any area of the plant facilities where NEMA 4X integrity is not required.

3.4 RIGID METALLIC

- A. Conduit shall be protected immediately after installation by installing flat non-corrosive metallic discs and steel bushings, designed for this purpose, at each end. Discs shall not be removed until it is necessary to clean the conduit and install the conductors. Before the conductors are installed, insulated bushings shall be installed at each end of the conduit.
- B. Where "all-thread" nipples are used between fittings and electrical equipment, they shall be so installed that no threads are exposed.

3.5 PVC COATED RIGID METALLIC

- A. All PVC coated conduit shall be installed in accordance with manufacturer's instructions. The Contractor shall use tools that are specifically suited for coated conduit systems. The use of pipe wrenches and other such tools on PVC coated RGS conduit is prohibited. The Engineer and Owner reserve the right to reject any installation of coated conduit that does not meet the requirements of the Section or the manufacturer's instructions. The Engineer and Owner also reserve the right to reject any installation that exhibits damage due to the improper use of tools. All rejected installations shall be replaced by the Contractor at no additional cost to the Owner. The use of PVC coated conduit repair compounds to repair damages or improper installation is prohibited.
- B. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. The Contractor shall furnish evidence of such training as specified herein. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract for all coated conduit installation personnel. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit or shall be trained/re-trained as required prior to commencement of conduit installation.
- C. PVC coated rigid steel conduit shall be furnished and installed, where exposed, in the following areas:
 - 1. All outdoor locations.
 - 2. Pump rooms.
 - 3. Wet-Process Areas

3.6 RIGID NON-METALLIC PVC

- A. A non-metallic raceway containing instrumentation cable (if specifically allowed herein) where installed exposed shall be installed to provide the following clearances:
 - 1. Raceway installed parallel to raceway conductors energized at 480 through 208 volts shall be 18 inches and 208/120 volts shall be 12 inches.
 - 2. Raceway installed at right angles to conductors energized at 480 volts or 120/208 volts shall be 6 inches.
 - 3. Where practical, exposed raceways containing instrumentation cable shall cross raceway containing conductors of other systems at right angles.
- B. Install polyvinyl chloride (PVC) coated steel conduits when entering or exiting concrete except under electrical equipment where the conduit is not subject to physical abuse. Also install PVC coated steel conduit when transitioning between grade and a structure or an equipment stand. Extend stub-ups at least 12 inches above and below grade or finish floor. Conduits extending through the concrete floor shall be installed using straight runs (for vertical penetrations) or factory elbows (for conduits installed within the slab) of PVC coated rigid steel conduit.

- C. All conduit extending through the floor behind panels or into control centers or similar equipment may be PVC Schedule 40 and shall extend a minimum of 6 inches above the floor elevations, where practicable, with no couplings at floor elevations.
- D. Unless specifically identified on the Drawings as "Direct Buried," all conduits in the earth, including conduits below slabs-on-grade, shall be concrete encased. Joints in conduit shall be staggered so as not to occur side by side. Rigid non-metallic (PVC) conduit shall be connected to PVC coated rigid steel conduit at the point where it leaves the ground, with the transition to metal conduit occurring inside the concrete encasement.
- E. Install non-metallic conduits in accordance with manufacturer's instructions where specified herein or indicated on the Drawings.
- F. Join non-metallic conduit using cement as recommended by the manufacturer. Clean and wipe non-metallic conduit dry before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for twenty (20) minutes (minimum).
- G. No PVC conduit shall be installed exposed unless specifically accepted in writing by the Engineer. Where PVC conduit is allowed to be installed exposed, the conduit shall be Schedule 80.
- H. PVC Schedule 40 conduit shall be furnished and installed in concrete slabs (for slab-on-grade construction) and in walls when the conduit is shown to be encased. Rigid steel conduit shall be installed in all elevated slabs when the conduits are shown to be encased.
- I. PVC Schedule 40 conduit shall be installed in reinforced concrete encasement. Conduit shall be "direct buried" only if specifically indicated on the Drawings.

3.7 LIQUID TIGHT FLEXIBLE METAL CONDUIT

- A. Installed length shall be less than 24 inches unless otherwise approved by the Engineer. Conduit shall be supported as required by the NEC and apply no strain to the connected devices.
- B. Liquid-tight flexible metal conduit shall be used for all motor connections and where vibrating or moving devices that are located in wet locations, hazardous locations, or outside.

3.8 CONDUIT IDENTIFICATION

- A. Refer to specification 260553 for exact identification requirements.
- B. Where there is an existing labelling system, the identification system for the conduits furnished and installed under this Contract shall match the existing identification system used at the facility.

3.9 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions. The following tests are required:
 - 1. Field Tests

- a. Field testing shall be done in accordance with the requirements specified in the General Conditions, and Basic Electrical (See Referenced Sections).
- b. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling tape.

END OF SECTION 260533.23

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull and junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.
- B. The types of electrical identification specified in this section include, but are not limited to, the following:
 - 1. Operational instructions and warnings.
 - 2. Danger signs.
 - 3. Equipment/system identification signs.
 - 4. Nameplates.

1.2 SIGNS

- A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.3 LETTERING AND GRAPHICS

- A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.4 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Submittals the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.5 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:

1. Product data sheets.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.2 NAMEPLATES

- A. Nameplates shall be engraved, high pressure plastic laminate, white with black lettering.
- B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or equal.

2.3 HIGH VOLTAGE SIGNS

- A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

2.4 WIRE AND CABLE IDENTIFICATION

- A. Field installed wire and cable identification shall be as specified in Section 260519 Low Voltage Power Conductors and Cables.
- B. A plastic laminate nameplate shall be provided at each panelboard, motor control center, switchgear assembly, and switchboard assembly. This nameplate shall be used to clearly convey the conductor identification means used at that piece of equipment (i.e. Phase A=Brown, Phase B=Orange, C = Yellow).
- C. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective section.

2.5 BOX IDENTIFICATION

- A. Pull, junction, and device box identification shall be as specified in Section 260533.16 – Boxes for Electrical System.

PART 3 - EXECUTION

3.1 NAMEPLATES

- A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.2 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.3 POWER SOURCE IDENTIFICATION

- A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.
- B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.
- C. Nameplates shall be as specified herein.

END OF SECTION 260553

SECTION 260573 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section. Should there be any conflict between provisions or requirements elsewhere indicated and the provisions of this division, request written clarification by addendum prior to submission of bid or abide by the interpretation of the Engineer.

1.2 SUMMARY

- A. General: This section specifies that the Contractor conduct the following power system studies for the electrical power distribution system.
 - 1. Short Circuit Study: Provide a complete short circuit study, equipment interrupting or withstand evaluation, and a protective device coordination study for the electrical power distribution system serving the wastewater treatment facility. The studies shall include all portions of the electrical power distribution system from the utility primary service drop through and including the 480 volt bus.
 - 2. Protective Device Coordination Study: A protective device coordination study shall be performed to determine proper selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and circuit breaker trip characteristics and settings. Study shall include coordination with upstream utility devices.
 - 3. Flash Hazards Analysis: A flash hazard analysis shall be conducted to determine the arc-flash incident energy at all power distribution and control equipment and to establish the flash protection boundary for said equipment. The scope of the analysis shall also include the preparation and installation of warning labels for all power distribution equipment.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with the requirements of Specification 16050.
 - 1. The reports specified in paragraph 260573-2.1. The report shall be approved by the Construction Manager prior to releasing any power distribution equipment for manufacture.
 - 2. Sample of the arc flash hazard warning label.
 - 3. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (in the margin adjacent to the beginning of the paragraph) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part

of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

1.4 QUALITY ASSURANCE

A. Qualifications: The studies shall be performed, sealed and signed by a professional engineer registered in the State of North Carolina. The individual responsible for performing the studies and preparing the reports shall be an employee of an independent testing firm and shall have a minimum of ten (10) years experience in power system analysis.

B. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and the National Electrical Code, NFPA 70.

2. Institute of Electrical and Electronic Engineers (IEEE) Compliance: Study and analysis procedures shall comply with the following standards:

IEEE 141	Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE 399	Recommended Practice for Industrial and Commercial Power Systems Analysis.
IEEE 1584	Guide for Performing Arc Flash Hazard Calculations

3. National Fire Protection Association (NFPA) Compliance: Study and analysis procedures shall comply with the following standards:

NFPA 70E	Electrical Safety in the Workplace
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PART 2 - PRODUCTS

2.1 REPORT

A. General: The product shall be a certified report summarizing the short circuit, protective device coordination, and arc flash hazard studies and provide conclusions and recommendations which may affect the integrity of the electric power distribution system.

B. Short Circuit Analysis: The short circuit analysis shall be performed with the aid of a digital computer program and shall be performed in accordance with IEEE Standards 141 and 242 and shall utilize the ANSI method of short circuit analysis in accordance with ANSI C37.010. Short circuit interrupting and momentary duties shall be determined for an assumed three phase bolted fault at each pad-mounted transformer primary terminal and secondary terminals, low voltage switchgear and switchboard, motor control centers and distribution panelboards. A ground fault current study shall be provided for the same system areas.

C. Normal system operating method, alternate operation, standby power operation, and operations which could result in maximum fault conditions shall be thoroughly addressed in the study. The study shall assume all motors operating at rated voltage with the exception that motors identified

as standby shall not be included as fault current sources. Power distribution equipment bus impedance shall be assumed zero. The study shall be based on actual equipment data.

1. Content: The short circuit study shall include the following information:
 - a. The equipment manufacturer's published information used to prepare the study.
 - b. Assumptions made during the study.
 - c. Identification of calculation methods employed in the study.
 - d. One-line diagram of the power distribution system. The following information shall be either indicated on the one-line diagram or tabulated within the report:
 - i. Location and function of each protective device in the system.
 - ii. Type designation, current rating, range or adjustment, manufacturer's style and catalog number for all protective devices.
 - iii. Power, voltage ratings, impedance, and primary and secondary connections of all transformers.
 - iv. Type, manufacturer, and ratio of all instrument transformers energizing each relay.
 - v. Nameplate ratings of all motors and generators with their subtransient reactances. Transient reactances of synchronous motors and generators and synchronous reactances of all generators.
 - vi. Sources of short circuit currents such as utility ties, generators, synchronous motors, and induction motors.
 - vii. All significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc.
 - e. Tabulation of all data used as input to the report including cable impedances, source impedances, equipment ratings, etc.
 - f. Fault current calculations including a definition of terms and guide for interpretation of computer-generated results.
 - g. Tabulation of results at each bus including fault impedance, X/R ratios, asymmetry factors, motor and generator contributions, short circuit kVA and symmetrical and asymmetrical fault currents.
 - h. Evaluation of results including a tabulation of equipment short circuit interrupt and withstand ratings and available fault currents at each device.
 - i. Conclusions and recommendations.
2. Utility System Impedance: Contractor shall be responsible for obtaining system impedance information from utility company. Actual transformer impedances and fault currents shall

be used in the study unless a more conservative approach is taken. Regardless of the approach proposed, the utility impedance data shall be provided in the study.

D. Protective Device Coordination Study: A protective device coordination study shall be conducted in accordance with the National Electrical Code and the recommendations of IEEE Standard 399 to select and to verify the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and circuit breaker trip characteristics and settings. The coordination study shall include all voltage classes of equipment from the utility's incoming line protective device down to and including the main device of each 208 volt AC panelboard.

1. Content: The protective device coordination study shall include time-current curve sets graphically indicating the coordination proposed for the system. Time-current curves shall be plotted on full-size, 5-cycle, log-log graph paper with a maximum of eight protective devices per plot. Device time-current characteristics shall be based on the published time-current curves for the equipment manufacturer proposed for use on this project. The coordination study time-current plots shall, at a minimum, include the following:
 - a. Time-current curve for each protective relay or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and the tap and time dial settings shall be specified.
 - b. Time-current curves for each device shall be positioned to provide for maximum selectivity to minimize system disturbances during fault clearing. Reasonable coordination intervals and separation of characteristic curves shall be maintained
 - c. Time-current curves and points for cable and equipment damage and symmetrical and asymmetrical fault currents.
 - d. Circuit interrupting device operating and interrupting times.
 - e. Maximum fault values.
 - f. Transformer full load currents, magnetizing inrush current, and ANSI withstand parameters.
 - g. Motor starting curves.
 - h. Pertinent generator characteristics.
 - i. Sketch of bus and breaker arrangement.
 - j. Tabulation of all device settings including tap, time dial, pickup, instantaneous, and time delay settings.
 - k. Conclusions and recommendations pertinent to final system coordination and selectivity.
 - l. Discrepancies, problem areas, or inadequacies shall be clearly identified.

- E. Flash Hazard Analysis: A flash analysis shall be conducted in accordance with the recommendations of IEEE Standard 1584 and NFPA 70E. The flash analysis shall address all power distribution and control equipment with potential to produce an arc flash when energized. The flash hazard analysis shall include the following:
1. Calculation of the flash protection boundary.
 2. Calculation of the arc-flash incident energy.
 3. Preparation and installation of all required warning labels. Warning labels shall be in accordance with the latest ANSI Z535.4 standards and shall minimally identify the equipment by type and designation, the arc flash boundary, and the type of personal protective equipment required.
 4. Identify the required personal protective equipment with arc rating to provide adequate protection for personnel working on or near energized equipment or conductors.

PART 3 - EXECUTION

3.1 DATA COLLECTION

- A. The Contractor shall be responsible for obtaining and verifying all data required in preparation of the studies.

3.2 FIELD SETTINGS

- A. The results of the approved short circuit and protective device coordination study shall establish the final field settings for all protective devices. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Owner.

END OF SECTION 260573

SECTION 260800 - ELECTRICAL TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions, apply to Work of this Section. Should there be any conflict between provisions or requirements elsewhere indicated and the provisions of this division, request written clarification by addendum prior to submission of bid or abide by the interpretation of the Engineer.

1.2 SUMMARY

- A. This section specifies the acceptance testing of electrical materials, equipment and systems. Contractor shall provide all labor, tools, material, power and other services necessary to provide the specified tests.

1.3 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions - SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL

1.4 REFERENCES

- A. General: This section contains references to the InterNational Electrical Testing Association (NETA), ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems. It is a part of this section as specified and modified. In case of conflict between the requirements of this section and those of said document, the requirements of this section shall prevail.
- B. Safety and Procedural Requirements:
 - 1. Safety and Precautions: This specification does not include specific safety procedures. It is recognized that tests and inspections set forth by this specification may be potentially hazardous. Consequently, individuals performing these tests must be capable of conducting these tests in a safe manner and with complete knowledge of the hazards involved. Each person involved in this project must be provided with and use appropriate personal protective equipment.
 - 2. Safety practices that shall be followed include, but are not limited to, the following:
 - a. Occupational Safety and Health Act.
 - b. Accident Prevention Manual for Industrial Operations, National Safety Council.
 - c. Applicable state and local safety operating procedures.
 - d. Owner's safety practices.

3. Perform all testing work in accordance with the applicable codes and standards of the following agencies except as provided otherwise herein:
 - a. InterNational Electrical Testing Association – NETA Acceptance Testing Specifications (ATS).
 - b. National Fire Protection Association.
 - c. National Electrical Code, ANSI/NFPA 70.
 - d. Recommended Practice for Electrical Equipment Maintenance, ANSI/NFPA 70B.
 - e. Electrical Safety Requirements for Employee Workplaces, NFPA 70E.

1.5 APPLICATION

- A. General: Requirements for testing in accordance with this section are specified in this and other sections of Division 16. Where testing in accordance with this section is required, the required tests, including correction of defects where found, and subsequent retesting, shall be completed prior to energization of material, equipment or systems.

1.6 SUBMITTALS

- A. General: Submit the following in accordance with the requirements of Specification 260500 – Common Work Results for Electrical.
- B. Description of all test procedures.
- C. Examples of test report forms for all specified tests including deficiency report forms.
- D. Final test report.
- E. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (in the margin adjacent to the beginning of the paragraph) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- F. Submittal Presentation: Submittal data shall be assembled in folders or three-ring binders. Each folder or binder shall contain a cover sheet, indexed by item and cross-referenced to the appropriate specification paragraph. Catalog cuts shall be edited to show only the items, model numbers, and information that applies to the equipment being furnished.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT AND MATERIALS

- A. General: Test instruments shall be calibrated to references traceable to the National Institute of Standards and Technology and shall have a current sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required.
- B. NETA Compliance: Test equipment shall be in complete compliance with the latest edition of the ATS, Paragraphs 5.2 and 5.3.

PART 3 - EXECUTION

3.1 GENERAL

- A. The test procedures to be conducted by the Installing Contractor are defined as those tests specified in this spec 260800 .

3.2 TEST DOCUMENTATION

- A. Inspection and Test Procedures Documentation: Test procedure documentation shall be submitted in accordance with paragraph -260800.1.6.
- B. Test Report Forms: The test report forms are appended to the end of this section.
- C. Deficiency Reports: Deficiency reports shall be prepared for each item under test and submitted to the Engineer at the end of each day of testing. Deficiency reports shall identify the equipment under test by tag number and location and shall describe all deficiencies observed through the course of inspection and testing.

3.3 EQUIPMENT TESTING

- A. General: The inspection and test procedures described by the latest edition of the ATS, Section 7 shall establish the minimum requirements for electrical equipment inspection and testing. Additional test procedures, beyond the scope of ATS, Section 7, are defined herein and shall be conducted as specified.
- B. Installing Contractor Tests: The following types of equipment and/or systems shall be inspected and tested by the installing contractor:
 - 1. Insulation Resistance Tests: Insulation resistance tests shall be performed on the following types of equipment or systems:
 - a. Low Voltage (600 volt maximum) Power and Control Conductors and Cables: Insulation resistance tests shall be performed on all circuits 120 volts and above except interior lighting and 120 volt receptacle circuits.
 - 2. Power and control conductor and cable insulation tests shall be performed in accordance with the latest edition of the ATS, Paragraph 7.3.2. Tests may be conducted with motors and other equipment connected, except that solid-state equipment shall be disconnected unless the equipment is normally tested by the manufacturer at voltages in excess of 1000 volts DC.

3. The ambient temperature at which insulation resistance is measured shall be recorded on the test form.
4. Test results shall be evaluated against the results for cables of same type and length. Test results of less than 50 mega-ohms shall be investigated.

C. Signal Cables: All analog signal cables shall be tested as specified herein.

1. The loop resistance of each signal pair or triad shall be measured. Any pair or triad exhibiting a loop resistance of less than or equal to 50 ohms shall be deemed satisfactory. For pairs with greater than 50 ohm loop resistance, the Contractor shall calculate the expected loop resistance considering loop length and intrinsic safety barriers if present. Loop resistance shall not exceed the calculated value by more than 5 percent.
2. Each shield drain conductor shall be tested for continuity. Shield drain conductor resistance shall not exceed the loop resistance of the pair or triad.
3. Each conductor (signal and shield drain) shall be tested for insulation resistance with all other conductors in the cable grounded.
4. Instruments used for continuity measurements shall have a resolution of 0.1 ohms and an accuracy of better than 0.1 percent of reading plus 0.3 ohms. A 500 volt megohmmeter shall be used for insulation resistance measurements.

D. Test Records: Insulation resistance measurements shall be recorded on test report forms in compliance with Specification 260800 paragraph 3.3-B.

E. Pre-functional Checkout: Functional testing shall be performed in accordance with the requirements of this specification. Prior to functional testing, all protective devices shall be adjusted and made operative. Prior to energization of equipment, all system component tests shall be completed and the Contractor shall perform a functional checkout of the control circuit. Checkout shall consist of energizing each control circuit and operating each control, alarm or malfunction device and each interlock in turn to verify that the specified action occurs. The Contractor shall submit a description of his proposed functional test procedures prior to the performance of functional checkout.

F. Witnessing:

1. The ENGINEER reserves the right to observe all CONTRACTOR testing. The ENGINEER shall be notified five (5) days prior to testing.

3.4 TEST RESULTS

- A. General: Minimum acceptable test values shall be as specified in this specification and ATS. Where acceptable test values are not specified, the equipment manufacturers recommended test values shall be used.

END OF SECTION 260800

Form 260800-A

Wire and Cable Resistance Test Data Form

Wire or Cable Number: _____ Date of Test: _____

Temperature, Degrees F: _____

Location of Test	Insulation Resistance, megohms
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

Form 260800-B
Signal Cable Resistance Test Data Form

Loop Number: _____

List all wiring associated with the loop in the table below. Make applicable measurements as indicated after disconnecting wiring.

Wire No.	Panel Tie	Field TB	Continuity Resistance		Insulation Resistance			
			Cond/Cond	Cond/Shield	Shield/Cond	Shield/GND	Cond/GND	Shield/Shield
A			--	(A/SH)				
B			(A/B)	--				
C			(A/C)	--				
D			(A/D)	--				

Continuity Test: Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of plus/minus 2 ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.

Insulation Test: Connect one end of a 500 volt megohmmeter to the panel ground bus and the other end sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

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SECTION 260916 - ELECTRICAL CONTROLS AND RELAYS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.
- B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL
- D. Section 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.3 REFERENCES

NEMA 250	Enclosures for Electrical Equipment
UL 508A	Standard for Industrial Control Panels
UL-1203	Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
ANSI/ISA	NonIncendive Electrical Equipment for use in Class I and II, Division II Hazardous (Classified) locations.
UL 489	Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures

1.4 ACTION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Product Datasheets.
- C. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each

Drawing related to this Specification Section.

1.5 INFORMATION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Prior to start-up, submit manufacturer's operation and maintenance manuals and recommended spare parts list, including but not limited to:
 - 1. Manufacturer's equipment warranty.
 - 2. Copies of Submittals
 - 3. Functional descriptions, operating instructions, calibration and adjustment, recommended maintenance, safety
 - 4. Contact information for local representative and supplier

1.6 TOOLS AND SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. In addition to the manufacturer recommended spare parts, the following spare parts shall be provided for the local control stations:
 - 1. One (1) contact block of each type furnished on the project
 - 2. One (1) indicating light lens of each color furnished on the project
 - 3. One (1) LED lamp of each color furnished on the project
 - 4. One (1) Control Relay of each type furnished on the project
 - 5. One (1) Timing Relay of each type furnished on the project
 - 6. One (1) Contact and Coil Kit for each type of motor starter furnished on the project
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.

PART 2 - PRODUCTS

2.1 CONTROL COMPONENTS

A. Pilot Devices

1. General

- a. All pilot devices shall be provided with a legend plate. Legend plates shall have a white background and black lettering and indicate the function of the respective pilot device. The text shown on the Drawings or indicated in the specifications shall be used as the basis for legend plate engraving (i.e., HAND-OFF-AUTO, RUN, EMERGENCY STOP, etc.).
- b. All pilot devices shall be selected and properly installed to maintain the NEMA 250 rating of the enclosure in which they are installed. All pilot devices shall be UL 508 Listed.
- c. All pilot devices shall be 30.5mm in diameter, unless otherwise indicated. 22mm devices are not acceptable.
- d. Pilot devices for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
- e. In Class I Division 2 hazardous locations, pilot devices shall be the hermetically sealed type, constructed in accordance with ANSI/ISA.

2. Pushbuttons

- a. Pushbuttons shall be non-illuminated, black in color, and have momentary style operation unless otherwise indicated on the Drawings.
- b. Pushbuttons shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each pushbutton. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.
- c. Pushbuttons shall be provided with a full guard around the perimeter of the button. Where a lockout style pushbutton is specified or indicated on the Drawings, provide a padlock-able guard.

3. Selector Switches

- a. Selector switches shall be non-illuminated, black in color, and have the number of maintained positions as indicated on the Drawings and as required. Handles shall be the extended type that provide a greater surface area for operation.
- b. Selector switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall

be installed at each selector switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

- c. Where indicated in the Drawings or Specifications, provide spring return positions.
- d. Selector switches shall be provided with an indexing component that fits into the keyed portion of the cutout for the device and prevents the switch from spinning when operated.

4. Indicating Lights

- a. Indicating lights shall LED type, with the proper voltage rating to suit the application, and push-to-test feature.
- b. Indicating light lens colors shall be as required in equipment specifications and/or as indicated on the Drawings. If lens colors are not indicated, the following colors shall be used:

Red	"Run", "On", "Open"
Green	"Off", "Closed"
Amber	"Alarm", "Fail"
White	"Control Power On"
Blue	General Status

5. Emergency Stop and Tagline Switches

- a. Emergency stop switches shall be non-illuminated, red in color, with a minimum 35mm diameter mushroom head. Once activated, switch shall maintain its position and require a manual pull or twist to release/reset.
- b. Tagline switches shall have a plunger that activates upon tension from the associated safety cable. Once activated, switch shall maintain its position and require a manual release/reset.
- c. Emergency stop and tagline switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

B. Relays and Timers

1. General

- a. Relays and timers shall be furnished with an integral pilot light for positive indication of coil energization.
 - b. Relays and timers shall have tubular pin style terminals with matching 11-pin DIN rail mount socket. Spade or blade style terminals are not acceptable.
 - c. Relays and timers for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
 - d. Relays and timers shall fit a standard 11-pin tubular pin socket.
2. Control and Pilot Relays
- a. Miniature or “ice-cube” type relays are not acceptable.
 - b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.
 - c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have 3-pole, double-throw (3PDT) contact arrangement.
3. Time Delay Relays
- a. Timers delay relays shall utilize electronic timing technology. Mechanical or thermal timing devices are not acceptable.
 - b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.
 - c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have double-pole double-throw (DPDT) contact arrangement.
 - d. Time delay ranges shall be as indicated on the Drawings and/or as required to suit the application. Timing range shall be adjustable from the front of the relay. On delay and off delay timer configurations shall be provided as indicated on the Drawings and/or as required to suit the application.
4. Elapsed Time Meters
- a. Elapsed time meters shall be non-resettable type with no less than a 6-digit display. Coil voltage shall be as required to suit the application and/or as indicated on the Drawings.
- C. Control Terminal Blocks
1. Control terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or subpanel. Terminals shall be tubular screw type with pressure plate that will accommodate wire size range of #22 - #8 AWG.
 2. Control terminal blocks shall be single tier with a minimum rating of 600 volts and 20A.

Separate terminal strips shall be provided for each type of control used (i.e., 120VAC vs. 24VDC). Quantity of terminals shall be provided as required to suit the application. In addition, there shall be enough terminals for the termination of all spare conductors.

3. Terminals shall be marked with a permanent, continuous marking strip, with each terminal numbered. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

2.2 MOTOR STARTERS

1. Motor starters shall conform to NEMA Standard IC1 and shall be for across-the-line starting, unless otherwise indicated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment. The size of the starter shall be as required for the particular load. Minimum starter size shall be NEMA Size 1.
2. A suitable control disconnect device(s) to comply with the requirements of the NEC shall be provided.
3. Magnetic starters and contactors shall be electromagnetic vertical or horizontal lift design with double break cadmium oxide silver contacts. Design shall meet or exceed the requirements of UL and NEMA Standards. Coils shall be hot molded construction to protect the coils from mechanical and environmental damage. Contacts and coils shall be replaceable without replacing the entire starter assembly.
4. Each starter shall be able to accommodate a minimum of three (3) auxiliary contacts in addition to the hold-in contact.
5. Each starter shall be supplied with a 3 pole, manual reset overload relay. The relays shall be solid state type, with at least one isolated normally open and one isolated normally closed auxiliary contact that operates when a trip condition has occurred. Relays shall be self-powered, have a visible trip indicator, have a trip test function, and have selectable Class 10 or 20 operation. Overload relays shall be set for Class 10 operation unless otherwise directed by the Engineer. Overload relay shall have phase loss protection built in to trip the unit and protect the motor against single phasing. The Contractor shall provide the overload relay model with the correct current range for each application. Overload relay shall have adjustable current range dial. Eutectic alloy or bi-metallic type overload relays are not acceptable.
6. Each motor starter coil shall be equipped with a surge-suppression device for protection of the solid-state equipment (e.g., programmable logic controller) wired as part of the control circuit.
7. The minimum control power transformer VA requirements are shown below. Control power transformers shall be sized as required for the connected loads, plus 25% spare capacity.

Size 1	75 VA
Size 2	75 VA
Size 3	200 VA
8. The Contractor is advised to review the Contract Documents for additional requirements for

space heaters, power factor correction capacitors, and similar equipment which may not be specified in this Division or shown on the Drawings. Control power transformers shall be fused or circuit breaker protected on both the primary and secondary sides as shown on the Drawings.

2.3 CIRCUIT BREAKERS

- A. Circuit breakers shall be molded case type with trip and frame ratings as indicated on the Drawings. Provide electronic trip unit where indicated on the Drawings, with adjustable functions as indicated on the Drawings. Provide adjustable instantaneous trip for all circuit breakers rated 100 amps or greater.
- B. The Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- C. Circuit breakers shall have an interrupting rating of 65,000 amperes symmetrical at 480 VAC, unless otherwise indicated on the Drawings.
- D. Circuit breakers in non-hazardous locations shall be UL 489 Listed. Circuit breakers in hazardous locations shall be UL 1203 Listed.
- E. Circuit breakers shall be quick-make, quick-break and with an interlocked cover which cannot be opened when the breaker is in the "ON" position and capable of being locked in the "OPEN" position. An interlock defeat to allow opening while energized shall be provided.
- F. Where indicated on the Drawings, circuit breakers shall be 100% rated.
- G. Circuit breakers shall be NEMA style construction, IEC style circuit breakers are not acceptable.
- H. Manufacturer shall be:
 - 1. Square D Company (Schneider Electric)
 - 2. Eaton
 - 3. Siemens Energy and Automation
 - 4. Or Approved Equal

2.4 LOCAL CONTROL STATIONS

- A. Local control stations shall be furnished and installed complete with pushbuttons, selector switches, indicating lights, and other devices as indicated on the Drawings.
- B. Specific devices installed in local control stations shall be provided in accordance with the requirements specified elsewhere in this Section.
- C. In non-hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

- D. In hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class I, Division 2, Group D	NEMA 7

- E. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs. Conduit hubs shall be external to the enclosure.
- F. Local control stations for use in non-hazardous locations shall be UL-508 Listed. Local control stations for use in Class I Division 1 and Class II Divisions 1/2 hazardous locations shall be UL-1203 Listed. Local control stations for use in Class I Division 2 hazardous locations shall be in accordance with ANSI/ISA.
- G. Provide a nameplate on each local control station in accordance with Basic Electrical (See Referenced Sections). The name and/or number of the equipment associated with each control station shall be engraved on the nameplate, followed by the words "LOCAL CONTROL STATION".

2.5 Manufacturer shall be:

1. Siemens Energy and Automation
2. Eaton
3. Square D (Schneider Electric)
4. Allen-Bradley
5. Or Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Local control stations shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.
- B. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices.
- C. Pilot devices shall be properly bonded to the equipment enclosure door where they are installed.

If proper bonding cannot be achieved through the locknuts that affix the device in place, a green colored bonding screw shall be provided on the pilot device. The bonding screw shall be bonded to the equipment enclosure using an insulated green bonding conductor.

- D. Local control station covers shall be bonded to the local control station enclosure using an insulated green bonding conductor.
- E. Wiring to devices at each local control station shall be provided with enough slack to permit the local control station cover to be removed and pulled at least 6 inches away from the enclosure.
- F. Terminal strips, relays, timers, and similar devices shall not be installed on the rear of the panel/cabinet doors. Terminal strips, relays, timers, and similar devices shall not be installed on the side walls of panel/cabinet interiors without written permission from the Engineer.

END OF SECTION 260916

SECTION 262200 - LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish, install, and test transformers for power and lighting distribution systems as specified herein, as indicated on the Drawings, and as required to complete the electrical installations.
- B. All equipment specified in this Section shall be furnished by the transformer manufacturer who shall be responsible for the suitability and compatibility of all included equipment.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL

1.3 REFERENCES

UL 1561	Dry Type General Purpose and Power Transformers
	U.S. Department of Energy 2016 Efficiency
NFPA 70	National Electric Code
NEMA ST-20	Dry Type Transformers for General Applications
ANSI C57	Standard General Requirements for Dry Type Distribution and Power Transformers

1.4 ACTION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and as specified herein.
- B. Product Datasheets.
- C. Layout Drawings - Show complete transformer layout, including materials, sizes, locations, and dimensions.
- D. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.5 INFORMATION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and as specified herein.
- B. Prior to start-up, submit manufacturer's operation and maintenance manuals and recommended spare parts list, including but not limited to:
 - 1. Manufacturer's equipment warranty.
 - 2. Copies of Submittals
 - 3. Functional descriptions, operating instructions, calibration and adjustment, recommended maintenance, safety
 - 4. Contact information for local representative and supplier

1.6 TOOLS AND SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. Spare parts lists, included with the Shop Drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.7 HANDLING AND STORAGE

- A. Equipment shall be carefully transported, stored, handled, and set in place in a manner that will prevent damage, misalignment, and distortion to the equipment.
- B. Follow manufacturer's recommendations regarding handling and storage at all times prior to placing the equipment in service.

1.8 GUARENTEES AND WARRANTY

- A. The equipment manufacturer shall guarantee for a period of five (5) years starting at the time of Substantial Completion, that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer's recommendations. The manufacturer shall correct any breach in this warranty at their expense.

PART 2 - PRODUCTS

2.1 DRY TYPE TRANSFORMERS

- A. Furnish and install single-phase and three-phase general purpose, dry-type transformers, as specified herein and indicated on the Drawings. The transformers shall be 60 Hz, self-cooled,

quiet design insulated of the two-winding type.

- B. The transformers shall be UL 1561 Listed.
- C. The primary windings shall be rated 480 VAC for use on 3 phase systems and connected delta unless indicated otherwise on the Drawings. KVA ratings shall be as shown on the Drawings. Furnish transformers with two 2 1/2% primary taps above, and four 2 1/2% primary taps below rated voltage for transformers 15 KVA and above, and two 2 1/2% primary taps above, and two 2 1/2% primary taps below rated voltage for transformers less than 15 kVA. All taps shall be full capacity rated.
- D. The ratings of the secondary windings shall be as indicated on the Drawings.
- E. Transformers shall be designed for continuous operation at rated KVA, 24 hours a day, 365 days a year, with normal life expectancy as defined in IEEE 65 and ANSI C57.96. This performance shall be obtainable without exceeding 150 degrees Celsius average temperature rise by resistance or 180 degrees Celsius hot spot temperature rise in a 40 degrees Celsius maximum ambient and 30 degrees Celsius average ambient. The maximum coil hot spot temperature shall not exceed 220 degrees Celsius. All insulating materials shall be flame retardant and shall not support combustion as defined in ASTM Standard Test Method D 635. All insulating materials shall be in accordance with NEMA ST 20 Standard for a 220 degrees Celsius UL component recognized insulation system.
- F. Transformers shall meet Department of Energy 2016 Efficiency standards and be Energy-Star compliant.
- G. Transformer coils shall be of the continuous wound copper construction and shall be impregnated with nonhygroscopic, thermosetting varnish.
- H. All cores are to be constructed of high grade, nonaging, grain-oriented silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be tightly clamped and compressed with structural steel angles. The completed core and coil shall then be bolted to the base by means of vibration absorbing mounts to minimize sound transmission. There shall be no metal to metal contact between the core and coil assembly and the enclosure.
- I. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees Celsius. Transformers shall be furnished with lugs of the size and quantity required and suitable for termination of the field wiring.
- J. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards.
- K. Transformers shall have core and coil assemblies mounted on rubber isolation pads to minimize the sound levels. Transformers shall not exceed the sound levels listed in NEMA ST-20.
- L. Transformers shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 3R, Painted Steel
Indoor Dry Process Area	NEMA 2, Painted Steel
Indoor Dry Non-process Area	NEMA 2, Painted Steel
All Outdoor Areas	NEMA 3R, Painted Steel

- M. The enclosure shall be made of heavy gauge steel and shall be degreased, cleaned, primed, and finished with a baked weather-resistant enamel using the manufacturer’s standard painting process.
- N. Manufacturer shall be:
 - 1. Square D (Schneider Electric)
 - 2. General Electric
 - 3. Eaton
 - 4. Siemens Energy and Automation
 - 5. Or Engineer Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The transformers shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer.
- B. Conduit routed to and from the transformer shall be arranged for easy removal of the transformer access covers.
- C. Where transformers 50 kVA and smaller are shown to be wall mounted, a transformer manufacturer supplied wall mounting kit shall be used. The lowest point of the wall mounting bracket shall be no lower than 7’-0” above the finished floor. Field fabricated mounting hardware is not acceptable unless reviewed and approved in writing by the Engineer.
- D. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.2 TESTING [AND STARTUP]

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Factory Shop Tests
 - a. The transformers shall be given routine factory tests in accordance with the requirements of the ANSI and NEMA standards. Temperature rises may be certified from basic design.

- b. As a minimum, the following tests shall be made on all transformers:
 - i. Ratio tests on the rated voltage connection and on all tap connections.
 - ii. Polarity and phase-relation tests on the rated voltage connection.
 - iii. Applied potential tests.
 - iv. Induced potential tests.
 - v. No-load and excitation current at rated voltage on the rated voltage connection.

2. Field Tests

- a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.
- b. Insulation between windings shall be tested by 1000 VDC Megaohmmeter for one (1) minute. Resistance value shall be no less than 100 Megaohms.

END OF SECTION 262200

SECTION 262300 - MEDIUM VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish, install, and test transformers for power and lighting distribution systems as specified herein, as indicated on the Drawings, and as required to complete the electrical installations.
- B. All equipment specified in this Section shall be furnished by the transformer manufacturer who shall be responsible for the suitability and compatibility of all included equipment.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL

1.3 REFERENCES

UL 1561	Dry Type General Purpose and Power Transformers
	U.S. Department of Energy 2016 Efficiency
NFPA 70	National Electric Code
NEMA ST-20	Dry Type Transformers for General Applications
ANSI C57	Standard General Requirements for Dry Type Distribution and Power Transformers

1.4 ACTION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and as specified herein.
- B. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated..
- C. Layout Drawings - Show complete transformer layout, including materials, sizes, locations, and dimensions.
- D. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the

deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.5 INFORMATION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and as specified herein.
- B. Prior to start-up, submit manufacturer's operation and maintenance manuals and recommended spare parts list, including but not limited to:
 - 1. Manufacturer's equipment warranty.
 - 2. Copies of Submittals
 - 3. Functional descriptions, operating instructions, calibration and adjustment, recommended maintenance, safety
 - 4. Contact information for local representative and supplier

1.6 TOOLS AND SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. Spare parts lists, included with the Shop Drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.7 HANDLING AND STORAGE

- A. Equipment shall be carefully transported, stored, handled, and set in place in a manner that will prevent damage, misalignment, and distortion to the equipment.
- B. Follow manufacturer's recommendations regarding handling and storage at all times prior to placing the equipment in service.

1.8 GUARENTEES AND WARRANTY

- A. The equipment manufacturer shall guarantee for a period of five (5) years starting at the time of Substantial Completion, that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer's recommendations. The manufacturer shall correct any breach in this warranty at their expense.

PART 2 - PRODUCTS

2.1 PAD-MOUNTED, LIQUID-FILLED TRANSFORMERS

- A. Description: ANSI C57.12.13, pad-mounted, 2-winding transformers suitable for outdoor use.
- B. All stainless steel tank and support pads with green factory finish paint and primer.
- C. Insulating Liquid: FR3 only, complying with ASTM D 1816 and tested according to ASTM D 877.
- D. Insulation Temperature Rise: 55/65 deg C when operated at rated kVA output in a 40 deg C ambient temperature. Transformer shall be rated to operate at rated kilovolt ampere in an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C without loss of service life expectancy.
- E. Basic Impulse Level: 95 kV on HV side, 30 kV on LV side.
- F. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.
- G. High-Voltage Switch: 200A minimum, make-and-latch rating of 10-kA RMS, symmetrical, arranged for radial feed with 3-phase, 2-position, gang-operated, load-break switch that is oil immersed in transformer tank with hook-stick operating handle in primary compartment.
- H. Primary Fuses: 15-kV fuse assembly with fuses complying with IEEE C37.47
 - 1. Externally replaceable without opening transformer tank.
 - 2. Current sensing expulsion fuse and partial range CLF.
- I. Surge Arresters: 18 kV MOVE, one for each primary phase; complying with IEEE C62.11 and NEMA LA 1; support from tank wall within high-voltage compartment. Transformers shall have three arresters for radial-feed circuits.
- J. High-Voltage Terminations and Equipment: Dead front with universal-type bushing wells for dead-front bushing-well inserts, complying with IEEE 386 and including the following:
 - 1. Bushing-Well Inserts: One for each high-voltage bushing well.
 - 2. Surge Arresters: Dead-front, elbow-type, metal-oxide-varistor units.
 - 3. Parking Stands: One for each high-voltage bushing well.
 - 4. Portable Insulated Bushings: Arranged for parking insulated, high-voltage, load-break cable terminators; one for each primary feeder conductor terminating at transformer.
- K. Accessories:
 - 1. Drain Valve: 1 inch (25 mm), with sampling device, valve and drain outside of terminal compartment
 - 2. Dial-type thermometer.
 - 3. Liquid-level gage.

4. Pressure-vacuum gage.
5. Pressure Relief Device: Self-sealing with an indicator.
6. Mounting provisions for low-voltage current transformers.
7. Mounting provisions for low-voltage potential transformers.
8. Busway terminal connection at low-voltage compartment.
9. Alarm contacts for gages and thermometer listed above.
10. CT's, relay and high resistance grounding neutral with Ethernet Modbus TCP/IP communications and alarming. Coordinate with MV Switchgear vendor.

2.2 CONDUCTORS, CONNECTORS, AND SPLICES

- A. Conductor Type ACC: Bare, aluminum conductor, complying with ASTM B 232/B 232M.
- B. Connectors, Splices, and Conductor Securing and Protecting Components: Items include wire clamps, ties, conductor armor, fittings, connectors, and terminals. Listed for the specific applications and conductor types and combinations of materials used. Descriptions as follows for various applications:
 1. Aluminum Composition to Aluminum Composition: Aluminum alloy, complying with UL 486A-486B.
 2. Connectors and Splices for Secondary Conductors: Listed and labeled for the conditions and materials involved in each application.
 3. Taps for Medium-Voltage Line Conductors: Hot-line clamps, screw type, with concealed threads and bare, hard-drawn copper stirrups. Listed for the combination of materials being connected.
 4. Splices under Tension: Compression type with strength exceeding the conductors spliced.
 5. Splices and Terminations for Covered Conductors: As recommended by conductor manufacturer for conductor and covering combination and for specific materials and physical arrangement of each splice.

2.3 HARDWARE AND ACCESSORIES

- A. Description: Ferrous-metal items include, but are not limited to, bolts, nuts, washers, crossarm gains and braces, insulator pins, anchor rods, anchors, eyebolts, staples, and transformer brackets.
 1. Comply with IEEE C135.1, IEEE C135.2, ANSI C135.4, ANSI C135.22, and RUS Informational Publication 202-1 listings with the exception that base material shall be malleable iron or ductile iron, and finish shall be hot-dip galvanized.
- B. Insulator Brackets: Hot-dip galvanized steel, style as indicated, designed to hold vertical-post-type or pin-type insulators, with one-bolt attachment to pole.

- C. Secondary Insulator Racks: Hot-dip galvanized steel, style as indicated, with smooth, rounded 12-gage struts designed to support three spool insulators for attachment of secondary drop conductors. Spool spacing of 8 inches.
- D. Pole Riser Shields: PVC
- E. Insulators: Units rated 6 kV and above shall be free from radio interference.
 - 1. Porcelain insulators shall be wet-process type, complying with the following:
 - a. Pin: ANSI C29.5.
 - b. Line Post: ANSI C29.7. Include mounting stud of length suitable for each mounting arrangement used.
 - c. Suspension: ANSI C29.2.
 - d. Guy Strain: ANSI C29.4.
 - e. Secondary Spool: ANSI C29.3, Class 53-2.
 - 2. Polymer-composite, fiberglass-reinforced insulators shall comply with the following:
 - a. Line Post: CEA LWIWG-02.
 - b. Dead End/Suspension: CEA LWIWG-01.
 - c. Guy Strain: Fiberglass reinforced, epoxy finished. Designed specifically for use in guy assemblies.

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 16075 "Electrical Identification."

2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Perform the following factory-certified tests on each transformer:
 - 1. Resistance measurements of all windings on rated-voltage connection and on tap extreme connections.
 - 2. Ratios on rated-voltage connection and on tap extreme connections.
 - 3. Polarity and phase relation on rated-voltage connection.
 - 4. No-load loss at rated voltage on rated-voltage connection.
 - 5. Excitation current at rated voltage on rated-voltage connection.
 - 6. Impedance and load loss at rated current on rated-voltage connection and on tap extreme

connections.

7. Applied potential.
8. Induced potential.
9. Temperature Test: If transformer is supplied with auxiliary cooling equipment to provide more than one rating, test at lowest kilovolt-ampere Class OA or Class AA rating and highest kilovolt-ampere Class OA/FA or Class AA/FA rating.
 - a. Temperature test is not required if record of temperature test on an essentially duplicate unit is available.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.
- B. Examine roughing-in of conduits and grounding systems to verify the following:
 1. Wiring entries comply with layout requirements.
 2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and that requirements in Section 16060 "Grounding and Bonding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers on pre-cast concrete bases.
 1. Anchor transformers to concrete bases according to manufacturer's written instructions, and seismic codes at Project.
- B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.3 IDENTIFICATION

- A. Identify field-installed wiring and components and provide warning signs as specified in Section 16075 "Electrical Identification."

3.4 CONNECTIONS

- A. Ground equipment according to Section 16060 "Grounding and Bonding."
- B. Connect wiring according to Section 16120 "Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing transformers but before primary is energized, verify that grounding system at substation is tested at specified value or less.
 - 2. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Test Reports: Prepare written reports to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.

END OF SECTION 262200

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The CONTRACTOR shall furnish, install, test and place in satisfactory operation, the low voltage switchboard as indicated on the Drawings and as specified herein.
- B. Drawings and General Provisions of Contract, including General and Supplementary Conditions, apply to Work of this Section. Should there be any conflict between provisions or requirements elsewhere indicated and the provisions of this division, request written clarification by addendum prior to submission of bid or abide by the interpretation of the ENGINEER.
- C. The main circuit breaker assembly shall serve as the service entrance equipment and shall be UL listed accordingly.
- D. The line-ups shall contain the main breaker, feeder breakers, metering equipment, control devices, and all accessories as specified herein, indicated on the Drawings, and as required to result in a complete and operable power distribution equipment assembly.
- E. The CONTRACTOR shall obtain the switchboard from a single manufacturer who shall manufacture the structure and major components, but is not limited to, circuit breakers, instrument transformers, meters, relays and controls.
- F. The switchboard shall be assembled using NEMA rated components; IEC rated components are not acceptable.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL
- D. Section 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- E. Section 260533.16 – BOXES FOR ELECTRICAL SYSTEMS
- F. Section 264300 – SURGE PROTECTIVE DEVICES

1.3 REFERENCES

NFPA 70	National Electric Code (NEC)
ANSI Standards	American National Standards Institute
UL 489	Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures
IEEE 141	Recommended Practice for Electrical Power Distribution for Industrial Plants

IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
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1.4 SUBMITTALS

- A. Each submittal shall be complete in all respects, incorporating all information required for evaluation of the proposed equipment’s compliance with the Contract Documents.
- B. Partial, incomplete or illegible submissions will be returned to the CONTRACTOR rejected without review.
- C. General: Submit the following in accordance with the requirements of Basic Electrical (See Referenced Sections) for each switchboard assembly.
 - 1. Complete assembly, layout, and installation drawings with clearly marked dimensions. Dimensions shall include height, length and width of the assemblies.
 - 2. Plan, front, side view drawings, including overall dimensions of each switchboard assembly. Identify shipping splits and show detailed top and bottom conduit windows.
 - 3. Manufacturer’s catalog data for all equipment and material provided under this section.
 - 4. Approximate total shipping weight of each assembly.
 - 5. Sample equipment nameplate data sheet.
 - 6. Internal wiring and connection diagrams of each low voltage switchboard assembly. Each wiring shall include wire identification and terminal numbers.
 - 7. Complete single line diagram for each assembly line-up comprising of, but not limited to, circuit breakers, control power and instrument transformers, meters, relays, and control devices. Clearly indicate electrical ratings of all devices.
 - 8. Bill of material list for each switchboard assembly.
 - 9. Manufacturer’s installation instructions.
 - 10. Manufacturer’s recommended spare parts. List shall indicate specific sizes, quantities and part numbers of the items. Term such as “1 lot of spare parts” are not acceptable.
 - 11. Manufacturer’s standard warranty.
 - 12. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (in the margin adjacent to the beginning of the paragraph) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. The submittal shall be accompanied

by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of equipment of types, sizes, and ratings required, whose products have in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and the National Electrical Code, NFPA 70.
 - 2. UL Compliance: Provide components that are listed and labeled by UL and comply with applicable UL standards.
 - 3. IEEE Compliance: Provide components that comply with the following standards:
 - IEEE Std. 141 Electrical Power Distribution for Industrial Plants
 - IEEE Std. 242 Protection and Coordination of Industrial and Commercial Power Systems
 - 4. NEMA Compliance: Comply with applicable construction and installation requirements of NEMA standards for service entrance equipment and accessories.
- C. Test Reports
 - 1. Furnish a certified report after the shop tests.
 - 2. Furnish a written report after the start-up.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment and components properly packaged. Utilize factory fabricated containers or wrappings for service entrance equipment and components which protect equipment from damage. Inspect equipment to ensure that no damage has occurred during shipment.
- B. Store equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.
- C. Handle entrance equipment carefully to prevent physical damage to equipment and components. Remove packaging, including the opening of crates and containers, avoiding the use of excessive hammering and jarring which could damage the electrical equipment contained therein. Do not install damaged equipment; remove from site and replace damaged equipment with new.

1.7 ENVIRONMENTAL CONDITIONS

- A. General: All switchboard components shall be rated for continuous operation in the configuration specified in an ambient temperature of -5 to 40 degrees Centigrade at the project site elevation specified in Basic Electrical (See Referenced Sections).

1.8 WARRANTY

- A. Without additional charge the manufacturer shall replace any work or material they have provided which develops defects within two years from date of acceptance.
- B. All materials and equipment shall be guaranteed against defective materials, design and workmanship.

1.9 TOOLS, SUPPLIES, AND SPARE PARTS

- A. The switchboard shall be furnished with all special tools (not readily available for purchase at local hardware store) necessary to disassemble, service, repair, and adjust the equipment and all spare parts as recommended by the equipment manufacturer.
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The CONTRACTOR shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the OWNER.

1.10 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The CONTRACTOR shall provide the services of a qualified manufacturer's technical representative who shall supervise the installation and testing of all equipment furnished under this Section.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS

- A. Manufacturers: The switchboards specified in this section shall be the product of a single manufacturer. Switchboards are specified on the basis of the following products for function and quality. Supply products modified as necessary by the manufacturer to provide the specified features and to meet specified operating conditions.

1. Eaton
2. Square D
3. General Electric
4. No Equal

The arrangement, dimensions, and characteristics of the equipment specified under this section are based on the above named manufacturer. Other manufacturer's products will not be

considered if the products do not have the ratings, features and functions specified herein.

2.2 APPLICATION

- A. General: Switchboards shall be rated 600 volts, 60 hertz, 3 phase, 3- or 4-wire as specified and shall be suitable for operation at the specified voltages and short circuit capacities indicated on the Drawings.
- B. Service Entrance Equipment: Switchboards shall be U.L. listed as "Service Entrance Equipment" where specified on the Drawings.

2.3 CONSTRUCTION

- A. Furnish and install dead-front type, completely metal enclosed, self-supporting electrical equipment including circuit breaker assemblies of number, rating and type as indicated on the Drawings. The equipment shall meet Underwriters' Laboratories requirements. The main breaker section shall be furnished with a U.L. Service Entrance label.
- B. The main breaker section and distribution sections shall be NEMA type 1 (gasketed) industrial use enclosures. The main circuit breaker section and distribution sections shall be totally accessible from the front. Equipment assemblies requiring rear access are not acceptable. Ventilation shall be provided as required.
- C. All painted parts shall be pretreated and provided with a corrosion-resistant, U.L. listed acrylic baked paint finish. The paint color shall be ANSI #61.
- D. The equipment assemblies shall be suitable for operation at the available fault current, 65 kAIC (minimum). The equipment assemblies shall be labeled to indicate the maximum available fault current rating, taking into account the structure, bussing, main circuit breaker and switchboard branch circuit devices. The short circuit rating shall not be less than the specified herein or indicated on the Drawings. The distribution switchboard branch circuit devices short circuit current rating shall be fully rated.
- E. All bus shall be tin-plated copper. The bussing shall be of sufficient cross sectional area to meet U.L. standard 891 for temperature rise. The fully rated main bus shall have a maximum ampacity as indicated on the Drawings and shall extend the full length of the equipment. The main buss shall be 100 percent rated. The ground bus shall be sized per U.L. standard 891, installed in the entire length of the equipment assemblies. The distribution switchboard bus shall be rated as required by the rating of the mounted branch devices, including spares and/or spaces. Full height vertical bus shall be provided to accommodate future circuit breakers; less than full height vertical bus shall not be acceptable.
- F. Provide engraved plastic nameplates to identify the main circuit breaker and each branch circuit breaker. The circuit number and circuit name shall appear on the nameplate in accordance with the single line diagram(s) as indicated on the Drawings.

2.4 MAIN CIRCUIT BREAKER ASSEMBLY

- A. The main circuit breaker shall fixed type, manually operated, low voltage power circuit breaker, with full-function trip system, sensors, and rating plug.

- B. The main circuit breaker shall be Magnum DS by Eaton, Square-D Company equivalent, or General Electric equivalent. The main circuit breaker shall be rated 65,000A RMS symmetrical at 480V and a two (2) second withstand rating of 30kA. The main circuit breaker shall be 100% rated with full function electronic trip unit as manufactured by Eaton, Square-D Company, or General Electric. The full function trip system shall have adjustable instantaneous, long-time pick-up and delay, short-time pick-up and delay, ground fault pick-up and delay, and trip indicator, minimum. The trip unit shall also have an arc flash reduction maintenance mode feature that allows specific alternate breaker settings to be programmed for use during maintenance periods. This reduced arc flash mode shall be capable of being armed via the trip unit, and the trip unit shall provide a dry contact to indicate when the system is in arc flash reduction mode.
- C. Provide control power and current transformers as required. Provide a minimum of two (2) auxiliary contacts for remote indication of breaker position.
- D. Provide shut trip such that a contact closure from a remote dry contact will open the circuit breaker.
- E. The main circuit breaker shall be furnished with a Power Expert 6000 as manufactured by Eaton, Square-D Company equivalent, or General Electric equivalent. All voltage and current transformers, fuses, wiring, and other devices shall be furnished and installed to produce a complete monitoring system. Power monitoring device shall be furnished with Modbus Ethernet communication capabilities. Power monitoring device shall be powered from the UPS and mounted no more than 5.5 feet or less than 4.5 feet from the horizontal centerline of the display to the floor.

2.5 DISTRIBUTION ASSEMBLY

- A. Each distribution switchboard shall include a main circuit breaker meeting the requirements of Main Circuit Breaker Section above minus the power monitor and individually mounted and/or branch mounted circuit breakers. The circuit breaker connections to the distribution panel bussing shall be of bolted-on design.
- B. The switchboard manufacturer shall provide all the proper lugs for all cable connections as required.
- C. Circuit breakers shall be UL 489 listed molded case type rated for 65,000A RMS symmetrical at 480V. Circuit breakers shall have shunt trips where indicated on the Drawings.

2.6 SURGE PROTECTIVE DEVICES

- A. Surge protective devices (SPD) shall be provided in accordance with Surge Protective Devices (See Referenced Sections), in the location and quantity as shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The equipment shall be furnished and installed as shown on the Drawings and in accordance with the manufacturer's installation instructions. One (1) copy of these instruction shall be included with the equipment at time of shipment. The equipment shall be well protected until accepted by the OWNER.
- B. The equipment shall be installed and checked in accordance with the manufacturer's

recommendations. This shall include but not limited to:

1. Ensure the pad is properly leveled.
2. Ensure all bus bars are torqued to the manufacturer's recommendations.
3. Remove all shipping braces and connect all mechanical and electrical shipping split connections.
4. Secure assemblies to foundation or floor channels.
5. Measure and record all readings.
6. Inspect and install all circuit breakers in their proper places.

3.2 LOAD IDENTIFICATION LABELS

- A. Each assembly shall be provide with an identification label as indicated on the Drawings (e.g. SWITCHBOARD A). A nameplate shall be securely affixed in a conspicuous place on each assembly.
- B. Each main and branch circuit breaker shall be provided with a completed load identification label. Application data shall be machine printed on the label.

3.3 TESTING

- A. Field Acceptance Testing: Each switchboard including circuit breakers and surge suppression systems shall be field acceptance tested in accordance with Boxes (See Referenced Sections).

3.4 CLEANING AND TOUCHUP

- A. Prior to final completion of work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.5 RUBBER MATS

- A. A three foot wide rubber mat shall be furnished and installed on the floor and in front of each switchboard assembly. The mat shall be long enough to cover the full length of the equipment line-up. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The mat shall be guaranteed extra quality, free from cracks, blow holes or other defects detrimental to their mechanical and electrical strength. The mat shall meet OSHA requirements and the requirements of ANSI/ASTM D-178 J6-7 Type 2, Class 2 insulation matting.

3.6 TRAINING

- A. The CONTRACTOR shall provide the services of a factory-trained instructor for the purpose of training the OWNER'S personnel in the proper operation and maintenance of the switchboards. Training shall consist of not less than four (4) hours of field instruction in the operation, testing, troubleshooting, and maintenance of the switchboard in accordance with the General Conditions.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish and install panelboards of voltage and current ratings as specified herein and indicated on the Drawings. Panelboards shall be furnished with circuit breaker ratings, number of breakers, number of poles and locations conforming to the panelboard schedules on the Drawings.
- B. All power distribution equipment shall be UL Listed.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL
- D. Section 264300 – SURGE PROTECTIVE DEVICES
- E. Section 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.3 REFERENCES

UL 67	Panelboards
UL 50	Cabinets and Boxes
NEMA PB1	NEMA Standard for Panelboards
NECA 407	NECA Standard for Installing and Maintaining Panelboards
NFPA 70	National Electric Code
UL 489	UL Standard for Circuit Breakers

1.4 ACTION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and as specified herein.
- B. Product Datasheets
- C. Layout Drawings - Show complete panel layout, including materials, sizes, classes, locations, and dimensions.
- D. Results of shop tests, if required.
- E. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be

for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.5 INFORMATION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and as specified herein.
- B. Prior to start-up, submit manufacturer's operation and maintenance manuals and recommended spare parts list, including but not limited to:
 - 1. Manufacturer's equipment warranty.
 - 2. Copies of Submittals
 - 3. Functional descriptions, operating instructions, calibration and adjustment, recommended maintenance, safety.
 - 4. Contact information for local representative and supplier.

1.6 TOOLS AND SPARE PARTS

- A. For each panelboard, the Contractor shall furnish to the Owner all spare parts as recommended by the equipment manufacturer. All spaces in the panelboards shall be furnished with a spare breaker as indicated in the panelboard schedules shown on the Drawings.
- B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.7 HANDLING AND STORAGE

- A. Equipment shall be carefully transported, stored, handled, and set in place in a manner that will prevent damage, misalignment, and distortion to the equipment.
- B. Follow manufacturer's recommendations regarding handling and storage at all times prior to placing the equipment in service.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. All main bus shall be tin plated copper sized in accordance with UL standards to limit the

temperature rise on any current carrying part to a maximum of 50 degrees C above a maximum ambient temperature of 40 degrees C.

- C. All circuit breakers shall be fully rated for the full short circuit rating shown on the drawings. Series ratings are not acceptable.

2.2 LIGHTING PANELBOARDS

A. General

1. Lighting panelboards shall be dead-front type with automatic trip-free, non-adjustable, thermal-overload, branch circuit breakers. Panelboards shall be of the configuration and rating as specified herein and indicated on the Drawings. Panelboards shall be service entrance rated where indicated on the Drawings.
2. Lighting panelboards shall be equipped with a main breaker or main lugs complete with branch circuit breakers, as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting.
3. Lighting panelboards shall be fully rated and shall have a minimum short circuit rating of 22,000 amperes symmetrical, unless otherwise indicated on the Drawings.
4. Lighting panelboards shall be Eaton Pow-R-Line Series, the Square D Company equivalent, the General Electric Company equivalent, or Siemens Energy and Automation, Inc. equivalent.

B. Enclosures

1. Enclosures shall have a NEMA rating as indicated on the Drawings. The minimum NEMA rating for panels in dry locations is NEMA 12, NEMA 12K panelboards are not acceptable. All other panelboards shall be rated NEMA 4X stainless steel at a minimum unless otherwise specified on the Drawings.
2. Enclosures shall be constructed of No. 12 U.S.S. code gauge galvanized steel. The door shall be fastened to the enclosure with concealed hinges and shall be equipped with flush-type catches and locks. The Contractor shall equip cabinet doors exceeding 40 inches in height with vertical bolt three point locking mechanism. All locks shall be keyed alike. The panelboard trim shall have a removable hinge assembly, in addition to the door hinge, that allows work inside the enclosure without the need to remove the trim. The enclosure shall have wiring gutters on sides and shall be at least 5-3/4 inches deep. The panelboard shall be provided with an information label. The information label shall include the panelboard designation, voltage, phase, wires, and bus rating.
3. All metal surfaces of the panelboard enclosures shall be thoroughly cleaned and given one prime of zinc chromate primer. All interior surfaces shall then be given one shop finishing coat of a lacquer of the nitro cellulose enamel variety. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be manufacturer's standard light gray. Stainless steel panelboards are not required to be painted unless indicated otherwise on the Drawings.
4. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the

cabinet.

C. Bus Work

1. Main bus bars shall be of ample size so that a current density of not more than 1000 amperes per square inch of cross section will be attained. This current density shall be based on the application of the full load connected to the panel plus approximately 25% of the full load for spare capacity. The main bus shall be full capacity as based on the preceding for the entire length of the panel to provide full flexibility of circuit arrangement.
2. Solid neutral bus bars are required, and neutral bus ampacity shall be the same as the main bus bars unless otherwise noted. Ratings shall be in accordance with applicable standards.
3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.
4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.
5. All bus shall be tin plated copper and shall extend the entire useable length of the panelboard, including spaces. Silver plated busswork is not an acceptable alternative.

D. Circuit Breakers

1. Circuit breakers shall be bolt-on, molded-case type conforming to UL 489. All circuit breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation. Tandem or half-size circuit breakers are not acceptable
2. Where indicated on the Drawings, or where required by Code, circuit breakers shall be equipped with integrally mounted ground fault interrupters (GFCI) complete with "TEST" push button and shall be of a type which fit standard panelboard spaces for the breaker continuous current rating required. Trip rating for ground fault shall be 6mA or less as required by UL and the NEC.
3. Where indicated on the Drawings, or where required by Code, circuit breakers shall be equipped with integrally mounted ground fault protection equipment (GFPE or E-GFCI) complete with "TEST" push button and shall be of a type which fit standard panelboard spaces for the breaker continuous current rating required. Trip rating for ground fault shall be 30mA or less as required by UL and the NEC. All heat tracing shall be protected by a GFPE breaker regardless of whether or not it is shown on the Drawings.
4. Circuit breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD".
5. Where required by Article 440 of the NEC, circuit breakers installed for air conditioning units shall be HACR type.
6. Circuit breaker voltage ratings shall meet or exceed the panelboard voltage indicated on the Drawings. Trip elements of circuit breakers shall be 20A unless otherwise indicated on the Drawings. Circuit breakers shall have an interrupting rating that matches the panelboard short circuit rating.

7. Where indicated on the Drawings, branch circuit breakers shall be provided with a padlockable hasp or handle padlock attachment for padlocking in the off position as required to meet the NEC requirement for disconnecting means and/or OSHA lock-out/tagout standard. Locking hardware shall remain in place even when the padlock is removed. Branch circuit breakers used for control, instrumentation, telephone, fire alarm, or auxiliary equipment circuits requiring continuous operation shall be provided with a similar lock on device where indicated on the Drawings.

E. Directories

1. Approved directories with noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be furnished and installed in each panelboard. The Contractor shall maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project. Designations and circuit locations shall conform to the panelboard schedules on the Drawings, except as otherwise authorized by the Engineer.

2.3 POWER DISTRIBUTION PANELBOARDS

1. Power distribution panelboards shall be of the configuration and rating as specified herein and as indicated on the Drawings. The panelboards shall be dead front type with automatic trip-free, nonadjustable, thermal overload branch circuit breakers unless otherwise indicated on the Drawings. Panelboards shall be service entrance rated where indicated on the Drawings.
2. Power panelboards shall be equipped with a main breaker or main lugs complete with branch circuit breakers as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting.
3. Power distribution panelboards shall be fully rated and shall have a minimum short circuit rating of 65,000 amperes symmetrical unless otherwise indicated on the Drawings.
4. Power distribution panelboards shall be Eaton Pow-R-Line Series, the Square D Company I-Line or NF equivalent, or Siemens Energy and Automation, Inc. equivalent.

B. Enclosures

1. Enclosures shall have a NEMA rating as indicated on the Drawings. The minimum NEMA rating for panels in dry locations is NEMA 12, NEMA 12K panelboards are not acceptable. All other panelboards shall be rated NEMA 4X stainless steel at a minimum unless otherwise specified on the Drawings.
2. Enclosures shall be constructed of No. 12 U.S.S. code gauge galvanized steel. The door shall be fastened to the enclosure with concealed hinges and shall be equipped with flush type catches and locks. The Contractor shall equip cabinet doors exceeding 40 inches in height with vertical bolt three point locking mechanism. All locks shall be keyed alike. The panelboard trim shall have a removable hinge assembly, in addition to the door hinge, that allows work inside the enclosure without the need to remove the trim. The enclosure shall have wiring gutters on sides and shall be at least 5 3/4 inches deep. The panel shall be provided with an information label. The information label shall include the panelboard

designation, voltage, phase, wires, and bus rating.

3. All metal surfaces of the panelboard enclosures shall be thoroughly cleaned and given one prime of zinc chromate primer. All interior surfaces shall then be given one shop finishing coat of a lacquer of the nitro cellulose enamel variety. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be manufacturer's standard gray. Stainless steel panelboards are not required to be painted unless indicated otherwise on the Drawings.
4. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet.

C. Bus work

1. Main bus bars shall be of ample size so that a current density of not more than 1,000 amperes per square inch of cross section will be attained. This current density shall be based on the application of the full load connected to the panel plus approximately 25% of the full load for spare capacity. The main bus shall be full capacity as based on the preceding for the entire length of the panel to provide full flexibility of circuit arrangement.
2. Solid neutral bus bars, where required, shall be provided. Neutral bus shall have the same ampacity as the main bus, unless otherwise indicated. Ratings shall be in accordance with applicable standards.
3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.
4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.
5. All busses shall be tin plated copper and shall extend the entire useable length of the panelboard, including spaces. Panelboards Listed and Labeled as a four-wire panel shall not be used in place of a three-wire panel where a neutral conductor does not exist in the supply conductors to that panel. Silver plated busswork is not an acceptable alternative.

D. Circuit Breakers

1. Circuit breakers shall be bolt-on, molded-case type conforming to UL 489. All circuit breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation.
2. Circuit breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD" where required by Article 440 by the NEC. Circuit breakers installed for air conditioning units shall be HACR type.
3. Circuit breaker voltage rating shall meet or exceed the panelboard voltage indicated on the Drawings. Trip elements of circuit breakers shall be 20A, unless otherwise indicated on the Drawings. Circuit breakers shall have an interrupting rating that matches the panelboard short circuit rating.
4. Where indicated on the Drawings, branch circuit breakers shall be provided with a padlock-

able hasp or handle padlock attachment for padlocking in the off position as required to meet the NEC requirement for disconnecting means and/or OSHA lock-out/tagout standard. Locking hardware shall remain in place even when the padlock is removed. Branch circuit breakers used for control, instrumentation, telephone, fire alarm, or auxiliary equipment circuits requiring continuous operation shall be provided with a similar lock on device where indicated on the Drawings.

5. Circuit breakers shall be an adjustable type where shown on the Drawings. Adjustments shall match what is shown on the Drawings, any deviation shall require Engineer approval. All other breakers shall be non-adjustable.
6. Circuit breakers shall be 100% rated where shown on the Drawings. All other breakers shall be standard thermal magnetic unless shown otherwise.

E. Directories

1. Approved directories with noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be provided in each panel. The Contractor shall maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project. Designations and circuit locations shall conform to the panelboard schedules on the Drawings, except as otherwise authorized by the Engineer.

2.4 SURGE PROTECTIVE DEVICE - INTERALLY MOUNTED

- A. The panelboards shall be furnished with integrated Type II surge protective devices (SPD). SPDs shall be provided in the location and quantity as shown on the Drawings.
- B. The SPD shall be rated, designed, tested, listed, and labeled in accordance with UL-1449, latest edition.
- C. The SPD shall be factory installed by the panelboard manufacturer using a direct bus connection. There shall be no cable connection between the bus bar and the SPD device.
- D. The SPD shall have a fault current rating equal to or greater than that of the fault current rating of the panelboard. The SPD shall employ metal-oxide varistor (MOV) technology. If integral fusing is used, the fuses shall allow the maximum rated surge current to pass without fuse operation.
- E. The SPD shall have a maximum continuous operating voltage (MCOV) of at least 115% of the nominal voltage of the panelboard. The Voltage Protection Rating (VPR) of each SPD shall not exceed the following:

SYSTEM VOLTAGE	L-N	L-G	L-L	N-G
208Y/120	600V	1000V	1000V	600V
480Y/277	1200V	1800V	2000V	1000V
480 Δ	N/A	1800V	3000V	N/A
240 Δ	N/A	1200V	1500V	N/A
120/240	600V	1000V	100V	600V

- F. The Nominal Discharge Current (In) of the SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.

The surge current rating for each SPD shall be as indicated on the Drawings. Surge current ratings are indicated in panel schedules. Surge current rating indicated is on a per phase basis.

- G. Each SPD system shall provide surge protection in all possible modes. Surge protection shall be as follows:

SYSTEM CONFIGURATION	MODES OF PROTECTION	NUMBER OF MODES
3-Phase Wye	L-N, L-G, N-G	7
3-Phase Delta	L-L, L-G	6
3-Phase Impedance Grounded	L-L, L-G	6
Single-Phase	L-N, L-G, N-G	3

- H. The SPD shall be furnished with an audible alarm and silence pushbutton, integral SPD status LEDs (one per phase), and a Form C dry contact for remote indication of alarm. A surge counter shall also be provided.

- I. The SPD equipment shall be SPD Series by Eaton, SurgeLogic by the Square D Company, Siemens Energy and Automation Inc. equivalent, or engineer approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Panelboards shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer, and as required by NECA 407.
- B. Panelboards shall be set true and plumb in locations as shown on the Drawings. The top of panelboard enclosure shall not exceed six (6) feet above finished floor elevation.
- C. Enclosures shall not be fastened to concrete or masonry surfaces with wooden plugs. Appropriate stainless steel bolts shall be used with expansion shields or other metallic type concrete insert for mounting on concrete or solid masonry walls. Stainless steel toggle bolts shall be used for mounting on concrete block or other hollow masonry walls. Bolt diameter shall be as required considering the size and weight of the completed panelboard and enclosure to provide adequate structural support.
- D. The Contractor shall not use factory furnished knockouts with surface mounted back boxes. The Contractor shall punch or drill required openings during installation and shall equip flush mounted back boxes with manufacturer's standard pattern of knockouts.
- E. The Contractor shall install cabinets (and other enclosure products) in plumb with the building construction. Flush mounted enclosures shall be installed so that the trim will rest against the surrounding surface material and around the entire perimeter of the enclosure.
- F. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for

shop finishing coats.

G. Upon completion of installation, all Spare circuit breakers shall be set to the “OFF” position.

3.2 TESTING [AND STARTUP]

A. All tests shall be performed in accordance with the requirements of the General Conditions. The following tests are required:

1. Prior to termination of any conductors to the circuit breakers, all bus work and circuit breakers shall be tested from phase to phase and phase to ground with a 1000 VDC megohmmeter for 1 minute in accordance with NECA 407. Resistance values shall be recorded and shall not be less than 100 megohms.
2. Prior to terminating any wires to the circuit breakers, the resistance of the connection between the bus work and each circuit breaker shall be tested using a low-resistance ohmmeter. Record the resistance values for each circuit breaker.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish and install all switches, occupancy sensors, and receptacles of the type and at the locations as shown on the Drawings.

1.2 REFERENCED SECTIONS

- A. General Conditions
- B. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL
- C. Section 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- D. Section 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- E. Section 260533.16 – BOXES ELECTRICAL SYSTEMS

1.3 REFERENCES

UL 20	General Use Snap Switches
UL 498	Standard for Attachment Plugs and Receptacles
UL 943	Ground Fault Circuit Interrupters
UL 1203	Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

1.4 ACTION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Product Datasheets.
- C. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.5 INFORMATION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Prior to start-up, submit manufacturer's operation and maintenance manuals and recommended spare parts list, including but not limited to:
 - 1. Manufacturer's equipment warranty.
 - 2. Copies of Submittals
 - 3. Functional descriptions, operating instructions, calibration and adjustment, recommended maintenance, safety

1.6 TOOLS AND SPARE PARTS

- A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.
- B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.7 HANDLING AND STORAGE

- A. Follow manufacturer's recommendations regarding handling and storage at all times prior to placing the equipment in service.

1.8 GUARENTEES AND WARRANTY

- A. All devices in this section shall be warrantied for a minimum of one (1) year after installation.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. The Contractor shall use the products of a single manufacturer for each type of wiring device.
- C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:
 - 1. Where the selected plate manufacturer does not manufacture a suitable finish plate.

2. For heavy duty receptacles rated at more than 30A.
 3. Where nonstandard plates are required, specified, or shown.
- D. The Contractor shall furnish and install all wiring devices and device plates.

2.2 WIRING DEVICES

- A. Wall switches for non-hazardous areas shall be rated for the current required to suit the application, but not less than 20A. Double pole, three-way, and four-way switches shall be provided where indicated on the Drawings, and as required. Switches shall be rated for 120-277VAC and shall be UL 20 Listed. All switches shall be specification grade industrial extra heavy duty rated. Commercial grade or light industrial grade devices are not acceptable.
- B. Convenience receptacles for non-hazardous areas shall be rated for 20A at 125VAC. Convenience receptacles shall be UL 498 Listed. Tamper resistant receptacles are not acceptable. All receptacles shall be specification grade industrial extra heavy duty rated. Commercial grade or light industrial grade devices are not acceptable.
- C. Special purpose receptacles (welders, lab equipment, etc.) shall be provided with the proper NEMA configuration and ampacity as indicated on the Drawings. The coordinating plug for each special purpose receptacle shall be provided with the equipment which it is serving.
- D. Ground fault circuit interrupter receptacles shall be rated for 20A at 125VAC. Ground fault circuit interrupter receptacles shall be UL 943 Listed. Tamper resistant receptacles are not acceptable. All GFCI receptacles shall be specification grade industrial extra heavy duty rated. Commercial grade or light industrial grade devices are not acceptable.
- E. Wall switches for hazardous areas shall be the factory sealed type, UL 1203 Listed for use in the hazardous area. Wall switches shall be rated for 120-277VAC, and shall be rated for the current required to suit the application, but not less than 20A.
- F. Receptacles for hazardous areas shall be rated 20A at 120-240VAC. Receptacles shall be UL 1203 listed for use in the hazardous area, utilizing delayed-action construction.
- G. All wiring devices shall be approved for use with stranded conductors, if stranded conductors are to be used with the device. Reference Low Voltage Wire and Cable (See Referenced Sections) for conductor requirements.

2.3 DEVICE PLATES

- A. Device plates for indoor flush mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Device plates shall be provided with a gasket.
- B. Device plates for outdoor installations, indoor wet process areas, and chemical storage/transfer areas shall be Appleton Type FSK, Crouse Hinds #DS185, or equal for wall switches. Device plates for receptacles shall be "in-use" style. "In-use" weatherproof covers shall be rugged, minimum 3 1/4" depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," Intermatic International, Inc., or equal.

- C. Device plates for indoor dry process and non-process areas with surface mounted boxes shall be Crouse-Hinds DS32, or equal for switches, and Crouse-Hinds DS23 or equal for receptacles.

2.4 PLUGS

- A. The Contractor shall furnish suitable plugs with equipment furnished under the respective specification Section. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

2.5 PROCESS INSTRUMENTS

- A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument etc.) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or equal. For hazardous locations, the device shall be UL 1203 Listed.
- B. Manufacturer shall be:
 - 1. In non-hazardous areas, provide specification grade devices manufactured by Appleton, Crouse-Hinds, Leviton, Hubbell, Pass & Seymour, or Engineer approved equal.
 - 2. In hazardous areas, provide devices manufactured by Appleton, Cooper Crouse-Hinds, Hubbell-Killark, or Engineer approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Where more than one (1) switch occurs at one (1) location, gang plates shall be used.
- B. All device plates shall be set true and plumb and shall fit tightly against the finished wall surfaces and outlet boxes.
- C. Wiring device box (outlet box) mounting heights shall be as specified in Boxes (See Referenced Sections).
- D. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the Contractor shall bring it to the attention of the Engineer for a decision.
- E. Receptacles installed in toilet, locker, and bathrooms, and within 6 feet of a sink, shall be of ground fault interrupter type. Ground fault circuit interrupter receptacles shall also be furnished and installed in additional locations where indicated on the Drawings, and as required by the NEC.
- F. All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14 point font.

3.2 CIRCUITING

- A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit, unless otherwise indicated on the Drawings.

END OF SECTION 262726

SECTION 262816.16 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall furnish and install separately mounted, individual disconnect switches as specified herein and indicated on the Drawings.
- B. Disconnect switches for process instruments are not included in the scope of this Section and shall be as specified in Section 262726 – Wiring Devices.

1.2 CODES AND STANDARDS

- A. Disconnect switches shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 98 – Enclosed and Dead-Front Switches
 - 2. L 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
 - 3. NEMA 250 – Enclosures for Electrical Equipment
 - 4. NEMA KS 1 – Heavy Duty Enclosed and Dead-Front Switches

1.3 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Spare Parts List
- B. Each submittal shall be identified by the applicable specification section.

1.4 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of disconnect switch.

3. Assembled weight of each unit.
4. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.
5. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.5 SPARE PARTS

- A. The equipment shall be furnished with all spare parts as recommended by the equipment manufacturer.
- B. One (1) complete set of spare fuses for each ampere rating installed shall be furnished and delivered to the Owner at the time of final inspection.
- C. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- D. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.6 IDENTIFICATION

- A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Switches shall be manufactured by the Square D Company, Eaton, the General Electric Company, or Siemens Energy and Automation, Inc.

2.2 DISCONNECT SWITCHES

- A. Disconnect switches shall be heavy-duty type and/or as specified in these Specifications. Switches shall be furnished and installed as shown on the Drawings and as required by the NEC. Handles shall be lockable.
- B. Disconnect switches shall be UL 98 Listed.
- C. Switches shall meet NEMA Standard KS 1 type HD requirements, be externally operated, and be fused or non-fused as indicated on the Drawings. Switches shall have the number of the poles, voltage, and ampere ratings as shown on the Drawings.
- D. In non-hazardous locations, disconnect switches shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Unless otherwise indicated on the Drawings. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
Indoor Dry Non-process Area	NEMA 1, Painted Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 304 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

- E. Disconnect switches shall be quick-make, quick-break and with an interlocked cover which cannot be opened when switch is in the "ON" position and capable of being locked in the "OPEN" position.
- F. A complete set of fuses for all switches shall be furnished and installed as required. Time-current characteristic curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than the circuit voltage.
- G. Disconnect switches shall be furnished with a factory installed internal barrier kit that helps prevent accidental contact with live parts and provides “finger-safe” protection when the door of the enclosed switch is open.
- H. Disconnect switches shall be furnished with a manufacturer-supplied ground lug kit for termination of equipment grounding conductors. Where a grounded (neutral) conductor is shown on the Drawings in the conduits connected to the disconnect switch, a manufacturer-supplied neutral bar shall be furnished for termination of the grounded conductors. Third party ground lug and neutral lug kits not supplied by the disconnect switch manufacturer are not acceptable.

- I. Disconnect switches for all motors connected to variable frequency drives (VFDs) shall be furnished with a factory installed electrical interlock kit that includes one (1) early-break auxiliary contact rated for 5A (minimum) at 120 VAC to be used to open the control circuit before the main switch blades break.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All disconnect switches shall be mounted five (5) feet above the floor or finished grade, at the equipment height where appropriate, or where shown otherwise.
- B. Disconnect switches shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

3.2 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 1. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.

END OF SECTION 262816.16

SECTION 26 29 00

LOW VOLTAGE CONTROLLERS

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in satisfactory operation, the motor control centers as specified herein and indicated on the Drawings.
- B. The Contractor shall obtain the motor control centers from one manufacturer who shall also manufacture the enclosure and major equipment components, which includes, but is not limited to, combination starters, reduced voltage solid state starters, circuit breakers, power monitoring equipment, and other components of the equipment assembly. Subcontracting of wiring is not acceptable.
- C. The motor control center shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions - SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL
- D. Section 264300 – SURGE PROTECTIVE DEVICES
- E. Section 260916 – ELECTRICAL CONTROLS AND RELAYS

1.3 REFERENCES

NEMA ICS 18	Motor Control Centers
UL 845	Standard for Safety Motor Control Centers
ISO 9001	Standard for Quality Management Systems

1.4 ACTION SUBMITTALS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings for each motor control center shall include but not be limited to:
1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.
 2. Product data sheets.
 3. Example equipment nameplate data sheet.
 4. Approximate total shipping weight of each shipping split.
 5. Plan, front, and side view drawings, including overall dimensions of each motor control center. Identify shipping splits and show conduit stub-up area locations on the Drawings.
 6. Internal schematic and point-to-point wiring diagrams of each motor control unit including reduced voltage solid state starters integrated into the motor control center. Standard wiring diagrams that are not custom created by the manufacturer for the motor control centers for this project are not acceptable. One wiring diagram which is typical for an equipment group (e.g., screw pump, backwash pumps) is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.
 7. Complete single-line diagrams for each motor control center showing circuit breakers, motor circuit protectors, motor controllers, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete assembly. Indicate electrical ratings of equipment and devices on these single-line diagrams. Ratings include starter size and type, motor circuit protector continuous current rating, circuit breaker frame size and trip rating, motor horsepower and full load current, and similar information.
 8. Bill of material list for each motor control center and each motor control unit.
 9. Nameplate schedule for each motor control center.

10. Manufacturer's installation instructions.
 11. Key interlock scheme drawing and sequence of operations.
 12. Manufacturer's Warranty Statement
 13. Table listing all motor loads connected to the motor control center. Table shall include the full load amps of the APPROVED motors. Final approval of MCC shop drawings cannot be given until all motor loads for MCC have been reviewed, approved, and shown in this table.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.
- E. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for each motor control center unit of each motor control center. These final drawings shall be included in the O&M manuals.

1.5 INFORMATIONAL SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and the Contractor shall obtain from the equipment manufacturer and submit the following:
1. Proposed Testing Methods and Reports of Certified Shop and Field Tests.
 2. Manufacturers Startup Certification.
 3. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.
- C. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions.

1.6 SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. In addition to the manufacturer recommended spare parts, the Contractor shall furnish the following spare parts for each motor control center:

<u>No. Required</u>	<u>Description</u>
2 sets	Fuses of each size provided

<u>No. Required</u>	<u>Description</u>
2	Starter coil and complete set of contacts for each size and type of starter provided.
2	Relay of each size and type used.
1	Control power transformer of each size used.
2	Lamps and lenses for indicating lights, each color.
1	Indicating lamp sockets for each type used.
1	Pilot device (e.g., pushbutton, selector switch, etc.) complete with contact blocks and legend plates for each type, color, size, and rating used.
1	Motor circuit protector for each type, size, and rating used.

- C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- E. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Term such as "1 lot of packing material" are not acceptable.
- F. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.7 IDENTIFICATION

- A. Each motor control center shall be identified with the identification number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each motor control center. Nameplates shall be engraved white with black lettering, affixed by #10 screws.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

- B. It is the intent of these specifications that all components of the motor control center be provided by one manufacturer who shall have the sole responsibility of matching all components and providing equipment which functions together as a system. The manufacturer of the motor control center shall also be the manufacturer of the motor controllers. The use of third-party supply and assembly of these components is not acceptable.
- C. Motor control centers shall be Freedom 2100 as manufactured by Eaton using NEMA rated Freedom Series contactors and starters, Model 6 as manufactured by the Square D Company using Type S starters and contactors, Centerline 2100 NEMA as manufactured by Allen-Bradley, or Tiastar as manufactured by Siemens Energy and Automation Inc. using NEMA contactors and starters. No substitutions allowed.

2.2 MOTOR CONTROL CENTER

A. General

1. The motor control centers shall be 600 VAC class suitable for operation on a three-phase, 60 Hz system. The motor control centers and their components shall conform to the requirements of applicable standards of NEMA Part ICS 2-322 and Underwriters' Laboratories, Inc. UL-845. Wiring shall be NEMA Class II, Type B. Each vertical section shall be a NEMA 1A (gasketed) or NEMA 12 industrial use enclosure unless otherwise specified or indicated on the Drawings.
2. The enclosures shall be cleaned, primed, and finish coated in accordance with the manufacturer's standard process. The pre-treatment process shall be a zinc chromate primer followed by a "One Coat" paint process that is monitored to meet the manufacturer's specifications for paint color, texture, thickness, and durability. Enclosure interior and exterior finish color shall be manufacturer's light grey. The color of the back panel/bucket located within the MCC enclosure shall be white.
3. The motor control centers shall be capable of withstanding the fault current available at its line terminals. Minimum bus bracing, withstand, and interrupting ratings are specified herein.
4. Unless otherwise specified or indicated on the Drawings, each vertical section shall be approximately 20 inches wide, and 90 inches high, 20 inches deep, and shall not contain more than six NEMA Size 1 starters. Motor control centers shown "back-to-back" on the Contract Drawings shall be complete motor control assemblies placed back-to-back in the location shown. Motor control center sections with common horizontal and/or vertical bus systems are unacceptable.
5. Continuous horizontal wiring troughs shall be provided at both the top and bottom of each section. These troughs shall line up to form a continuous wireway for the full length of the motor control center. Each section shall be provided with a large, continuous, full height vertical wiring trough in the right side of each section. Each vertical wiring trough shall be furnished complete with tie bars for conductor support.

6. All control wiring shall be No. 14 AWG (minimum) labeled at each end in accordance with the wiring numbers shown on the accepted shop drawings. Power wiring shall be sized to suit the maximum horsepower rating of unit; No. 12 AWG (minimum). Wiring shall be type MTW rated for 105°C. Wire color coding shall be red for control and black for power. Wire numbers shall not be repeated in a motor control center.
7. Starter units shall contain the number of auxiliary contacts, unit-mounted pilot devices and indicating lights, control relays, elapsed time meters, and other devices as shown on the Drawings and required for the applications. A minimum of two (2) normally open (NO) and two (2) normally closed (NC) spare contacts shall be provided for each magnetic starter. These spare contacts shall be shown on the submittal wiring diagrams.
8. The motor control centers shall be furnished with warning signs to notify maintenance personnel of multiple sources of power within the motor control units.

B. Power

1. The motor control centers shall be supplied from a 480V, 3-phase, 3 or 4 wire as indicated on the Drawings, 60 Hz power source. The incoming power feeders shall be sized as shown on the Drawings. All terminals for incoming and outgoing power cables shall be provided with long barrel compression lugs.

C. Bus

1. Power shall be distributed by means of a continuous, tin plated copper horizontal bus, rated as shown on the Drawings. The bus shall be braced for 65,000A rms symmetrical at 480V unless otherwise indicated on the Drawings. The horizontal bus shall be effectively isolated from all wiring troughs and other working areas. Vertical bus extensions shall be tin plated copper, isolated by rigid, glass-polyester moldings to be a separate self-supported assembly. Full height vertical bus shall be installed in all sections including those containing spare units and "prepared" spaces. No extra safety jacks or similar devices shall be required to obtain an essentially dead-front condition. Access shall be provided for inspection and maintenance from the front. Minimum horizontal bus rating shall be 600A. Minimum vertical bus rating shall be 600A.

D. Incoming Line Units

1. Each incoming line unit shall contain buswork and fittings as required with cable lugs for cables of sizes and quantities shown on the Drawings. Cable lugs shall be suitable for their respective conductors. Incoming lugs shall be long barrel, crimp type only. Mechanical lugs are not permitted.
2. A neutral landing pad shall be furnished in the main circuit breaker section. A neutral landing pad is required to terminate the grounded conductor from the utility transformer in accordance with the NEC. The neutral landing pad shall be capable of serving as the neutral-ground bonding location where shown on Drawings.

E. The Unit Compartments

1. Each unit compartment shall be provided with an individual front door hinged to the vertical structure. Each plug-in unit shall be supported and guided by a removable unit support pan, so that the unit rearrangement is easily accomplished. The rearrangement of the unit support pan from one location to the other shall be accomplished without use of tools. After insertion, each plug-in unit shall be held in place by at least one multi-turn latch, located at the front of the unit. The latch shall be located for front accessibility and installation convenience. An additional mechanical interlock shall be provided to prevent withdrawal of the unit from the stationary structure with the operating mechanism in the ON position.
2. The unit plug in power stabs shall be electromagnetically tin plated copper to yield a low resistance connection and designed to tighten during heavy current surges and short circuits. The stab shall be backed by spring steel clips to provide and maintain a high pressure, two point connection to the vertical bus. They shall be free floating and self loading plug-in. Wiring from the unit disconnecting means to the plug-in stab shall be exposed at the rear of the unit. The power cable terminations at the plug-in stab shall be mounted in a two-piece, glass polyester support assembly. This support assembly shall provide a separate isolated pathway for each phase, minimizing the probability of a unit fault condition reaching the power bus system.
3. NEMA Size 1 through Size 5 non-reversing starters shall be plug-in units. Size 1, 2, and 3 shall utilize stab assembly rated 100A. Stab assemblies for Size 4 and Size 5 starters shall be rated for the starters maximum output current rating.
4. An industrial, heavy-duty flange handle mechanism shall be supplied for the control of each disconnecting means. This mechanism shall be engaged with the disconnect device at all times as an integral part of the unit regardless of the unit door position. The operator handles shall have an up-down motion with the down position as off. The ON-OFF condition of the disconnecting means shall be permanently marked on the handle operator. It shall be possible to lock the handle in the "OFF" position with up to three (3) 3/8 inch diameter shackle padlocks and in the "ON" position with one (1) 3/8 inch diameter shackle padlock.
5. The operator handle of all units shall be interlocked with the door units so that the disconnect means cannot be switched unless the door unit is closed. A means shall be provided for purposely defeating the interlock during maintenance or testing. This interlock shall also prevent opening the unit door unless the disconnecting means is in the off position. An externally operated defeater requiring the use of a screwdriver shall provide access to the unit without interrupting service.
6. The overload relays shall be resettable from the outside of the enclosure by means of an insulated bar or button.

F. Ground Bus

1. The horizontal ground bus shall be tin plated copper and located in the bottom horizontal wireway. The minimum size of the horizontal ground bus shall be 1/4 inch x 2 inch (6.35mm x 50.8mm).

2. Compression lugs shall be mounted on the ground bus in each section, in the size and quantity as required for the termination of system and equipment grounding conductors.
3. The vertical ground bus shall be tin plated copper and solidly connected to the horizontal ground bus. This ground bus, in combination with the unit ground bus stab, establishes unit grounding before the plug-in power stabs engage the power bus, and conversely, as the unit is withdrawn, grounding is maintained until after the plug-in power stabs are disengaged.
4. The vertical load ground bus shall be tin plated copper and solidly connected to the horizontal ground bus. The vertical load ground bus assembly, comprised of the vertical load ground bus and the unit load ground bus connector, shall provide a termination point for the load equipment grounding conductor at the unit. This fixed connection shall not have to be removed when the unit is withdrawn from the motor control center.

G. Isolation and Insulation

1. Horizontal bus access covers and vertical bus covers shall isolate the energized buses to guard against the hazard of accidental contact. These covers shall be molded of a glass polyester material.
2. The horizontal bus shall be isolated from the top horizontal wireway by a grounded steel barrier. This barrier shall be removable to allow access to the bus and connections for maintenance.
3. The vertical bus cover shall provide unit plug-in openings which shall permit unit plug-in stab assemblies to pass through and engage the vertical bus. The unit plug-in openings shall be sized to minimize the probability of inadvertent contact with the vertical bus.
4. Isolation of unused stab openings shall be accomplished by use of a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection) they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the motor control center.
5. All units shall be isolated from one another, above and below, by unit support pans or steel barriers, which can remain in place when the units are withdrawn.
6. Incoming line compartments shall be isolated from horizontal and vertical wireways by steel barriers. These barriers shall ensure that switching off the incoming circuit breaker isolates the load side for servicing as de-energized equipment as required by NFPA 70E.
7. A molded unit isolating barrier shall be provided to isolate the unit from the vertical wireway.

H. Combination Motor Control Units

1. Motor branch circuits shall be protected by a motor circuit protector (MCP). The motor circuit protector shall be NEMA design and rated, and of phenolic resin construction. IEC design devices and devices with thermoplastic construction are not permitted.

2. The motor circuit protector shall be operated by a toggle type handle and shall have a quick make, quick break overcenter switching mechanism that is mechanically trip free from the handle, so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close, and trip simultaneously.
3. Each pole of these motor circuit protectors shall provide instantaneous short circuit protection by means of an adjustable magnetic only element. Thermal magnetic circuit breakers are not an acceptable substitution and will be rejected.
4. The motor circuit protectors in combination with a contactor and overload relay shall have an interrupting rating that matches the motor control center short circuit rating at the motor control center rated voltage. Series ratings are not acceptable.
5. Motor circuit protector's ratings, modifications, etc., shall be as specified herein and as indicated on the Drawings.
6. Motor circuit protectors shall be completely enclosed molded case devices with a current sensing coil in each of the 3 poles and have a magnetic trip adjustment located on the front. The motor circuit protector shall be manually operable. The protector shall be designed to meet the NEC requirement concerning motor full load and locked-rotor current. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes, consisting of metal grids mounted in an insulating support.

I. Motor Starters

1. Motor starters shall conform to NEMA Standard IC1 and shall be for across-the-line starting, unless otherwise indicated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment. The size of the starter shall be as required for the particular load. Minimum starter size shall be NEMA Size 1. Size 1 and 2 starters shall be completely drawout type, so that units may be withdrawn without disconnecting any wiring. Size 3 and 4 full-voltage, non-reversing starters shall be drawout type after disconnecting power leads only. Starters over three-space units high may be bolt-on type. A positive guidance system shall be provided to assure proper alignment of wedge-shaped power stabs in deadfront openings in vertical power bus.
2. A suitable control disconnect device(s) to comply with the requirements of the NEC shall be provided.
3. Magnetic starters and contactors shall be electromagnetic vertical or horizontal lift design with double break cadmium oxide silver contacts. Design shall meet or exceed the requirements of UL and NEMA Standards. Coils shall be hot molded construction to protect the coils from mechanical and environmental damage. Contacts and coils shall be separately replaceable without replacing the entire starter assembly.

4. Each starter shall be able to accommodate a minimum of three (3) auxiliary contacts in addition to the hold-in contact.
5. Each starter shall be supplied with a 3 pole, manual reset overload relay. The relays shall be solid state type, with at least one isolated normally open and one isolated normally closed auxiliary contact that operates when a trip condition has occurred. Relays shall be self-powered, have a visible trip indicator, have a trip test function, and have selectable Class 10 or 20 operation. Overload relays shall be set for Class 10 operation unless otherwise directed by the Engineer. Overload relay shall have phase loss protection built in to trip the unit and protect the motor against single phasing. The Contractor shall provide the overload relay model with the correct current range for each application. Overload relay shall have adjustable current range dial. Eutectic alloy or bi-metallic type overload relays are not acceptable.
6. Each motor starter coil shall be equipped with a surge-suppression device for protection of the solid state equipment (e.g. programmable logic controller) wired as part of the control circuit.
7. The minimum control power transformer VA requirements are shown below. Control power transformers shall be sized as required for the connected loads, plus 25% spare capacity.

a. Size 1	75 VA
b. Size 2	75 VA
c. Size 3	200 VA
d. Size 4	300 VA
e. Size 5	500 VA
8. The Contractor and motor control center manufacturer is advised to review the Contract Documents for additional requirements for space heaters, power factor correction capacitors, and similar equipment which may not be specified in this Division or shown on the Drawings. Control power transformers shall be protected on both the primary and secondary sides as indicated on the Drawings.

J. Circuit Breakers

1. Where specified herein, indicated on the Drawings, or required, the main circuit breaker shall be rated for service entrance and bear a service entrance label.
2. Unless otherwise indicated, circuit breakers shall be manually operable and shall provide thermal-magnetic, inverse-time-limit overload, and instantaneous short-circuit protection.
3. Circuit breakers shall be molded case type, rated 480 VAC, 2 or 3 pole and have 100 ampere or larger frames. The interrupting rating shall match that of the motor control center short circuit rating at 480V.

4. Overload protection shall be provided on all poles with trip settings as indicated on the Drawings. Breakers of 225-ampere frames and larger shall have interchangeable trip units and adjustable magnetic trip elements.
5. Horizontally mounted operator handles for feeder circuit breaker units up to 225A are not accepted unless indicated on Drawings.
6. Where indicated on the Drawings, shunt trip devices shall be provided to trip a circuit from a remote location by means of a trip coil energized from a separate circuit. A 120V shunt trip shall be capable of operating 55% or more of rated voltage. All other shunt trips shall be capable of operating at 75% or more of rated voltage. Contractor is responsible for coordinating shunt trip voltages.

K. Terminal Blocks

1. Terminal blocks associated with removable units within the motor control center shall be provided as follows:
 - a. Terminal blocks shall be mounted within the unit insert and in the front for ease of accessibility.
 - b. Pull-apart style terminal block assemblies shall be provided. Terminal block assembly shall consist of a male and female component held together with captive screws. The terminal block assembly shall be designed to withstand the effects of vibration, yet able to be pulled apart without difficulty. The terminals of the assembly shall be recessed to isolate them from accidental contact. Terminal markings shall be provided for the purpose of identifying terminations. Terminal strips shall be suitable for use as a disconnecting means of foreign interlock voltages.
 - c. For starters Size 2 and smaller, terminate all starter wiring (power and control) and external field wiring on terminal blocks provided in each unit.
 - d. For starters Size 3 and larger, terminate control wiring and external field control wiring on terminal blocks provided in each unit.
2. Terminal blocks associated with non-removable units within the motor control center shall be provided in accordance with Electrical Controls and Relays (See Referenced Sections).
3. Provide a minimum of four (4) spare terminals in each terminal block assembly.

L. Control Devices

1. Furnish and install control devices as required and/or shown on the Drawings. The following control devices shall be provided as specified in Electrical Controls and Relays (See Referenced Sections):
 - a. Pilot devices (switches, indicating lights, etc.)
 - b. Relays and timers

M. Nameplates

1. Provide engraved plastic nameplates to identify the motor control center, each unit compartment, door mounted devices, and internal components.
2. Equipment names and numbers as indicated on the single line diagrams shall be used as the basis to engrave the nameplates.
3. Provide a master nameplate giving motor control center designation, voltage rating, ampere rating, short circuit rating, manufacturer's name, general order number and item number.
4. Control components mounted as part of the assembly, such as fuse blocks, control relays, pushbuttons, switches, and similar devices, shall be suitably marked for identification corresponding to appropriate designations on the manufacturer's wiring diagrams.

N. Future Space Requirements

1. Provide spaces for future combination starter and other units in the motor control centers. Furnish spaces with hardware to accommodate future plug-in control unit without modification of vertical sections. Provide the number of spaces required for future units as indicated on the Drawings, minimum.
2. Provide additional vertical sections to ensure total number of spaces as indicated on the Drawings. The number of vertical sections is contingent upon specific manufacturer's final proposed and Engineer-accepted configuration of motor control center units.

O. Motor Control Center Additions

1. The Contractor shall furnish and install complete motor control center sections or individual motor control center units to be added to existing motor control centers in accordance with these Specifications and as indicated on the Drawings.
2. These additions shall be of the same manufacturer, type, rating, and color as the existing motor control centers. Furnish and install all hardware necessary to connect the buses of the new and existing motor control centers, including ground buses. Enclosures shall match existing.

P. Motor Control Center Modifications

1. The Contractor shall modify existing motor control centers and specific motor control center units as specified herein and indicated on the Drawings. These modifications include, but are not limited to, additions of door mounted pilot devices, modifications to existing motor control circuits and other work.

Q. Metering

1. Each motor control center assembly shall be furnished and installed with an Eaton Power Xpert 4000 power quality meter and graphic display module or an approved equivalent meter.

2.3 SURGE PROTECTIVE DEVICES

- A. The motor control center shall be furnished with integrated Type II surge protective devices (SPD). SPDs shall be provided in the location and quantity as shown on the Drawings.
- B. The SPD shall be rated, designed, tested, listed, and labeled in accordance with UL-1449, latest edition.
- C. The SPD shall be factory installed by the motor control center manufacturer using a direct bus connection. There shall be no cable connection between the bus bar and the SPD device.
- D. The SPD shall have a fault current rating equal to or greater than that of the fault current rating of the motor control center. The SPD shall employ metal-oxide varistor (MOV) technology. If integral fusing is used, the fuses shall allow the maximum rated surge current to pass without fuse operation.
- E. The SPD shall have a maximum continuous operating voltage (MCOV) of at least 115% of the nominal voltage of the motor control center. The Voltage Protection Rating (VPR) of each SPD shall not exceed the following:

SYSTEM VOLTAGE	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V
480Y/277	1200V	1200V	1800V	1200V
480 LTA	N/A	1200V	2000V	N/A
240 LTA	N/A	1200V	1200V	N/A
120/240	700V	700V	1200V	700V

- F. The Nominal Discharge Current (I_n) of the SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.
- G. The surge current rating for each SPD shall be as indicated on the Drawings. Surge current ratings are indicated on single line diagrams. Surge current rating indicated is on a per phase basis.
- H. Each SPD system shall provide surge protection in all possible modes. Surge protection shall be as follows:

SYSTEM CONFIGURATION	MODES OF PROTECTION	NUMBER OF MODES
3-Phase Wye	L-N, L-G, N-G	7
3-Phase Delta	L-L, L-G	6

3-Phase Impedence Grounded	L-L, L-G	6
Single-Phase	L-N, L-G, N-G	3

- I. The SPD shall be furnished with an audible alarm and silence pushbutton, integral SPD status LEDs (one per phase), and a Form C dry contact for remote indication of alarm. A surge counter shall also be provided.
- J. The SPD equipment shall be SPD Series by Eaton, SurgeLogic by the Square D Company, Tranquell by the General Electric Company, Siemens Energy and Automation Inc. equivalent, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The motor control centers shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.
- B. Install motor control centers to allow complete unit door swing required for unit removal. This is specifically required where a vertical section of motor control center is set next to a wall to the left of the motor control center section.
- C. Where motor control center structures are located away from walls to allow bottom conduit entry, the Contractor shall furnish and install sheet metal coverings for openings along the sides and top of the motor control center line-up. The purpose of the coverings is to minimize dust, dirt, and undesirable materials from collecting behind the equipment. The sheet metal coverings shall be of the same material, gauge, and finish as the motor control center.
- D. Motor control centers shall be furnished with anchor bolts as required for aligning and mounting. Floor channels with end covers shall be of type recommended by the manufacturer and shall be furnished for installation in a concrete pad.
- E. All field wiring that is terminated directly to a unit within the motor control center shall be neatly routed in a manner that does not hinder the ability to service, adjust, or replace components within that unit. Field wiring shall be properly anchored to the motor control center and individual unit structures.
- F. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.
- G. Prior to energizing, Contractor shall vacuum out motor control center compartments and floor underneath motor control center fully. Contractor shall also wipe all surfaces with a lint free cloth to ensure no dust or metal particles remain.

3.2 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions. The following tests are required:
 - 1. Certified Shop Tests and Reports
 - a. As a minimum, the entire motor control center shall go through a quality inspection before shipment. This inspection shall include, but is not limited to, the following:
 - i. Physical inspection of the structure and the electrical conductors including bussing, general wiring, and units.
 - ii. General electrical tests including power circuit phasing, control circuit wiring, instrument transformers, meters, ground fault system, and device electrical operation.
 - iii. AC dielectric tests of the power circuits and control circuits.
 - iv. Markings/labels, including instructional type, Underwriters Laboratory (UL), and inspector's stamps.
- B. The manufacturer shall use integral quality control checks throughout the manufacturing process to maintain the correctness of the motor control center.
- C. Field Tests
 - 1. Field tests shall be performed in accordance with the requirements specified in the General Conditions and NETA Acceptance Testing Specifications, latest edition.

3.3 FIELD ADJUSTMENTS

- A. All adjustable settings of circuit breakers shall be set in the field by a qualified representative of the manufacturer, or an outside testing company retained by the Contractor, in accordance with the settings designated in the coordination study. See Basic Electrical Requirements (See Referenced Sections).
- B. The settings of the motor circuit protectors and overload relays for existing equipment shall be set based on the coordination study and the motor nameplate data of the motors installed.
- C. The settings of the motor circuit protectors and overload relays for all equipment installed in this contract shall be determined and provided by the Manufacturer of the connected equipment. Contractor is responsible for guaranteeing that settings meet criteria for connected equipment Manufacturer's warranty.

3.4 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the services of a qualified, factory-trained manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment

furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Owner.

- B. The manufacturer's technical representative shall perform startup and functional testing of the equipment as specified herein.
- C. The Contractor shall provide training for Owner personnel. Training shall be conducted by the manufacturer's factory-trained representative who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section. Training shall be provided for one (1) session of two (2) hours. Training shall be at times coordinated with the Owner. Training shall be provided in accordance with the requirements of the General Conditions.
- D. The services of the manufacturer's representative shall be provided for a period of not less than as follows:
 - 1. One (1) trip of one (1) working day during the installation and startup of the equipment.
 - 2. One (1) trip of one (1) working day two (2) months before the warranty expiration to identify any issues to be corrected under warranty.
 - 3. One (1) trip of one (1) working day to perform training as specified herein.
- E. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

END OF SECTION

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SECTION 262913 - ENLCOSED CONTROLLERS

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall furnish and install separately mounted, individual motor controllers for 120 volt single phase, and 208 and 480 volt three phase motors as specified herein and indicated on the Drawings. Individual motor controllers specified in this Section include magnetic motor starter and manual motor starters

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions - SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL
- D. Section 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE
- E. Section 260916 – ELECTRIC CONTROLS AND RELAYS

1.3 REFERENCES

UL 508	Standard for Industrial Control Panels
NEMA 250	Enclosures for Electrical Equipment

1.4 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings.
 - 2. Spare Parts.
 - 3. Reports of Certified Shop and Field Tests.
 - 4. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

1.5 ACTION SUBMITTALS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.
2. Product data sheets.
3. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of individual motor controller.
4. Custom wiring diagrams for each individual motor controller. Standard wiring diagrams that are not custom created by the manufacturer for the individual motor controllers for this project are not acceptable. One wiring diagram which is typical for an equipment group (e.g., reuse water pump) is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.
5. Bill of material list for each individual motor controller.
6. Nameplate schedule for each individual motor controller.
7. Manufacturer's installation instructions.
8. Time-current curves for each type and size protective device if requested by the Engineer.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

E. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for individual motor controller. These final drawings shall be plastic laminated and securely placed inside each individual motor controller unit door and included in the O&M manuals.

1.6 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions.

1.7 TOOLS AND SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. The Contractor shall furnish the following additional spare parts:

<u>No. Required</u>	<u>Description</u>
2 sets	Fuses of each size provided
2	Starter coil and complete set of contacts for each size and type of starter provided.
2	Relay of each size and type used.
1	Control power transformer of each size used.
2	Lamps and lenses for indicating lights, each color.
1	Indicating lamp sockets for each type used.
1	Pilot device (e.g., pushbutton, selector switch, etc.) complete with contact blocks and legend plates for each type, color, size, and rating used.
1	Motor circuit protector for each type, size, and rating used.
1	Molded case circuit breaker for each type, size, and rating used (except main circuit breakers).
1	Set of replacement surge protection modules

- C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- E. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- F. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.8 IDENTIFICATION

- A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved with the equipment name and/or number with which it is associated. Equipment identification shall be in accordance with Basic Electrical (See Referenced Sections).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.2 INDIVIDUAL MAGNETIC MOTOR STARTERS

- A. Individual magnetic motor starters shall be combination type complete with motor circuit protectors (MCP's). Starters shall be rated 480 VAC, 3-pole, sized for the intended load unless otherwise indicated. In no case shall a starter smaller than a NEMA Size 1 be used. Each starter shall be furnished with a minimum of two spare auxiliary contacts. Only fully rated NEMA starters are acceptable. Fractionally stepped "half size" starters between full NEMA sizes are not permitted.
- B. Only NEMA starters with replaceable contacts and coils are permitted. NEMA-rated IEC starters are not acceptable.
- C. In non-hazardous locations, motor starters shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
Indoor Dry Non-process Area	NEMA 12, Painted Steel
Chemical Storage/Transfer Area	NEMA 4X, Fiberglass
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

- D. Starters shall be provided with all coils and controls for 120 VAC operation, unless otherwise indicated on the Drawings.
- E. The minimum control power transformer VA requirements are as shown below. Control power transformers shall be sized as required for the connected loads, plus 25% spare capacity.

Size 1 150 VA

Size 2 150 VA

Size 3 200 VA

Size 4 300 VA

Size 5 500 VA

- F. The panel manufacturer is advised to review the total Contract Documents for additional requirements for space heaters, power factor correction capacitors, and similar equipment which may not be specified in this Division or shown on the Drawings. Control power transformers shall be protected on both the primary and secondary sides.
- G. Each starter shall be supplied with a manually resettable overload relay. Manual reset shall be accomplished by a door mounted overload reset pushbutton, as shown on Drawings. The relays shall be solid state type, with at least one isolated normally open and one isolated normally closed auxiliary contact that operates when a trip condition has occurred. Relays shall be self-powered, have a visible trip indicator, have a trip test function, and have selectable Class 10 or 20 operation. Overload relays shall be set for Class 10 operation unless otherwise directed by the Engineer. Overload relay shall have phase loss protection built in to trip the unit and protect the motor against single phasing. The Contractor shall provide the overload relay model with the correct current range for each application. Overload relay shall have adjustable current range dial. Eutectic alloy and bi-metallic type overload relays are not acceptable.
- H. Control Devices
 - 1. Furnish and install control devices as required and/or shown on the Drawings. The following control devices shall be provided as specified in Electric Controls and Relays (See Referenced Sections):
 - a. Pilot devices (switches, indicating lights, etc.)
 - b. Relays and timers
 - c. Control Terminal blocks
 - I. All control wiring shall be No. 14 AWG (minimum) labeled at each end in accordance with the wiring numbers shown on the accepted shop drawings. Power wiring shall be sized to suit the maximum horsepower rating of unit; No. 12 AWG (minimum). Wiring shall be type MTW rated for 105°C. Wire color coding shall be as specified in Low Voltage Wire and Cable (See Referenced Sections).
 - J. Each motor starter coil shall be equipped with a surge-suppression device for protection of the solid state equipment (e.g. programmable logic controller) wired as part of the control circuit.
 - K. Individual magnetic motor starters shall be as manufactured by Eaton using NEMA rated Freedom Series starters and contactors, the Square D Company Type S, Allen-Bradley Bulletin 500 Series, or Siemens Energy & Automation, Inc. Class 14 style.

2.3 INDIVIDUAL MANUAL MOTOR STARTERS

- A. Individual manual motor starters in enclosures as specified above shall be furnished and installed for outdoor and indoor exposed work. Furnish and install manual motor starters in outlet boxes with flush wall plates as required for concealed work.
- B. Furnish and install manual motor starters with pilot lights and overload heater elements of correct rating based on motor nameplate data.
- C. Manual motor starters shall be equipped with either a push button or toggle operator with reset device or mechanism accessible without opening the enclosure.
- D. Individual manual motor starters for motors one (1) horsepower and less shall be Eaton Type MS, the General Electric Company equivalent, the Square D Company equivalent, Allen-Bradley equivalent, or Siemens Energy & Automation, Inc. equivalent.
- E. Individual manual motor starters for integral horsepower motors shall be Eaton Type B100 or B101, the General Electric Company equivalents, the Square D Company equivalents, Allen-Bradley equivalent, or Siemens Energy and Automation, Inc. equivalents.

2.4 REDUCED VOLTAGE SOLID STATE STARTER

- A. The solid-state reduced-voltage starter shall be UL Listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, an integral paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing. The starter shall meet all applicable requirements of this Section and other sections in this Division.
- B. The RVSS shall be suitable for continuous operation at 115% of its continuous ampere rating. The Contractor is fully responsible for the review of the mechanical specifications to determine specified motor speed, horsepower and full load amperes. This information is available in the applicable mechanical specifications for each piece of equipment (e.g., water pumps).
- C. The RVSS shall be suitable for the following environmental conditions:
 - 1. Operating Temperature: 0-50 degrees C
 - 2. Humidity: 0-95 percent non-condensing.
 - 3. Altitude: up to 3,300 feet.
- D. The RVSS shall be suitable for operation on a 480 VAC, 3-phase, 60 Hertz system.
- E. The starter shall provide protection against the following conditions:
 - 1. Improper line-side phase rotation. The starter shall stop the motor load if a line-side phase rotation other than A-B-C exists.
 - 2. Phase loss or unbalanced conditions. The starter shall stop the motor load if a 50% or greater current differential between any two phases is encountered.
 - 3. Motor stall conditions.

4. Motor jam conditions.
- F. The following control function adjustments on the device keypad shall be provided:
1. Selectable Torque Ramp Start or Current Limit Start
 2. Adjustable Kick Start Time; 0-2 seconds
 3. Adjustable Kick Start torque; 0-90%
 4. Adjustable Ramp Start Time; 0.5-180 seconds
 5. Adjustable Initial Starting Ramp Torque; 0-100%
 6. Smooth Stop Ramp Time; 0-60 seconds

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All individual motor starters shall be installed as indicated on the Drawings and as recommended by the equipment manufacturer.
- B. Individual motor starters shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

3.2 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions. The following tests are required:
 1. Witnessed Shop Tests
 - a. None required.
 2. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions and NETA acceptance testing specifications, latest edition.

END OF SECTION 262913

SECTION 264113.13 - LIGHTNING PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish, install, test, and place in satisfactory operation a complete lightning protection system as specified herein. This is a performance specification. The Drawings do not show a complete lightning protection system design. The Contractor shall retain the services of a firm specializing in the design, installation, and testing of lightning protection systems.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.3 REFERENCES

UL 96	Lightning System Components
UL 96A	Installation Requirements for Lightning Protection Systems
UL 467	Grounding and Bonding Equipment
ANSI/NFPA 780	Lightning Protection Code
LPI-175	Lightning Protection Institute Standard of Practice

1.4 ACTION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- C. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
- D. Shop drawings for each lightning protection system shall include, but not be limited to:
 - 1. Product data sheets.
 - 2. Complete U.L. approved, full size layout and installation drawings/details with clearly marked dimensions. Drawings shall indicate the exact location of all system components. Drawings shall be signed by a full time employee of the lightning protection system manufacturer who is in responsible charge of this project and has been engaged in the business for at least ten (10) years.
 - 3. Weights of major all components.

4. Bill of material list for each lightning protection system.
 5. Manufacturer's installation instructions.
 6. Manufacturer's and installer's standard warranty.
 7. Evidence of the designer/installers UL listing.
- E. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.5 INFORMATION SUBMITTALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1. The manuals shall include:
1. Instruction books and/or leaflets.
 2. Recommended spare parts list.
 3. Final as-built construction drawings included in the shop drawings incorporating all changes made during the installation.
 4. All other information that was included in the shop drawing submittal.
- B. Additionally, the following shall be submitted after the construction is complete:
1. Test Reports
 2. UL Master Label Certification

1.6 QUALITY ASSURANCE

- A. System designer/supplier qualifications shall be as follows:
1. System components shall be manufactured by a company specializing in lightning protection equipment with a minimum of 5 years documented experience. Company shall be listed in the Section entitled "Lightning Conductor, Air Terminals and Fittings" of the U.L. "Electrical Construction Materials Directory" for at least 5 years previous to this Contract's bid opening date.
 2. The system designer/installer shall be an authorized installer of manufacturer with a minimum of 5 years of documented experience. Designer/Installer shall be listed in the section entitled "Lightning Protection Installation" of the U.L. "Electrical Construction Materials Directory" for at least 5 years previous to this Contract's bid opening date.

1.7 TOOLS AND SPARE PARTS

- A. The lightning protection system shall be furnished with all spare parts as recommended by the equipment manufacturer.

In addition to the manufacturer recommended spare parts, the Contractor shall furnish the following minimum spare parts for each structure provided with a lightning protection system under this Contract:

No. Required	Description
2	Air Terminals
2	Point Tip Protectors

- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.

1.8 HANDLING AND STORAGE

- A. Equipment shall be carefully transported, stored, handled, and set in place in a manner that will prevent damage, misalignment, and distortion to the equipment.
- B. Follow manufacturer's recommendations regarding handling and storage at all times prior to placing the equipment in service.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEMS

- A. General
 - 1. All components and parts of the lightning protection system shall be as specified herein. The materials used shall meet or exceed the material specification requirements of the Underwriters Laboratories, Inc. All materials shall be marked with a UL label or stamp.
 - 2. The complete lightning protection system shall be inspected and included in the Master Label certification.

B. Conductors

1. Conductors shall be aluminum cable, consisting of a minimum of 24 strands of No. 14 AWG aluminum wire. Copper conductors shall be furnished and installed only where required and when in contact with the earth. Where termination of copper conductors is required to aluminum parts, suitable bi-metallic connectors approved for the purpose shall be furnished and installed.

C. Fittings

1. Fittings shall be the bolted type with stainless steel bolts, nuts, and washers. Fittings shall be of cast metal construction specifically designed for the application. Crimp-type fittings are not acceptable. Bi-metallic type fittings shall be furnished where required.

D. Fasteners

1. Fasteners shall be manufactured from non-corrosive material of ample strength and rigidity for the application.

E. Bases

1. Bases shall be bolted style provided with the model to suit the application (i.e. parapet, standing seam, etc.). Bolts, nuts, and washers shall be made of stainless steel. Bases shall be of aluminum or bronze construction, compatible with the material of the surface to which it is attached. Crimp-type bases are not acceptable.

F. Ground Rods

1. Ground rods shall be 3/4-inch by 10-foot 0-inch sectional type copper-clad steel rods; as specified in Section 260526 Grounding and Bonding for Electrical Systems; quantity as required. Ground rods and all associated hardware shall be UL 467 listed.

G. Air Terminals

1. Air terminals shall be solid aluminum. Air terminals shall be tapered or blunt tip type to suit the application and furnished with air terminal bases and safety tips (ball or bullet type) for impalement protection.

H. Thru-Roof Hardware

1. Thru-roof penetrations shall have stainless steel nuts, bolts, and washers. Sealing washers and sealing boots shall be provided as required and shall be compatible with the roofing material. Conductor connections to this roof hardware shall be by bolted connection. Crimp type connections are not acceptable.
1. Manufacturer shall be:
 1. A-C Lightning Security, Inc.,
 2. Thompson Lightning Protection, Inc

3. Lightning Elimination and Consultants
4. Modern Lightning Protection Company, Inc.
5. Or Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The lightning protection system shall be furnished and installed in accordance with the manufacturer's installation instructions. One (1) copy of these instructions shall be included with the system components at time of shipment. The system components shall be suitably protected until accepted by the Owner.
- B. The equipment shall be installed in accordance with the manufacturer's recommendations. This shall include, but not be limited to the following:
 1. Course all main down conductors to maintain a downward or horizontal run free of pockets or sags. Maintain an eight-inch (8") minimum radius and make no bend greater than 90 degrees. Follow the most direct route with inductance bonding conductors maintaining the horizontal or downward course of the main conductor. Interconnect roof conductors to provide at least two paths to ground from each terminal and to form closed loops. Follow the most direct path possible with down conductors between roof conductors and ground terminals. All down conductors for new occupiable buildings shall be placed in a concealed manner. Down conductors for existing occupiable structures, tanks, basins, and other non-occupiable structures may be installed exposed.
 2. Install ground connections at no less than 60-foot intervals and at each down conductor on perimeter. If the structure has a ground grid, the ground rods from that grid may be used for connection to the down conductors. At each ground connection, determine the extent of the grounding arrangement according to the volume and type of soil encountered and the lowest expected moisture content. Have the Owner's representative observe each ground connection. Bond together all electrical service, telephone service, and lightning protection grounds to all underground metallic piping systems as required by Article 250 of the NEC.
 3. The structural steel frame (where provided) may substitute for main down conductors provided the frame is electrically continuous and of adequate cross-section. Where the steel frame is utilized, connect the roof conductor to steel at least as often and at the same column as the ground connections. Make connections to steel with exothermic welds wherever possible. Provide bonding as required to make the entire metal frame continuous.
 4. Bond all sizable metal objects within 6-feet of down, roof, or grounding conductors to the system. Use only approved fittings and conductors.
 5. Wherever possible problems with corrosion are encountered, use substitute approved materials and/or provide corrosion protection. Use bimetallic or other specially designed and approved connectors where dissimilar metals are to be joined.
 6. Install air terminals within 2-feet of the edge of structure and at intervals not greater than 20-feet along perimeter and peak. Provide additional terminals to limit spacing across roof to

50-feet maximum. Bond any exposed metallic object or surface to the roof conductor. Flash all terminal or conductor penetrations in the roof to conform to the roofer's requirements.

7. Record each ground connection location and mark up a reproducible copy of the approved shop drawings with their location. Also, indicate any substantial field modifications on these drawings. These drawings shall be included in the O&M manual.
8. Log all continuity tests of metal framing, ground grid connections, bonding, and similar connections. Indicate the location of tests or plans. Include test results in the O&M manual.
9. Retain U.L. to make an inspection of the completed installation and issue a Master Label Certification. Furnish a copy of the Certification to the Owner upon receipt.

3.2 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Field Tests

- a. After installation, the lightning protection system shall be tested for continuity to the ground grid. The tests shall be made by the lightning protection system installer. Test shall be as follows:
 - i. Record the resistance between each down conductor and the ground grid to ensure a suitable low-resistance connection. All resistance values shall be 1 ohm or less. Test shall be made after the ground grid has been installed and tested per the requirements of Section 260526 Grounding and Bonding for Electrical Systems.

END OF SECTION 264113.13

SECTION 264300 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish, install, and place in satisfactory operation, the surge protective devices (SPD) as specified herein and indicated on the Drawings.
- B. The surge protective devices specified under this Section shall be provided as a stand-alone unit, separate from the enclosure of the equipment to which they are connected. The requirements of this Section shall not apply to equipment where an integral SPD is specified.

1.2 REFERENCED SECTIONS

- A. General Conditions – COORDINATION AND MEETINGS
- B. General Conditions – SUBMITTALS
- C. Section 264300 – COMMON WORK RESULTS FOR ELECTRICAL
- D. Section 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- E. Section 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

1.3 REFERENCES

UL 1449	Surge Protective Devices
UL 1283	Electromagnetic Interference Filters
IEEE C62.41.1	Guide for Surge Voltages in Low-Voltage AC Power Circuits
IEEE C62.41.2	Recommend Practice on Characterization of Surges in Low Voltage (100V and Less) AC Power Circuits.
IEEE C62.45	IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits
IEEE C62.62	IEEE Standard Test Specifications for Surge Protective Devices for Low Voltage (1000V and Less) AC Power Circuits
NFPA 70	National Electric Code (NEC)

1.4 ACTION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Product Datasheets.
- C. Layout Drawings - Show complete layout, including materials, sizes, locations, and dimensions.
- D. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section.

In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

- E. Proof that all products provided under this Section are UL listed and labeled by Underwriters Laboratories to UL1449, latest Edition. This proof shall be a copy of the data listed under the UL File Number for the manufacturer, which may be obtained from the UL Online Certification Directory. No other means of proving compliance (such as manufacturer data sheets, marketing material, etc) will be considered acceptable.
- F. Proof of Short Circuit Current Ratings (SCCR), Voltage Protection Ratings (VPRs) for all modes, Maximum Continuous Operating Voltage rating (MCOV), Nominal Discharge Current (In), and device listing Type shall be submitted using the same means as described in the paragraph above.
- G. Proof that all products provided under this Section are UL listed and labeled by Underwriters Laboratories to UL 1283, latest Edition. This proof shall be a copy of the data listed under the UL File Number for the manufacturer, which may be obtained from the UL Online Certification Directory. No other means of proving compliance (such as manufacturer data sheets, marketing material, etc.) will be considered acceptable.
- H. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "Soft Cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are to provide are acceptable and shall be submitted.

1.5 INFORMATION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Prior to start-up, submit manufacturer's operation and maintenance manuals and recommended spare parts list, including but not limited to:
 - 1. Manufacturer's equipment warranty.
 - 2. Copies of Submittals
 - 3. Functional descriptions, operating instructions, calibration and adjustment, recommended maintenance, safety
 - 4. Contact information for local representative and supplier

1.6 FACTORY TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions. The following tests are required:

1. Factory Shop Tests

- a. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, ANSI, and UL standards.
- b. All surge protective devices, subassemblies, and components shall be 100% tested and certified by the manufacturer to meet their published performance parameters.

1.7 TOOLS AND SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished by the Contractor to the Owner.
- B. The Contractor shall furnish three (3) spare field replacement module of each rating provided under this Contract.
- C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner.
- E. Spare parts lists, included with the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- F. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.

1.8 HANDLING AND STORAGE

- A. Equipment shall be carefully transported, stored, handled, and set in place in a manner that will prevent damage, misalignment, and distortion to the equipment.
- B. Follow manufacturer's recommendations regarding handling and storage at all times prior to placing the equipment in service.

1.9 GUARANTEES AND WARRANTY

- A. All SPDs, associated hardware, and supporting components shall be warranted to be free from defects in materials and workmanship, under normal use and in accordance with the instructions provided, for a period of five (5) years after acceptance of the equipment by the Owner.
- B. Any component or subassembly contained within the surge protection system that shows evidence of failure or incorrect operation during the five (5) year warranty period, shall be replaced by the manufacturer at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The SPD units shall be UL 1449 Listed and must bear the UL mark. Units that are “manufactured in accordance with” UL 1449 or tested by other testing agencies “in accordance with” UL 1449 are not acceptable and will be rejected.
- B. Type II SPD units shall be UL 1283 Listed and must bear the UL mark. Units that are “manufactured in accordance with” UL 1283 or tested by other testing agencies “in accordance with” UL 1283 are not acceptable and will be rejected. Further, SPD units using UL 1283 capacitors but not tested to UL 1283 will be rejected.
- C. SPDs shall be provided internal to the equipment to which it is connected unless otherwise specified. SPDs mounted externally shall have the shortest possible cable length between the SPD and the device it is connected to.
- D. All SPDs furnished and installed under this Contract shall be from the same manufacturer.

2.2 PRODUCTS

- A. Type I surge protective devices (SPD) shall be furnished and installed when shown without upstream overcurrent protection on the Drawings. Type II SPDs shall be provided in all other locations. Type II SPDs shall not require the use of a specific upstream overcurrent device. SPDs shall be provided in the location and quantity as shown on the Drawings.
- B. Each SPD shall be rated for the voltage and configuration of the equipment to which it is connected.
- C. Each Type II SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.
- D. The short circuit current rating of each SPD shall match or exceed the rating of the equipment to which it is connected. The Contractor shall reference the Drawings for short circuit current rating of each piece of equipment.
- E. Each SPD system shall provide surge protection in all possible modes. Surge protection shall be as follows:

SYSTEM CONFIGURATION	MODES OF PROTECTION	NUMBER OF MODES
3-Phase Wye	L-N, L-G, N-G	7
3-Phase Delta	L-L, L-G	6
3-Phase Impedance Grounded	L-L, L-G	6
Single-Phase	L-N, L-G, N-G	3

- F. Each SPD shall have a Maximum Continuous Operating Voltage (MCOV) of at least 115% of the nominal voltage of the equipment to which it is connected.
- G. The Nominal Discharge Current (In) of each SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.
- H. The Voltage Protection Rating (VPR) of each SPD shall not exceed the following:

SYSTEM VOLTAGE	L-N	L-G	L-L	N-G
208Y/120	600V	1000V	1000V	600V
480Y/277	1200V	1800V	2000V	1000V
480 DELTA	N/A	1800V	3000V	N/A
240 DELTA	N/A	1200V	1500V	N/A
120/240	600V	1000V	100V	600V

- I. The surge current rating for each SPD shall be as indicated on the Drawings. Surge current ratings are indicated on single line diagrams and in panel schedules. Surge current rating indicated is on a per phase basis.
- J. Each SPD shall be provided in an enclosure to match or exceed the NEMA rating of the equipment enclosure that it is serving (i.e., NEMA1, NEMA 12, NEMA 4X, etc.).
- K. Each SPD shall be provided with the following accessories:
 - 1. Each individual module shall feature an LED indicating the individual module has all surge protection devices active. If any single component is taken off-line, the LED shall turn off and another LED shall illuminate, providing individual module as well as total system status indication.
 - 2. Surge counter and audible alarm with reset/silence switch.
 - 3. One set of Form C (SPDT) dry contacts rated for at least 5A at 120VAC.
- L. Manufacturer shall be:
 - 1. Eaton
 - 2. Schneider (Square D)
 - 3. Thor Systems
 - 4. ASCO/Emerson Network Power
 - 5. Or Engineer Approved Equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The SPD units shall be furnished and installed as shown on the Drawings and in accordance with the manufacturer's installation instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- B. The SPD units shall be mounted such that the conductor lengths are as short as possible, but no greater than 36 inches. Any installation resulting in a conductor length of greater than 36 inches shall be reviewed with the Engineer as a special type of cable may need to be installed. For equipment such as panelboards, the Contractor shall relocate the circuit breaker that is to be connected to the SPD as needed to achieve the shortest conductor length possible.
- C. The Contractor shall use a close nipple to enclose the conductors between the SPD and the equipment served.
- D. Conductors between the equipment served and the SPD shall be 600V power wire and cable as specified in Low Voltage Wire and Cable (See Referenced Sections). The individual conductors shall be gently twisted and shall be sized as indicated on the Drawings.

3.2 TESTING [AND STARTUP]

- A. Prior to energizing, the Contractor shall verify that the SPD unit voltage and configuration is suitable for the system to which it is connected.
- B. Prior to energizing, the Contractor shall also verify that any Neutral to Ground bonding jumpers are installed as required.
- C. Prior to energizing, the Contractor shall also verify that the impedance of the equipment grounding conductor between the SPD and the grounding electrode system is less than 1 ohm.

END OF SECTION 264300

SECTION 265000 - LIGHTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish and install all lighting fixtures, labor, and material, in accordance with the preceding Specifications, the requirements of this Section, and as shown on the Drawings.
- B. Lighting shall be in accordance with the latest requirements of the Illuminating Engineering Society, and all lighting fixtures shall have the Underwriters Laboratories, Inc. label of approval.
- C. All wiring shall be placed in conduit and shall comply with the Specifications for conduit, outlet boxes, pull and junction boxes, wires and cables, grounding, and other Sections as set forth in these Specifications and as noted herein.

1.2 REFERENCED SECTIONS

- A. General Conditions - COORDINATION AND MEETINGS
- B. General Conditions - SUBMITTALS
- C. Section 260500 – COMMON WORK RESULTS FOR ELECTRICAL
- D. Section 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.3 REFERENCES

UL 924	Emergency Lighting and Power Equipment
UL 844	Luminaries for Use in Hazardous (Classified) Locations
UL 1598	Luminaries
ANSI C62.41	Guide for Surge Voltages in Low-Voltage AC Power Circuits
IESNA LM-80-08	IES Approved Method for Measuring Lumen Maintenance of LED Light Sources
IESNA TM-21	IESNA Projecting Long Term Lumen Maintenance of LED Light Sources
NFPA 70	National Electric Code

1.4 ACTION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Shop Drawings shall include but not be limited to:

1. Product Datasheets
 2. Layout Drawings - Show complete layout, including materials, sizes, classes, locations, and dimensions.
 3. Results of shop tests, if required.
 4. Catalog cuts for each fixture type showing performance and construction details of standard fixtures, and complete working drawings showing all proposed construction details of special or modified standard fixtures.
 5. Photometric curves.
 6. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens.
 7. Custom wiring diagrams for each individual lighting contactor. Standard wiring diagrams that are not custom created by the manufacturer for the individual lighting contactors for this project are not acceptable. One wiring diagram which is typical for all lighting contactors is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.
 8. System (entire fixture assembly) efficiency data.
- C. Shop drawings shall be submitted to the Engineer for review and acceptance for all fixtures before fixtures and poles are manufactured. Substitutions will be permitted only if acceptable to the Engineer.
- D. Manufacturer's catalog number and description in the fixture schedule on the Contract Documents establishes a level of quality, style, finish, etc. The use of a catalog number describing the various types of fixtures shall be used as a guide only, and does not exclude all the required accessories or hardware that may be required for a complete installation.
- E. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.
- F. If a fixture is submitted as an "Equal" the Engineer may request a copy of the regulatory file be provided by the contractor to verify compliance with the UL Listing requirement.

1.5 INFORMATION SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions, and as specified herein.
- B. Prior to start-up, submit manufacturer's operation and maintenance manuals and recommended spare parts list, including but not limited to:
 - 1. Manufacturer's equipment warranty.
 - 2. Copies of Submittals
 - 3. Functional descriptions, operating instructions, calibration and adjustment, recommended maintenance, safety
 - 4. Contact information for local representative and supplier

1.6 FACTORY TESTING

- A. The lighting fixtures shall be given routine factory tests in accordance with the requirement of ANSI, NEMA and Underwriters Laboratories standards.

1.7 TOOLS AND SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. The following minimum spare parts shall be furnished:
 - 1. A minimum of one (1) LED driver for every type of fixture installed.
 - 2. A minimum of one (1) set of LED arrays for every type of LED fixture with replaceable LED arrays.
 - 3. If either the arrays or the driver are not replaceable, a minimum of one (1) spare fixture of each type must be provided.
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.8 HANDLING AND STORAGE

- A. Equipment shall be carefully transported, stored, handled, and set in place in a manner that will

prevent damage, misalignment, and distortion to the equipment.

- B. Follow manufacturer's recommendations regarding handling and storage at all times prior to placing the equipment in service.

1.9 GUARENTEES AND WARRANTY

- A. Fixtures shall carry a minimum one (1) year warranty from the date of Substantial Completion, that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer's recommendations. The manufacturer shall correct any breach in this warranty at their expense.
- B. LED fixtures shall carry a minimum 50,000 hour warranty on the LEDs and the ballast.

PART 2 - PRODUCTS

2.1 FIXTURES

- A. Each fixture shall bear the Underwriters Laboratories, Inc. label. All lighting fixtures shall be furnished complete with lamps of the size and type as indicated on the Drawings and all fittings and hardware necessary for a complete installation. Lighting fixtures shall have all parts and fittings necessary to completely and properly install the fixtures.
- B. Fixture leads shall be as required by NEC and shall be grounded by the equipment grounding conductor in the conduit.
- C. All glassware shall be high quality, homogeneous in texture, uniform in quality, free from defects, of uniform thickness throughout, and properly annealed. Edges shall be well rounded and free from chips or rough edges.
- D. HID fixture housings shall be finished with a seven-stage phosphate pretreatment and thermal-set, electrostatically applied polyester paint. Color shall be as indicated in the fixture schedule or as selected by the Engineer.
- E. Indoor metal halide fixtures shown in non-hazardous locations shall be furnished with a tungsten/halogen lamp and time delay relay as specified in the fixture schedule or indicated on the Drawings. For hazardous locations where this feature is not available, emergency fixtures shall be provided with a time delay feature.
- F. Emergency fixtures shall be UL 924 listed and have a minimum 90 minutes battery back-up.
- G. Fixtures for use in hazardous locations shall be UL 844 Listed.
- H. Fixtures specified to be damp or wet locations rated shall be UL 1598 listed.
- I. Fluorescent fixtures shall be complete with housing, louvers (if required), and accessories of the types and quantities specified herein and indicated on the Drawings.
- J. Fixtures shall be as specified in the fixture schedule on the Drawings.

2.2 LED DRIVERS

- A. Drivers shall have a voltage range of (120-277) +/- 10% at a frequency 60Hz.
- B. All drivers shall be designed to a power factor >90% with a total harmonic distortion THD <20% at full load.
- C. Case temperature shall be rated for -40°C through +80°C.
- D. Drivers shall have overheat protection, self-limited short circuit protection and overload protected.
- E. Drivers shall be furnished with a fused primary. Fixtures operating on 208V, 240V, or 480V shall have double-fusing with fuses present on all line connections.
- F. Drivers shall have an output current ripple <30%
- G. Drivers shall have a five year (50,000 hour) warranty.
- H. Drivers shall be manufactured by Advance, Universal or equal.
- I. Drivers shall be UL Listed for damp location, UL1012, UL935, ROHS.
- J. Drivers shall meet FCC 47 Sub Part 15.
- K. All drivers shall be provided with ANSI/IEEE C62.41 Category C (10kV/5kA) surge protection.

2.3 LEDs

- A. Luminaires provided with LED technology shall utilize high brightness LEDs.
- B. Color Temperature: as specified in fixture schedule.
- C. Junction point shall be designed and manufactured to allow adequate heat dissipation.
- D. LEDs shall be rated for 50,000 hours of life, minimum (based on IESNA L70). The 50,000 hour life guarantee shall be based on in-fixture tests. LED L70 lifetime values that are collected with the LED not installed in the submitted fixture are not acceptable.
- E. Manufacturer shall be:
 - 1. As shown on the fixture schedule in the Drawings. Equivalent fixtures are only acceptable or permitted if "or Equal" is called out on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures shall be located symmetrically with building lines as shown on the Drawings. The Contractor shall furnish and install the lighting fixtures to allow "convenient" access for maintenance such as cleaning, relamping, and other activities. The fixtures shall be installed to be accessed by a 12 ft. (max.) ladder. Where fixtures are shown in locations on the Drawings

where maintenance would be difficult, the Contractor shall notify the Engineer for direction.

- B. The Contractor shall provide and install all inserts, conduit, structural supports as required, lamps, ballasts, poles, wiring, and any other items required for a complete system. Contractor shall properly adjust and test, to the satisfaction of the Engineer, the entire lighting system. The Contractor shall provide pigtails and flexible conduit connected to an outlet box where necessary or required resulting in a neat and complete installation.
- C. The Contractor shall protect all fixtures at all times from damage, dirt, dust, and the like. Before final acceptance, all fixtures and devices shall be cleaned of all dust, dirt or other material, be fully re-lamped (except LED fixtures) and in operating condition to the satisfaction of the Engineer.
- D. The Contractor shall furnish and install all pendant trapezes and pendant stem hangers with durable swivel or equivalent trapeze hanger permitting normal fixture motion and self-alignment. Fixture pendants shall be Appleton Type UNJ ball type flexible hanger at the fixture and supports from an Appleton JBLX junction box with JBLX hub cover, or equal. Pendant lengths shall be adequate and adjusted to provide uniformity of installation heights above the reference datum. Stems shall be one piece, with matching canopies and fittings.
- E. Fixtures located on the exterior of the building shall be provided with neoprene gasket and nonferrous metal screws finished to match the fixtures.
- F. The finish or exposed metal parts of lighting fixtures and finish trims of all recessed lighting fixtures shall be as directed by the Engineer.
- G. The Contractor shall furnish and install recessed fixtures with a separate junction box concealed and located as to be accessible when fixture is removed.
- H. The Contractor shall furnish and install all boxes for lighting fixtures such that the box is not the sole support of the fixture. The boxes shall be offset to allow maintenance such that access to wiring within the box can be attained without having to consider supporting (holding) the fixture.
- I. All lighting units, when installed, shall be set true and be free of light leaks, warps, dents, and other irregularities. All hangers, cables, supports, channels, and brackets of all kinds for safely erecting this equipment in place, shall be furnished and erected in place by the Contractor.
- J. The Contractor shall install fixtures at mounting heights indicated on the Drawings or if not indicated on the Drawings they shall be located as shown below. In areas with exposed ducts and/or piping, installation of lighting fixtures shall be adapted to field conditions as determined by the Engineer.
 - 1. Fixtures located on the exterior of the building shall be located a minimum of 10 Feet above grade.
 - 2. Ceiling mounted fixtures shall be mounted directly to the ceiling.
- K. The Contractor shall support each fixture securely. Each fluorescent or LED fixture shall be secured to the building structure. The Contractor shall not secure fixtures to the work of other trades, unless specified or noted otherwise, and shall not support fixtures from plaster. The Contractor shall furnish and install all steel members and supports as required to fasten and

suspend fixtures from the structure.

- L. In all mechanical equipment areas, the Contractor shall install lighting fixtures on the ceiling after all piping and equipment therein has been installed. Exact locations for such fixtures may be determined by the Engineer on the site during the course of the work.
- M. Upon completion of work, and after the building area is broom clean, all fixtures shall be made clean and free of dust and all other foreign matter both on visible surfaces, and on surfaces that affect the lighting performance of the fixture including diffusers, lenses, louvers, reflectors, and lamps.
- N. All fixtures that require physical adjustment shall be so adjusted in accordance with the directions of the Engineer. The Contractor shall also adjust angular direction of fixtures and/or lamps, as directed.
- O. Relamping access of fixtures including LED fixtures shall require no special tools. All optical control surfaces such as lenses and reflectors shall be safely and securely attached to fixtures and shall be easily and quickly removed and replaced for cleaning without the use of special tools. No fixture part that may be removed, for maintenance, shall be held in place by metal tabs that must be bent to remove said part.
- P. The Contractor shall furnish and install time switches and photocells as specified herein or indicated on the Drawings. Time switches shall be provided with a manual bypass switch controlling the lights locally and remotely. Time switches shall control contactors, relays, or direct controlling of one, two, or three lighting circuits, as indicated. The Contractor shall furnish and install photocells as specified herein or indicated on the Drawings for automatic "ON/OFF" switching of outdoor lighting.
- Q. Lighting contactors shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

3.2 TESTING [AND STARTUP]

- A. Field testing shall be done in accordance with the requirements specified in the General Conditions, and NETA Acceptance Testing Specifications, latest edition.

END OF SECTION 265000

SECTION 312000 - EARTH MOVING

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. Preparing subgrades for walks, pavements and turf and grasses.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slab-on-grade.
4. Subbase course and base course for asphalt paving.
5. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:

1. Division 01 Section "Construction Progress Documentation" recording pre-excavation and earth moving progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
3. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
4. Division 31 Section "Site Clearing" for site stripping, grubbing and removal of above- and below-grade improvements and utilities.
5. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
6. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

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. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. 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. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
 - 3. 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 without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom; measured according to SAE J-1179.
 - 2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp (172-kW) flywheel power and developing a minimum of 47,992-lbf (213.3-kN) breakout force with a general-purpose bare bucket; measured according to SAE J-732.
- I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume that exceed a standard penetration resistance of 100 blows/2 inches (97 blows/50 mm) when tested by a geotechnical testing agency, according to ASTM D 1586.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Warning tapes.
- B. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Warning Tape: 12 inches (300 mm) long; of each color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each on-site soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.7 PROJECT 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.
- B. Utility Locator Service: Notify "Miss Utility" for area where Project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Section 311500 "Erosion and Sedimentation Control," are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, CL, ML and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than

3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.
- J. Sand: ASTM C 33; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
 - 1. Red: Electric
 - 2. Blue: Non-potable Water systems
 - 3. Green: Sanitary Sewer

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: are not permitted on site and are not acceptable.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms of exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
- B. Crushed Stone:

1. Definition: Unless stated otherwise, crushed stone shall conform to either ASTM C-33 with gradation number 57 or VDOT Road and Bridge specification with size number 58.
2. Placement: Unless otherwise specified, this material shall be placed and consolidated if necessary to achieve maximum density in place.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
 1. Clearance: 12 inches (300 mm) each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of

pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduits less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms to support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depression with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms to support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

- D. Pavement Removal and Replacement: If the route of pipe transverse paved areas, the existing pavement shall be removed as little as practical, but shall provide at least 6 inches of undisturbed earth between the excavation and pavement left in place. Cut into pavement shall be made or trimmed to meet straight edges with undamaged pavement left in place. Replacement of pavement will conform to VDOT Road and Bridge Standards.

3.8 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.
- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph (5 km/h).
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Engineer.
1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.10 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.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable and subdrainage.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Miscellaneous Cast-in-Place Concrete."
- D. Backfill voids with satisfactory soil while removing shoring and bracing.
- E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- G. Install detectable warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under footings and foundations, use engineered fill as shown on drawing.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
 - 2. Walks: Plus or minus 1 inch (25 mm).
 - 3. Pavements: Plus or minus 1/2 inch (13 mm).

3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1. Place base course material over subbase course under hot-mix asphalt pavement.
 - 2. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 3. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
 - 4. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 5. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.18 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.

3. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.20 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 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.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

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 construction dewatering.
- B. Related Requirements:
 - 1. Section 312000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.
 - 1. Include plans, elevations, sections, and details.
 - 2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
 - 3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
 - 4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- 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 before Work begins.
- D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

PART 2 - PRODUCTS

2.1 PERFORMANCE 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 ground water and permit excavation and construction to proceed on dry, stable subgrades.
 - 1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
 - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 5. Remove dewatering system when no longer required for construction.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 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 311000 "Site Clearing," during dewatering operations.

3.2 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.

3.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
 - 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 3. Maintain piezometric water level a minimum of 24 inches (600 mm) below bottom of excavation.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches (900 mm) below overlying construction.

3.4 FIELD QUALITY CONTROL

- A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.
 - 1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
 - 2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
 - 3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Survey-Work Benchmarks: Resurvey benchmarks monthly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.
- C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.
- D. Prepare reports of observations.

3.5 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 312319

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION (TRENCHING)

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 support and protection systems.
- B. Related Sections:
 - 1. Division 32 Section "Earth Moving" for Utility Trenching

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - 1. Delegated Design: Design excavation support and protection system to provide safe excavation and installation of new utilities and below grade structures and facilities.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

1.4 SUBMITTALS

- A. Shop Drawings: For excavation support and protection system.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify Owner no fewer than two (2) days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Owner's written permission.
 - 3. Interruption of utilities shall be in accordance with expressly written direction of the Utility Owner.
 - 4. Provide all temporary service and bypass pumping requirements during construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. 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.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 - 1. Fill voids immediately with approved backfill compacted to density specified in Division 31 Section 312000 – "Earth Moving."
 - 2. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

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. Hot-mix asphalt paving overlay.
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 - 1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- B. Qualification Data: For qualified manufacturer and Installer.
- C. Material Certificates: For each paving material, from manufacturer.
- D. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 2. Slurry Coat: Comply with weather limitations in ASTM D 3910.
 - 3. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
 - 4. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22.
- B. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

- C. Water: Potable.
- D. Undersealing Asphalt: ASTM D 3141, pumping consistency.

2.3 AUXILIARY MATERIALS

- A. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.
- B. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type I, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - 2. Base Course: 3"
 - 3. Surface Course: 2"
- B. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1 1/2.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 2 inches (50 mm).
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Keep milled pavement surface free of loose material and dust.

3.3 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.4 REPAIRS

- A. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).
 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.
 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 2. Protect primed substrate from damage until ready to receive paving.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 2. Place hot-mix asphalt surface course in single lift.
 3. Spread mix at minimum temperature of 250 deg F (121 deg C).
 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
 3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered"

method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
 2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 1. Base Course: Plus or minus 1/2 inch (13 mm).
 2. Surface Course: Plus 1/4 inch (6 mm), no minus.

- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch (6 mm).
 - 2. Surface Course: 1/8 inch (3 mm).

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.11 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow milled materials to accumulate on-site.

END OF SECTION 02741

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. Hydroseeding.
- 3. Erosion-control material(s).

- B. Related Sections:

- 1. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.

1.3 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

- H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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.
- C. Qualification Data: For qualified landscape Installer.
- D. Product Certificates: For soil amendments and fertilizers, from manufacturer.
- E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: Three years of experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 4. Personnel Certifications: Installer's personnel assigned to the Work shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Certified Landscape Technician - Exterior, with installation specialty area(s), designated CLT-Exterior.
 - b. Certified Turfgrass Professional, designated CTP.
 - c. Certified Turfgrass Professional of Cool Season Lawns, designated CTP-CSL.

1.6 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 conformance 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 fertilizers, lime, and soil amendments with appropriate certificates.

1.7 PROJECT CONDITIONS

- A. 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 AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: State-certified seed of grass species as listed on plans.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.
 2. Provide lime in form of ground dolomitic limestone.

2.3 FERTILIZERS

- A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.4 PLANTING SOILS

- A. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native

surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

1. Mix existing, native surface topsoil with the following soil amendments and fertilizers at the rate shown on plans.

2.5 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.
- C. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- D. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- E. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.6 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 (150 mm) long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- C. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 3-inch (75-mm) nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Invisible Structures, Inc.; Slopetame 2.
 - b. Presto Products Company, a business of Alcoa; Geoweb.
 - c. Tenax Corporation - USA; Tenweb.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
 - 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. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable and which is too 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 Engineer 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 TURF AREA PREPARATION

- A. Limit turf subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.

2. Spread planting soil to a depth of 4 inches (100 mm) but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top [2 inches (50 mm)] [4 inches (100 mm)] of subgrade. Spread remainder of planting soil.
- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- D. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- E. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Turf Area Preparation" Article.
- 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.

3.5 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

- C. 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.
- D. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.
- E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) 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. (38 to 49 L/92.9 sq. m). Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- F. Protect seeded areas from hot, dry weather or drying winds by applying planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch (4.8 mm), and roll surface smooth.

3.6 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
 - 2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre (15.6-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.7 TURF RENOVATION

- A. Renovate existing turf.
- B. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - 2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).
- I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches (100 mm) of existing soil. Install new planting soil to fill low spots and meet finish grades.
- J. Apply seed and protect with straw mulch as required for new turf.
- K. Water newly planted areas and keep moist until new turf is established.

3.8 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Engineer:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.9 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. 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.
- C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 331200 – VALVES AND APPURTENANCES

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. This section shall include furnishings, installing, adjustment, painting, etc. as specified and indicated on the drawings complete and ready for use.
- B. Related selections:
 - 1. Division 26 – Electrical for power that maybe required to operate the valves and appurtenances.
 - 2. Division 33 Section “Facility Pressure Piping” for piping and testing requirements.

1.3 SUBMITTALS

- A. The Contractor shall submit shop drawings for all items of equipment specified in this section and as required in Division 01 Section 013300.
 - 1. All valves, air valves, valve boxes or enclosures and other appurtenances stating manufacturer and sufficient detail to show compliance with these specifications.
- B. Owner’s Manuals. Operations and maintenance information and equipment maintenance summary sheets shall be furnished for the equipment specified herein.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicated size, profiles, and dimensional requirements of valves specialties and are based on the specific types and models indicated. Other manufacturer’s products with equal performance characteristics may be considered. Refer to Division 01 Section “Substitutions”.
- B. Comply with requirements of utility supplying water including backflow prevention.
- C. Comply with NFS 61, “Drinking Water System Components – Health Effects” for materials being installed on potable water system.
- D. Comply with NFPA 20, “National Electrical Code,” for electrical connections between wiring and electrically operated devices.
- E. Provide listing/approved stamp, label, or other marking on specialties made to specified standard.

- F. Listing and Labeling: Provide electrically operated specialties and devices specified in this Section that are listed and labeled.
 - 1. The terms “listed” and “labeled” as defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” as defined in OSHA Regulation 1910.7.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure valves are dry and internally protected against waste and corrosion.

PART 2 - PRODUCTS

2.1 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves (4 inches and larger):
 - 1. Available Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - b. McWane, Inc.; Kennedy Valve Div.
 - c. Mueller
 - d. Approved Equal
 - 2. Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient wedge, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 250 psig.
 - 3) End Connections: As required.
 - 4) Interior Coating: Complying with AWWA C550.
- B. Bronze Gate Valves (3 inches and smaller):
 - 1. Nonrising system.
 - 2. Maximum psi rating: 200 psig (1380 kPa).
 - 3. End Connections: NPT (F).

2.2 GATE VALVE ACCESSORIES

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.
 - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2. Tapping valves shall be the same valves, subject to the standards, providing that tapping valves shall have the tapping ring.
3. All valves shall open left (counter clockwise).

B. Valves installed above grade or in vaults shall have flanged ends, with handwheel. Valves below grade shall have bell and spigot or mechanical joint ends with non-rising stem and valve box. The Contractor shall refer to the Drawings for all exceptions. Valve stems shall be manganese bronze with threads accurately cut to gauge. All valves shall have a clear waterway of full diameter of the valve. The handwheel or 2" square operating nut of each valve shall have an arrow cast on it showing the direction of opening. Where required, valves shall be equipped with gearing having a ratio of not less than 2 to 1. Gears and shafting shall be approved types and materials. Pinion shafts shall be bushed with bronze, composition A, and shall be provided with suitable oil holes. All gears shall be machine cut.

2.3 CHECK VALVES

A. AWWA Check Valves (4 inches or larger):

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - b. McWane, Inc.; Kennedy Valve Div.
 - c. Approved Equal
2. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
 - a. Standard: AWWA C508.
 - b. Minimum Working Pressure Rating: 200 psig (1380 kPa)
 - c. End Connections: As required.
 - d. Interior Coating: Comply with AWWA C550

B. Valves 3-1/2 inches and smaller shall have solder or threaded ends with all parts bronze or copper. The valve shall have a bronze or composition swing disc suitable for the service use of the valve. Valves will comply with Federal Specification WW-V-51, Class A, Type IV. Valves with solder-joint ends shall conform to USAS B 16.18 for Cast Brass Solder-Joint Fittings.

C. Check Valves 4 inches and larger shall be iron body, bronze mounted, full opening swing check valves. Outside weight and lever or outside spring and lever check valves will be installed. These valves shall be furnished with the type ends required for the piping in which they are installed.

D. Check Valves (less than 2 inches):

1. Description: PVC True Union Swing Check Valves.
 - a. Mount either in vertical or horizontal position.

- b. Seat: EPDM
- c. Flapper: BUNA-N
- d. Max Pressure PSI Rating: 125 psi
- e. Connections: Socket

2.4 PLUG VALVES

A. Plug Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufactures offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. McWane, Inc.; M&H Valve Company Div.
 - b. Val-Matic Valve & Manufacturing Corp.
 - c. Approved Equal
2. Description: Resilient-seated eccentric.
 - a. Standard: MSS SP-108.
 - b. Body: Cast iron.
 - c. Pressure Rating: 175-psig minimum CWP.
 - d. Seat Material: Suitable for potable-water service.
3. Plug valves for sewage and sludge shall be permanently lubricated eccentric plug valves, suitable for at least 125 psi working pressure. Valves installed in horizontal runs of pipe shall be mounted with the plug horizontal and at the top of the body when the valve is open, except as otherwise specified. Valves installed in pipe lines carrying suspended or settleable solids shall be mounted with higher pressure (upstream) against plug face (seat side) when valve is in closed position.
4. Plug valve pressure ratings shall be as follows and shall be established by hydrostatic tests as specified by ANSI Standard B16-1-1967. Pressure ratings shall be 175 psi for valves through 12", 150 psi for valves in sizes 14" through 36" and 125 psi for valves in sizes 42" and larger. Valves shall be capable of providing drip-tight shutoff up to the full rating with pressure in either direction. Valve bodies shall be of ASTM A126 Class B cast iron, in compliance with AWWA Standard C-504, Section 54. All exposed nuts, bolts, springs, washers, etc. shall be zinc plated. Resilient plug facings shall be neoprene, suitable for use with sewage. Valves shall be furnished with corrosion resistant seats which comply with AWWA Standard C507, Section 7, paragraph 7.2, and with AWWA Standard C504 Section 8.3. Seats in 3" and larger valves shall have a welded-in overlay of not less than 90% pure nickel on all surfaces contacting the plug face.
5. Plug valves shall be furnished with replaceable, sleeve-type bearings in the upper and lower journals. These bearings shall comply with AWWA Standard C507, Section 8, paragraphs 8.1, 8.3, and 8.4, and with AWWA Standard C504, Section 9. Valves through 20" shall have stainless steel permanently lubricated upper and lower plug stem bushings. Valves 24" and larger shall have stainless steel upper and lower plug stem sleeves and bronze bushings. Valve shaft seals shall comply with AWWA Standard C507, Section 10, and with AWWA C504 Section 10. Stem bushings with "O" ring seals must be in accordance with AWWA C504, Section 10.3, relative to a removable corrosion resistant recess. All valves 4" and larger shall be of the bolted bonnet design. Valves shall be designed so that they can be repacked without removing bonnet from valve. Packing on all valves shall be adjustable.
6. Flanged plug valves shall be faced and drilled to the ANSI 125/150 lb. standard. Mechanical joint ends shall be to the AWWA Standard C111.

7. Bell ends shall be in accordance with AWWA Standard C100, Class B. Screwed ends shall be in accordance with the NPT Standard.
8. Port areas for plug valves through 20" shall be at least 80% of full pipe area. Port areas of 24" and larger valves shall be at least 100% of full pipe area. The port shall be smoothly shaped with an unobstructed waterway when open.
9. All plug valves 8" and larger shall be equipped with gear actuators. All gearing shall be enclosed, suitable for running oil, with seals provided on all shafts to prevent entry of dirt and water into the actuator. All shaft bearings shall be furnished with permanently lubricated bronze, bearing bushings. Actuator shall clearly indicate valve position, and an adjustable stop shall be provided to set closing torque. Valve packing adjustment on non-submerged valves shall be accessible without removing the actuator from the valve. Construction of actuator housing shall be semi-steel. All exposed nuts, bolts and washers shall be zinc plated.
10. Plug valves and actuators for submerged or buried service shall have seals on all shafts, and gaskets on valve and actuator covers, to prevent the entry of water. Actuator mounting brackets for submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs, and washers for submerged valves shall be stainless steel.
11. Gear actuators shall be of the type that can be mounted for remote operation and a high head extension, waterproof, enclosure pipe.
12. Plug Valve Floor Stand - Where specified floor stands shall be the handwheel actuated type with valve position indicator. Buried valves shall have pipe encasements around the shaft extension for protection.

2.5 BUTTERFLY VALVES

A. AWWA Butterfly Valves:

1. Available Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Mueller Co.; Water Products Div.
 - b. Val-Matic Valve & Manufacturing Corp.
 - c. Approved Equal
2. Description:
 - a. Standard: AWWA C504 for Class 150B.
 - b. Body: Cast or ductile iron per ASTM A126, Class B.
 - c. Body Type: Flanged.
 - d. Pressure Rating: 150 psig (1035 kPa).
 - e. Disc: Shall be offset to provide an uninterrupted 360 degree setting edge and shall be cast iron per ASTM A-48 Class 40 or ductile iron per ASTM A-536. The disc seating edge shall be 316 stainless steel. The disc shall be securely attached to the valve using 304 stainless steel pins.

2.6 ELECTRIC VALVE ACTUATORS

A. Electrical Valve Actuators

1. Available Manufacturers: Subject to compliance with requirements, provide the product indicated on drawings or a comparable product by one of the following:

- a. AUMA Actuators, Inc.
- b. Or approved equal.
2. All electric actuators shall conform to the requirements of AWWA Standard C540-93.
3. Actuators shall contain motor, gearing, manual over-ride, limit switches, torque switches, drive coupling, integral motor controls, position feedback transmitter (where required) and mechanical dial position indicator (where required).
4. The motor shall be specifically designed for actuator service. The motor will be of the induction type with class F insulation and protected by means of thermal switches imbedded in the motor windings. Motor enclosure will be totally enclosed, non-ventilated.
5. Motor shall operate on 120 volt - single phase - 60 hertz power.
6. Actuator enclosure shall be NEMA 4 (watertight). All external fasteners on the electric actuator will be stainless steel. Fasteners on limit switch and terminal compartments shall be captured to prevent loss while covers are removed.
7. All gearing shall be grease lubricated and designed to withstand the full stall torque of the motor.
8. Manual over-ride shall be by handwheel. Manual operation will be via power gearing to minimize required rimpull and facilitate easy change-over from motor to manual operation when actuator is under load. Return from manual to electric mode of operation will be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation.
9. Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by countergear. Limit switches must be capable of quick adjustment requiring no more than five (5) turns of the limit switch adjustment spindle. One set of normally open and one set of normally closed contacts will be furnished at each end of travel where indicated. Contacts shall be of silver and capable of reliably switching low voltage DC source from the control system furnished by others.
10. Mechanically operated torque switches shall be furnished at each end of travel. Torque switches will trip when the valve load exceeds the torque switch setting. The torque switch adjustment device must be calibrated directly in engineering units of torque.
11. All wiring shall be terminated at a plug and socket connector.
12. All quarterturn actuators shall be furnished with mechanical stops that restrict the valve/actuator travel.
13. Actuator must be capable of the following valve closing times/operating speeds: quarterturn valves - 60 second closing time.
14. Actuators will be capable of operating in an ambient temperature range of -20 to +175 degrees F (without motor controls) and -20 to +160 degrees F (with motor controls).
15. Actuators in modulating service shall be selected such that the required dynamic valve torque is no more than 60% of the electric actuator's maximum rated breakaway torque. Power gearing in modulating actuators shall have zero backlash between the motor and actuator output.
16. All actuators in modulating service shall be furnished with a feedback potentiometer in addition to the following motor controls: reversing starters, control transformer, phase discriminator, monitor relay, positioner, "open-stop-close" pushbuttons, "local-off-remote" selector switch in addition to red and green indicating lights. The positioner shall be capable of accepting a 4-20mADC command signal and positioning the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator. The positioner shall be field adjustable to fail to the "open", "closed" or "last" position on loss of 4-20mADC command signal.

2.7 AIR RELEASE VALVES

A. Air/Vacuum Valves for Wastewater Pressure Main:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crispin-Multiplex Manufacturing Co. (Model US20SB)
 - b. Val-Matic Valve & Manufacturing Corp.
 - c. Or Approved Equal

2. Description: Direct-acting, float-operated, hydromechanical device with large orifice to automatically release accumulated air or to admit air during filling of piping.
 - a. Standard: AWWA C512.
 - b. Pressure Rating: 150 PSI
 - c. Body Material: Cast iron
 - d. Trim Material: Stainless steel
 - e. Inlet and Outlet Size: 2"
 - f. Orifice Size: ¼"
 - g. Design Air Capacity: 98 cfm (L/s) at 150 psig (kPa) differential pressure.

2.8 FLOOR STAND

- A. Unless otherwise specified, where shown on the drawings, a floor stand shall be non-rising stem with indicators to show valve position. Floor stand shall be Clow F-5505 or approved equal.

2.9 BLOW-OFF YARD HYDRANT AND ACCESSORIES

- A. Blow-off hydrants shall be Eclipse No. 2 Post Hydrants as manufactured by John C. Kupferle Foundry Company, St. Louis, MO or approved equal. Hydrants shall be self-draining, non-freezing, compression type with 2-3/16" main valve opening. Inlet connection shall be 3" MJ. Outlet shall be 2-1/2" NST. Hydrants shall have a 3" ductile iron pipe riser with a cast iron stock top and non-turning operating rod. Hydrants shall be furnished with handwheel. Principal interior operating parts shall be brass and removable from the hydrant for servicing without excavating the hydrant. Hydrants shall be set in ½ cubic yard of crushed stone to allow for drainage of the hydrant and located as shown on plan. Recommendations of the AWWA should be followed when installing the hydrants. Each blow-off hydrant shall be furnished with one (1) field-install 1 ½" Brass Outlet Hose Connection NST Adapter with stainless steel chain attachment.
- B. Stream nozzle for washing down tank walls shall be provided. Nozzle shall be a selectable gallonage nozzles. Furnish a 1 ½" coupling size with a 30, 60, 95 and 125 PSI pressure rating and a 2 ½" coupling size with a 75 PSI pressure rating. They shall be a Task Force Tips Model No. FQS125LPF and HDL-2BLITZ respectfully or approved equal.

- C. Furnish two (2) sets of 2 ½” NST fire hoses. Fire hose shall be a 2-1/2” NST by 50 feet long single jacketed polyester covered hose with a 250 PSI working pressure rating. Hose shall be USA Blue Book Catalog No. 120 Stock No. AD-26956 or approved equal.
- D. The Contractor shall provide and affix aluminum markers to the hydrant post which shall state “Non-Potable Water – Do Not Drink”.

2.10 OPERATING MECHANISMS, VALVE BOXES, ETC.

- A. Extension Stems shall be made of stainless steel 304 of a diameter to safely withstand the opening and closing thrust encountered in operation of the valves. The exact length of all extension stems shall be determined by measurements in the field.
- B. Stem Guides shall be cast iron and bronze brushed. The guides shall be adjustable in two directions to provide full adjustment for proper alignment with the stem. The slenderness ratio (L/4) of the stem shall not exceed 200. Guides shall be spaced as shown on the Drawings.
- C. Valve boxes shall be cast iron of the two piece slip type, 5-1/4" shaft, arranged to adequately cover the stuffing box and other exposed working parts of the valves, and shall have round flush covers and frames appropriately marked. Valve boxes shall be set vertically and concentric with the valve stem. Provide pinned extension pieces as necessary to extend from valves to finished grade.
- D. Valve boxes shall be of cast iron, three-piece screw type with covers and bases. They shall be of suitable size for the valve with which they are used and fully adjustable for depth of setting, extension pieces being furnished where necessary. Drop type covers shall be provided for each box with the proper word “WATER” designating the valve service cast into its top surface. Oval type bases shall be provided and shall be so designed to fully support the box without weight of the box and/or superimposed load being transmitted to any part of the valve or adjacent pipe on either side.
- E. One foot-eight inch by one foot-eight inch by six inch deep (1' 8" x 1' 8" x 6") concrete collar or equivalent circular precast collar shall be installed around all valve boxes.
- F. Wrenches of the various lengths needed shall be provided for operating valves with operating nuts. One wrench of suitable length for each three of such size operating nuts shall be provided.
- G. Where floor stand and operator are shown, operator shall be gear-reduction hand crank unless specified otherwise.

2.11 BALL VALVES

- A. Ball valves shall be used where shown on the Drawings for all lines 2-inches in diameter or smaller.
- B. Ball valves shall be bronze conventional port type with ends to meet application.
- C. Ball valves shall be as manufactured by Nibco, Inc, Mueller, Trueline, or approved equal.

- D. PVC ball valves shall be PVC Type 1, Grade 1 with Teflon seats and Viton "O" rings and shall be listed by NSF for use in potable water.

2.12 SADDLESTANDS

- A. Saddle stands shall be of the adjustable type. Each stand shall consist of a length of wrought pipe fitted at the base with a standard screw threaded cast iron flange and at the top with an adjustable saddle or roll. The base flanges shall be bolted to the floor or foundation.

2.13 WALL SLEEVES AND FLOOR, WALL AND CEILING PLATES

- A. Wall sleeves above grade and not subject to hydrostatic pressure shall be finished flush at both wall faces and shall be constructed of 18 gauge sheet metal soldered and shall clear the pipe sides of the wall using yarn and hot-poured lead.
- B. Wall sleeves below grade or where lines are subjected to hydrostatic water pressure shall be of cast iron, bell and bell ended with center flanged water stop external to the sleeve at the mid-point of the wall or as shown on the Drawings. The line within the sleeve shall be caulked watertight both sides of the wall using yarn and hot-poured lead.
- C. Wall sleeves shall be of cast iron, bell and bell ended with center flanged water stop external to the sleeve at the mid-point of the wall or as shown on the Drawings. The line within the sleeve shall be grouted watertight both sides of the wall using a linked-plastic mechanical seal device and grout as approved by the Owner's Representative.

2.14 FLOOR DRAINS

- A. Floor drains shall be made of high grade, strong, tough, and even-grained metals suitable for heavy duty use. Castings shall be free from blowholes, porosity, hard spots, excessive shrinkage, cracks, or other injurious defects. They shall be smooth and well-cleaned both inside and outside, and all fins and roughness shall be removed. Castings shall not be repaired, plugged, brazed, or "burned in." The wall thickness of iron castings shall be not less than 1/4 inch. The size of the drains shall be determined by the branch sizes indicated on drawings. Floor drains shall include integral P-trap, cleanout and backwater valve.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 GENERAL

- A. In shipping, delivering, storing and installing, pipe and accessories shall be kept in a sound, undamaged condition. Pipe coating shall not be injured, and no other pipe or material shall be placed inside a pipe or fitting after the coating has been applied.

- B. All pipe between structures and terminus shall be of the same size and material and shall be furnished by the same manufacturer. Each pipe length and all fittings shall be clearly marked at intervals of five feet or less with the manufacturer's name or trademark and pipe type or strength.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
 - 2. Relief Valves: Use for piping in vaults and aboveground.
 - a. Dual air release sewer valve.

3.4 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.5 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

3.6 MANUFACTURER'S FIELD SERVICES

- A. Installation start-up and training for the control valve and actuator is required by the manufacturer's representative and shall include a minimum of one (1) eight hour day in (1) trip.
- B. Service personnel shall be fully qualified and full-time employees of electric actuator manufacturer.

END OF SECTION 331200

SECTION 333000 - FACILITY SANITARY SEWERS

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.
- 2. Manholes.

- B. Related Requirements

- 1. Division 33 Section "Sanitary Sewer Manholes Rehabilitation" for procedures to perform manhole rehabilitation.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE

- A. Ductile iron pipe shall be centrifugally cast and conform to ASTM A746 and AWWA C151/A21.51, Thickness Class 52.
- B. Joints and rubber gaskets shall conform to AWWA C111/A21.11, push-on type, unless shown otherwise on the Contract Drawings.
- C. Interior coating: Piping shall be provided with a manufacturer applied Protecto 401 ceramic epoxy liner or an equivalent Engineer approved lining system.
- D. Exterior Coating: Piping shall be provided with a manufacturer applied asphaltic coating in conformance with AWWA C151/A21.51.

2.2 PVC PIPE AND FITTINGS

- A. PVC Type PSM Sewer Piping:
 - 1. Pipe: ASTM D 3034, SDR 21, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
 - 2. Gaskets: ASTM F 477, elastomeric seals.

2.3 MANHOLES

- A. Standard Precast Concrete Manholes:
 - 1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
 - 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - 4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (100-mm) minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
 - 5. Riser Sections: 4-inch (100-mm) minimum thickness, of length to provide depth indicated.
 - 6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
 - 7. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
 - 8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
 - 9. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser, with 4-inch- (100-mm-) minimum-width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.
3. Manufacturers: Standard ring and cover shall be Capital Foundry Item No. MH-3000 and the watertight ring and cover to be Capitol Foundry Item MH-3000 WT or approved equal.

2.4 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: As shown on drawings.
2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 4 percent.

2.5 PIPE CONNECTIONS

A. Openings for pipe shall be pre-cast and supplied with a flexible connection boot similar to the KOR-N-SEAL or press wedge type or as approved by Engineer to provide a flexible joint unless otherwise shown on the Drawings. The joint shall be of neoprene rubber and meet the requirements of ASTM Specification C-923. Expansion bands and pipe clamps shall be stainless steel that meets or exceeds the requirements of ASTM Specifications C-923 and A-167.

2.6 CONCRETE ENCASEMENT

- A. Where specified on the Drawings and where as directed by the Engineer, pipe shall be encased in concrete. The concrete shall be Class B, as specified in Section 033000 Cast-in-place Concrete. The dimensions of the encasement shall conform to the dimensions shown on the Drawings. The concrete shall be placed carefully around the pipe to avoid displacing the pipe. No concrete shall be placed in water. The Contractor shall not backfill over concrete encasement until 24 hours after pouring, unless directed otherwise by the Engineer.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- E. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 0.4 percent unless otherwise indicated.
 - 2. Install piping with 48-inch (1220-mm) minimum cover.
- F. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere unless otherwise indicated.
- E. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.6 CONNECTIONS

- A. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.7 CLOSING ABANDONED SANITARY SEWER SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 36 inch minimum from invert with oakum and fill pipe with quick setting hydraulic cement.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
 - 1. Remove Manhole:
 - a. Remove manhole and close open ends of remaining piping as specified in paragraph 3.8 above.
 - 2. Abandon Manhole in Place:
 - a. Remove existing ring and cover and deliver to Owner at location designated by Owner.
 - b. Break top of manhole down to at least 36 inches below final grade.
 - c. Fill bottom of existing manhole with concrete six inches above top of pipe.
 - d. Remaining depth shall be filled and compacted with soil in 8 inch lift.
- C. Backfill to grade according to Section 312000 "Earth Moving."

3.8 NEW PIPE TO EXISTING MANHOLE CONNECTIONS

- A. Pipe shall be laid into manholes on a uniform grade. A short length of pipe shall be used for all existing pipe entering or existing pipe entering or existing manholes with a maximum length of two feet from the wall if the manhole. Bell ends of these joints shall point upstream. The annular opening between the pipe and manhole section shall be closed with a quick-setting, non-shrinking mortar.
- B. Where the new line inverts are above the existing manhole floor, the manhole shall be filled with cementitious grout and a new bench and channel installed.

3.9 GRAVITY SEWER WATER TIGHTNESS TESTS

- A. General
 - 1. All gravity sewers and manholes shall be tested for water tightness by one of the following methods:
 - a. Infiltration tests (pipe and manhole).
 - b. Ex-filtration tests (pipe and manhole).
 - c. Low pressure air (pipe).
 - d. Vacuum test (manhole).
 - 2. Conditions under which each test may be used and criteria for passing or failing are stated under the description of the respective test.
 - 3. The Contractor shall provide the materials, labor, and equipment to conduct all tests. All tests method shall be conducted after backfilling and the results submitted to Engineer.

The Contractor may test the pipeline and manholes prior to backfilling to inform him of the condition of the installation. However, the results of testing taken prior to backfilling will not be accepted. Water for testing shall be provided by the Contractor.

4. Test sections shall be determined by the Engineer. Generally, a test section shall be one manhole and the downstream pipe to the inlet of the next manhole. Several such pipe sections shall be tested as one test section of directed by the Engineer.
5. All tests for record shall be conducted in the presence of the Engineer or his representative.
6. Test sections which fail any of the tests described herein shall be corrected and retested by the Contractor at no additional expense to the Owner.

B. Infiltration Test

1. Infiltration testing shall be used only when groundwater equals or exceeds a depth of four feet above the top of the pipe throughout the length of the test section. If the above condition exists and flow in the pipe is, in the Engineer's opinion, below the allowable, the pipe and manholes shall be considered to have passed the test and no measurement need be made.
2. Procedure shall be to plug the inlet pipes to the upstream manhole in the test section and all other openings. Place an approved measuring device (quick insert weir or equal) in the pipe at the downstream end of the test section. Allow flow to reach maximum and remain unchanged for thirty minutes or more. Record this figure as infiltration. Compute the inch-miles of pipe in the test section.
3. A test section passes the infiltration test if the flow from both pipe and manhole is less than 100 gallons per day per inch-mile of pipe within the section.

C. Ex-Filtration Test

1. Ex-filtration testing may be used for all gravity sewer pipes and manholes where infiltration testing cannot be used.
2. Procedure shall be to plug the inlet to the pipes in the manholes at each end of the test section and all other openings. Fill the sewer and upstream manhole with water to the lesser of; four feet above the top of the outlet pipe or, the top of the manhole. Allow to stand overnight. Refill if necessary to the depth above. Measure the height of the water twice, two hours apart, and compute the rise or fall. Convert measurements to gallons per day. Compute the inch-mile or pipe in the test section.
3. A test section passes the Ex-filtration test if the computed Ex-filtration from both pipe and manhole is less than 100 and equal to or greater than zero gallons per day per inch-mile of pipe within the test section.

D. Low Pressure Air and Manhole Ex-Filtration Tests

1. These manholes may be used where infiltration testing cannot be used.
2. Procedures:
 - a. Air testing-minimum-time requirements: When the air test is specified, the Engineer shall give explicit instructions for conducting the test. The recommended time for a 1.0 psi air pressure drop is shown in the table below. This data has been taken from Uni-Bell specification UNI-B-6-79, "Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe." Should any test on any section of pipeline disclose an air loss expense, locate and repair defective joints or pipe sections. After the repairs are completed, the pipeline shall be retested until the air loss rate is within the specified allowance.
 - b. Manhole Ex-filtration tests shall be conducted as specified in 3.1-C above except that inlet and outlet pipes of the manhole being tested shall be plugged.

c. Vacuum testing is accepted as an alternative to the Ex-filtration test, but only applicable to precast concrete manholes. The installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specifications for which performance information has been provided by the manufacturer and approved by the Bureau. A measured vacuum of 10” of mercury shall be established in the manhole.

1) A measured vacuum of 10” of mercury shall be established in the manhole. The time for the vacuum to drop to 9” of mercury shall be recorded. Acceptances standards for leakage shall be established from the elapsed time for a negative pressure change from 10” to 9” of mercury. The maximum allowable leakage rate for a 4’ diameter manhole shall be in accordance with the following:

<u>Manhole Depth</u>	<u>Minimum Elapsed Time for a Pressure Change of 1” Hg</u>
10 ft. or less	60 seconds
>10 ft. but <15 ft.	75 seconds
>15 ft. but <25 ft.	90 seconds

a) For manholes 5’ in diameter, add an additional 15 seconds and for manholes 6’ in diameter, add an additional 30 seconds to the time requirements for 4’ diameter manholes.

2) If the manhole fails the test, necessary repairs shall be made and the vacuum test and repairs shall be repeated until the manhole passes the test.

3) If a manhole joint mastic is completely pulled out during the vacuum test, the manhole shall be disassembled and the mastic replaced.

3. Pass/Fail Criteria

a. Criteria for passing the low pressure air testing of pipe is based on a net pressure differential of 3 psi avg. The test section shall pass if the time required for a drop in net pressure from 3.5 to 2.5 psi is equal to or greater than the time shown on the following Table I and II.

b. Low-Pressure Air Test Method for PVC sewer pipe.

TABLE I SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR PVC SEWER PIPE											
1 Pipe Diameter (In.)	2 Min. Time (min: sec)	3 Length for Min. Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31

24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

Note: Test Time Calculation: All test times shall be calculated using Ramseier’s Equation as listed below:

$$T = (0.085) * \frac{DK}{Q}$$

Where: T = shortest time, in seconds, allowed for the air pressure to drop 1.0 psig
 K = 0.000419 DL, but not less than 1.0
 Q = 0.0015 cubic feet/minute/square feet of internal surface
 D = Nominal pipe diameter in inches
 L = Length of pipe being tested in feet

c. Low-Pressure Air Test Method for Concrete Sewer Pipe:

- 1) Determine the test time for the sewer line to be tested by using Table II. Table II has been established using the criteria specified in Table III and the formulas listed below.

Table II Minimum Test Time for Various Pipe Sizes			
Normal Pipe Size in	T (Time) Min/100 ft	Nominal Pipe Size in.	T (Time) Min/100 ft
4	0.3	15	2.1
6	0.7	18	2.4
8	1.2	21	3.0
10	1.5	24	3.6
12	1.8		

Table III Allowable Air Loss for Various Pipe Sizes			
D ₁ Nominal Pipe Size in	Q ft ³ /min	D ₂ Nominal Pipe Size in	Q
4	2	15	4
6	2	18	5
8	2	21	5.5
10	2.5	24	6
12	3		

- 2) The required test time per 100 ft. of pipe for a single diameter pipe using Table III:

$$T_T = (0.00037) \frac{D_2 L}{Q}$$

- d. Manholes shall pass if the calculated leakage does not exceed 0.25 gallons per hour.
4. Stream Crossings: Where sewers cross through or under streams, pipe and joints shall be tested in place and shall exhibit zero discharge.

3.10 DEFLECTION REQUIREMENTS AND TESTS

A. Scope: All pipe installed under this contract shall be subject to the deflection requirements of this section. Failure to meet deflection requirements shall be cause for rejection of the Work. Pipe not meeting deflection requirements shall be removed, replaced if necessary, reinstalled and retested at no cost to the Owner.

B. Deflection Requirement: The deflection of installed pipe, 30 days (minimum) after final backfill, shall not exceed the following percent of average inside diameter for the following types of pipe:

Cement lined3%

All other.....5%

The method of test for average inside diameter and for deflection of installed pipe shall be as specified below.

C. Average Inside Diameter

1. Average inside diameter of the pipe shall be determined by Section 7 of ASTM D2122 or approved equal test. Submittal required for approved equals.
2. In the absence of approved equal test and frequency of tests, performed by manufacturer as a routine quality control program, one average inside diameter determination shall be made for each one thousand feet, or fraction thereof, of each type, size and class of pipe delivered to the site. Furnish certified copies of measurement and calculations for each inside diameter determination.
3. The results of all inside diameter determinations shall be averaged to determine the inside diameter to be used for deflection requirements. If the average inside diameter thus determined falls within plus or minus one-half of one percent of the specified inside diameter for the pipe, the specified average inside diameter shall be used.

D. Deflection Test Method:

1. Test shall consist of manually pulling an approved go/no-go gauge through the pipe for which it was sized. Failure to pass the test gauge shall demonstrate failure to meet the deflection requirement. No test performed sooner than 30 days after completion of final backfill shall be used to demonstrate compliance with deflection requirements. Test gauge shall be furnished by Contractor.
2. The test gauge shall consist of a rigid cylindrical mandrel. Contact length for the mandrel shall equal or exceed the nominal pipe diameter. Leading and trailing edges shall be rounded and smooth. Mandrel cross-section shall be circular or with an odd number of points, not less than nine, spaced uniformly about the circumference. If a circular cross section is used, mandrel diameter shall be the following percentage of the average inside diameter as determined in 3.2-C.
 Cement lined3%
 All other5%
 If an odd reamed cross section is used, Engineer shall calculate a mandrel diameter equivalent to that above. Tolerance on mandrel diameter shall be plus or minus one-tenth of one percent of the average inside diameter for which it was sized.
3. Furnish one steel proving ring for each size test gauge required. Proving ring shall be rigid and true with tolerance of radius of plus or minus 0.005 inches.

4. Submittal required for each test gauge and proving ring. Gauges shall be Wortco or approved equal.
5. Mandrel Size for PVC Pipe:

Non. Diam.	L	ASTM D3039 D	ASTM D2680 D
8"	8"	7.56"	7.40"
10"	10"	9.45"	9.31"
12"	12"	11.26"	11.22"
15"	15"	13.78"	14.09"

L = Mandrel Length
 D = I.D. of Proving Ring

E. Deflection Test Requirements

1. General: Perform deflection test on all installed flexible or semi-rigid pipe with pipe stiffness, as determined by Engineer, less than 100 psi. For flexible or semi-rigid pipe with stiffness (as determined by Engineer) greater than 100 psi, perform deflection test where ordered by Engineer in writing. Engineer shall order deflection tests only if (in his judgment) as a result of his inspection of the installed pipe, the deflection requirements have not been met. Perform deflection tests required by this paragraph at no additional cost to Owner.
2. Pipe Stiffness: For the purpose of deflection test requirements, Engineer has determined pipe stiffness values as follows:

<u>Material or Specification</u>	<u>Nom. Dia. (in)</u>	<u>Stiffness (psi)</u>
Ductile Iron C150 or greater	18	330 or greater
Ductile Iron C150 or greater	24	190 or greater
PVC – SDR 35	8-24	46

3.11 IDENTIFICATION

- A. Materials and their installation are specified in Division 02 Section "Earth Moving." Installation shall be as follows:
 1. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.12 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.
 1. Submit separate report for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.

- b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.13 CLEANING

- A. Clean dirt and superfluous material from interior of piping.

3.14 CCTV

- A. New gravity piping shall be videoed by the contractor post installation and the video shall be provided to the Engineer and Owner for review and comment prior to substantial and final completion being issued for the project.
- B. Closed Circuit TV Equipment: Select and use closed circuit television equipment that will produce a color video.
- C. Pipe Inspection Camera: The pan tilt zoom (PTZ) camera shall be waterproof and corrosion resistant with a minimum depth rating of 30 m (100 ft) and able to operate in temperatures between 0-50 degrees C (32-122F). Produce a video recording using a pan and tilt, radial viewing and pipe inspection camera that pans plus or minus two-hundred seventy-five degrees ($\pm 275^\circ$) and rotates three-hundred and sixty degrees (360°). The television camera used for the inspection shall be satisfactorily designed and constructed for such inspection. The camera shall be operative in one hundred percent (100%) humidity conditions. Use a camera with an accurate footage counter which displays on the monitor the exact distance to the camera from the center line of the starting manhole. Use a camera with camera height adjustment so the camera lens is always centered at one-half ($1/2$) the inside diameter, or higher, in the pipe being televised. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the

pipe. The lights on the camera shall also be capable of panning 90-degrees to the axis of the pipe. Lighting intensity shall be remote controlled and shall be adjusted to minimize glare. Under ideal conditions (no fog in the pipeline) the camera lighting shall allow for a clear picture up to five (5) pipe diameter lengths away for the entire periphery of the sewer. The light shall provide uniform light clear of shadows or hot spots. A reflector in front of the camera shall be capable of showing on the video recording the Owner's name, Contractor's name, date, line size and material, line identification (Owner's manhole numbers at both ends) and ongoing footage counter. The camera, television monitor and other components of the video system shall be capable of producing a picture quality to the satisfaction of the Owner; and if unsatisfactory, the equipment shall be removed and replaced with adequate equipment. The camera unit shall have sufficient quantities of line and video cable to inspect sewers with access as far apart as 2,000 feet. No payment will be made for an unsatisfactory inspection.

- D. Distance Measurement: A suitable distance-reading device which uses cable length to accurately measure the location of the camera in the pipe shall be provided. This device shall be accurate to $\pm 1\%$ of the length of the inspection. In order to obtain a full record of the pipe length, the distance shall be recorded as zero from the beginning of the pipeline segment (usually the intersection of the start of the pipeline and the inside face of access chamber) to the end point of the inspection (usually the intersection of the endpoint of the pipeline and the inside face of the terminal access chamber).

- E. CCTV Video Capture and Data Recording: Video capture equipment shall be capable of continuously capturing digital video from first generation recordings with no frame loss, regardless of the progression of the inspection. Software must be NASSCO or WRc certified and integrate seamlessly with other third-party NASSCO or WRc certified data management software.
 - 1. Video Recording
 - a. A CD or DVD disk or USB flashdrive shall be supplied for all inspection surveys. All videos shall be performed and submitted at a resolution capable of providing a picture quality which is adequate for the purpose of inspection as stated in these Specifications and to the satisfaction of the Owner. All videos shall be submitted to the Owner in MPEG 1 format (mpg.), user friendly and easy to view utilizing standard Windows software and will become the property of the Owner.

END OF SECTION 333000

SECTION 333400 - FACILITY PRESSURE 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. This section is intended to define the required quality standards of the materials furnished and the workmanship performed in connection with the herein specified items of piping and all the required accessories and appurtenances including, in part, all labor, tools, materials and equipment for the complete piping work for this contract which are not defined elsewhere in the Specifications or on the Drawings.
- B. Related work described elsewhere:
 - 1. Division 03 Section "Cast-In-Place Concrete" for installing pipe supports and thrust blocks.
 - 2. Division 09 Section "Painting" for coating pipes for protection and/or color code.
 - 3. Division 26 Section "Electrical" for operation of electrical valves.
 - 4. Division 33 Section "Valves" for installation of valve within piping system.
 - 5. Division 33 Section "Sanitary Gravity Sewer" for gravity sewer and manholes.

1.3 SPECIAL PROVISIONS

- A. All 3-inch and larger non-potable water main shall be ductile iron pipe as specified in paragraph 2.1 of this section. Non-potable water main smaller than 3 inches shall be schedule 40 PVC as specified in paragraph 2.3 (A) of this section.
- B. All air piping 3-inch and larger shall be ductile iron pipe as specified in paragraph 2.2 of this section unless specified otherwise. All other air piping 2-inch to ½" inch shall be schedule 40 galvanized steel pipe as specified in paragraph 2.1-E of this section unless specified otherwise.
- C. All yard pipe not listed above shall be ductile iron pipe as specified in paragraph 2.1 of this section.
- D. All chlorination and dechlorination piping shall be schedule 80 PVC as specified in paragraph 2.3 B of this section.

1.4 DEFINITIONS

- A. EPDM: Ethylene propylene diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.

- C. PA: Polyamide (nylon) plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
 - 1. Wiring Diagrams: Power, signal, and control wiring for alarms.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. NSF Compliance:

1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves according to the following:
 1. Ensure that valves are dry and internally protected against rust and corrosion.
 2. Protect valves against damage to threaded ends and flange faces.
 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves according to the following:
 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.10 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 1. Notify Owner no fewer than five days in advance of proposed interruption of service.
 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151 centrifugally cast-in-metal molds or sand, lined molds for water and other liquids, with mechanical-joint bell and plain spigot end unless flanged ends are indicated. All piping and fittings shall be a minimum Class 52 unless shown otherwise on the drawings or elsewhere in the specifications. Where piping is located beneath structures it shall be Class 53. Pipe and fittings should be cement lined with bituminous seal coat conforming to AWWA C104.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless flanged ends are indicated.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110 centrifugally cast-in-metal molds or sand, lined molds for water and other liquids, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
- C. Flanges: ASME 16.1, Class 125, cast iron.
- D. Joints
1. All exposed fittings within buildings and structures shall be class 125 flanged fittings in accordance with ANSI B16.1. All flanges shall be finished flat faced for full area gasket bearing and shall be back-faced or have the back face spotted for full bearing of the nut.
 2. Flanges shall be furnished with factory punched full face gaskets 1/16 inch thick, as manufactured by Crane Co., Chicago; Anchor Packing Co., Philadelphia, Garlock Packing Co., Palmyra, or equal. Steel regular unfinished square head machine bolts shall be threaded US National Coarse Threads Series, ANSI B1.1., Class 2 Fit, and shall be furnished with heavy pattern unfinished hex nuts, ANSI B18.2. After threaded bolts or tapping nuts, threads shall be coated with a rust preventive lubricant and bolts and nuts packaged separately.
 3. All below grade pipe fittings outside of buildings and structures shall be mechanical joint. The mechanical joint shall be of the stuffing box type and shall conform to latest revisions of ANSI A21.11. The joint consists of a bell cast integrally with the pipe or fitting provided with an exterior flange having cored or drilled bolt holes and an interior annular recess for receiving the sealing gasket and straight spigot end of the pipe or fitting, a wedge shaped sealing gasket of a vulcanized rubber especially compounded for sewage or water, a separate cast iron follower gland having cored or drilled bolt holes, and high strength cast iron tee head bolts threaded US National Coarse Treads, Class 2 Fit, in accordance with American National Standard Institute (ANSI) B1.1, furnished with heavy pattern steel hex nuts. After threading or tapping, threads shall be coated with a rust preventative lubricant. Push-on or other type joints may be used with approval of the Engineer.

E. Joint Restraints

1. Mechanical joint restraints shall be incorporated in the design of the follower gland and shall include a restraining mechanism which consists with a plurality of individually actuated gripping surfaces that impact multiple wedging action against the pipe, increasing its resistance as the pressure increases. Glands shall be manufactured of ductile iron conforming to ASTM A 536-80.
2. Restraining device shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist-off nuts shall be used to ensure actuating of the restraining devices.
3. The mechanical joint resistant device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1. Restraining glands for PVC pipe shall have a pressure rating equal to that of the pipe on which it is used. The restraining gland shall have been tested to UNI-B-13-92, be listed by Underwriters Laboratories, and be approved by Factory Mutual.
4. Restrained joint pipe fittings shall consist of bolted retainer rings and welded retainer bars or boltless types which include ductile iron locking segments and rubber retainers. Bolts for restrained joints (if applicable) shall conform to ANSI B18.2. Restrained pipe and fittings shall be Flex-Ring or Lok-Ring type joints as manufactured by Griffin Pipe Products, or equal. Mega Lug by EBAA Iron may also be an acceptable restraint system for ductile iron pipe, on a case by case basis with prior approval of the Owner's Representative.
5. Refer to restrained joints detail shown on drawings for the location of each restrained joint as well as the concrete thrust block sizing
6. No Uniflange or other devices that rely on the use of friction clamps and/or retainer glands with set screws alone are not acceptable.
7. All restraining appurtenances and tie rods shall be coated with an approved bituminous paint after assembly.

F. Coatings and Linings

1. Pipe exterior shall have bituminous coating with the exception of exposed piping which shall be coated in accordance to Section 099600.
 - a. Outside coating shall be a bituminous coating of either coal tar or asphalt base with a minimum 1 mil dry film thickness per ANI A21.51 (AWWA C151). The coating shall be applied to all pipes unless it is exposed or otherwise specified. The finished coating shall be continuous, smooth, neither brittle when cold nor sticky when exposed to the sun, and shall be strongly adhered to the pipe at all temperatures. When leaving the foundry, all outside abrasion marks shall be repaired with a coat of bituminous paint.

- G. Handling Ductile Iron Pipe: Ductile iron pipe, fittings and accessories, shall be handled in such a manner as to ensure that sound, undamaged pipe entirely suitable in all respects to the specific requirements of each particular fitting, pipe and accessory is provided and installed. Particular care shall be taken not to injure either the coating, pipe, or threads. Equipment, tools, and methods used in loading, reloading, unloading, hauling, and laying pipe and fitting shall be such that no damage is done thereto or the coatings thereon. Where hooks are used for lifting, they shall have broad well-padded contact surfaces and shall be of such design and length that they will provide uniform support for a distance back from the end of the pipe not less than one-half of the internal pipe diameter. Defective or damaged coatings or linings may be repaired, if properly done, by and at the expense of this Contractor, who may employ the pipe manufacturer

to make such repairs, but in any case, all such field repairs shall be made under the direct supervision of a representative of the pipe manufacturer. No field repair work may be done on any damaged pipe coating or lining without the prior approval of the Engineer. Any bituminous pipe coating that is damaged by shipment or by the Contractor, shall be repaired prior to installation or placing of any backfill or hanging within hangers, by removing all the damaged coatings, wire brushing to expose the metal and applying two coats of bituminous coating material of a type and quality equal to that used originally for the bituminous coating of the pipe.

- H. Cutting, Cleaning and Inspecting Ductile Iron Pipe: The cutting of pipe for closure pieces or for other reasons, shall be done in a neat and workmanlike manner by a method which will not damage the pipe or its liner. Unless approved by the Engineer, all cutting of such pipe shall be done by means of mechanical cutter of an approved type. Wheel cutter shall be used wherever practical. After cutting, the interior of the pipe shall be thoroughly swabbed or cleaned of all foreign matter and shall be kept clean during and after installation. Before installation of any pipe and fitting, each piece shall be inspected for defects and shall be rung with a light hammer to detect any cracks. All defective, damaged, or unsound pipe or fittings shall be rejected.
- I. All buried or underground gray-cast iron pipe shall be furnished in accordance with the same specification stated above, except that pipe thickness shall be designed on the basis of the depth of cover as indicated on the drawings. Care shall be exercised in laying the cast iron piping to the elevations shown on the drawings. Where specified elevations of piping are not shown on the plans, piping shall be placed with a minimum of three (3) feet of cover. Cast iron piping that does not have specific elevations, or that conflicts with other piping that does not have specific elevations, or that conflicts with other piping that has specific elevations shown on the drawings shall be varied in depth, or necessary fittings shall be used to avoid the piping with the specific elevations shown on the drawings at no added expense.
- J. DIP Bedding: The surface at the bottom of the trench shall be continuous, smooth, and free of large rocks. Bedding material shall be a minimum 6" deep of non-cohesive granular material placed uniformly under the pipe. Maximum particle size shall not exceed 1" in diameter. Bedding material shall be lightly compacted. Bedding material shall be VDOT No. 57 stone. Non-cohesive granular material shall be backfilled from the bedding to 0.10* diameter.

2.2 PVC PIPE AND FITTINGS

- A. PVC, Schedule 40 Pipe: ASTM D 1785.
 - 1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.
 - 2. Threading of schedule 40 PVC pipe will not be permitted.
- B. PVC, Schedule 80 Pipe: ASTM D 1785.
 - 1. PVC, Schedule 80 Socket Fittings: ASTM D 2467
 - 2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464
 - 3. PVC Flange Fittings: Flange fittings shall have wall thickness and strength equal to those of Schedule 80 pipe, and shall have faces scored for semi-rigid gaskets of not more than 1/8 inch thick material. Gasket material shall be the same as specified for Ductile Iron pipe and shall have reinforced shoulders under the bolt and nut heads. Bolts shall be square headed machine bolts with hexagon nuts and they shall be of corrosion resistant metal or of galvanized steel.

- C. PVC, AWWA Pipe: PVC pipe 4 inches through 12 inches shall conform to AWWA C900, Class 150 (DR 18). PVC pipe less than 4 inches shall conform to SDR 21 Cell Classification 12454 per ASTM D1784 with a working pressure of 200 psi. Pipe shall have bell end with gasket, and with spigot end unless specified otherwise.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber
 - 2. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.3 HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

- A. Qualifications of Pipe Manufacturers. The HDPE pipe shall be or has been manufactured in a plant capable of providing continuous quality control through inspection. The facility shall have the necessary testing equipment to verify that the pipe meets the requirements of NSF Standard #61 and ASTM standards.
- B. Qualifications of the Fitting Manufacturer. The facility shall have the necessary testing equipment to verify that the fittings meet the requirements of AWWA C906 for sizes 3” through 54”.
- C. PE Materials for Water Service Pipe and Fittings
 - 1. Materials for pipe and fittings shall conform to the requirements of ASME B31.1 Appendix III, Paragraphs III-3.0 and III-4.0.
 - 2. Materials used for the pipe and fittings shall be PE3408 high density polyethylene with a minimum cell classification of 3454464C per ASTM D3350. The material shall have a long term hydrostatic design basis rating of 160 psi at 73°F when tested and analyzed in accordance with ASTM D2837, and shall be a Plastic Pipe Institute (PPI) listed compound.
 - 3. The raw material shall contain a minimum of 2% well dispersed carbon black.
 - 4. PE3408 pipe and fittings shall be manufactured in accordance with AWWA C901, AWWA C906, ASTM D3035, ASTM D3261, and/or ASTM F714 as specified.

The requirements of this cell classification are:

HDPE Resin Specifications

Property	Specification	Unit	Typical Value
Material Designation	PPI/ASTM		PE3408
Material Classification	ASTM D 1248		III C 5 P34
Cell Classification	ASTM D 3350-02		345464C
Density (3)	ASTM D 1505	g/cm3	0.941-943
Melt Index (4)	ASTM D 1238	gm/10 min	0.05-0.11
Flexural Modulus (5)	ASTM D 790	psi	110,000 to 140,000
Tensile Strength (4)	ASTM D 638	psi	3,200

Property	Specification	Unit	Typical Value
Slow Crack Growth			
ESCR	ASTM D 1693	hours in 100% igeval	>5,000
PENT (6)	ASTM F 1473	hours	>100
HDB @ 73 deg F (4)	ASTM D 2837	psi	1,600
UV Stabilizer (C)	ASTM D 1603	% C	2 to 2.5

- D. PE3408 pipe shall normally be supplied in 40ft lengths, with longer lengths permissible with the approval of the Purchaser. PE100 pipe shall be supplied in 5 meter (16.4 ft) lengths minimum.
- E. Pipe shall have a manufacturing standard of ASTM F-714 as supplied by ISCA Industries. Pipe O.D sizes 4” to 24” shall be available in both steel pipe sized (IPS) and ductile iron pipe sizes (DIPS). The HDPE pipe shall be **DR 11** (160 psi WPR) and in compliance with ASTM F 1962-05 medi-HDD. All materials furnished must be new, unused, and not previously fused, and undamaged, conforming to this specification and the applicable referenced standards and suitable for intended services. The pipe shall contain no recycled compounds except that generated in the manufacturer’s own plant from resin of the same specification from the same raw material. Pressure ratings used in this specification are at 73° F for PE3408 materials and 68° F for PE100 materials. All pipes shall be suitable for use as pressure conduits, listed as NSF 61 and per AWWA C906 Pressure Class (PC) 100 have a nominal burst value of three and one-half times the Working Pressure Rating (WPR) of the pipe.
- F. Fabrication
 - 1. Fabrication of butt fusion fittings shall be in accordance with ASME B31.1, Paragraph III-5.0 except that Joint Identification (III-5.1.1(G)) is not required and the Qualification Tests (III-5.1.2 (D)) may be replaced with the manufacturer’s standard joint qualification testing with the Purchaser’s approval.
 - 2. The Fabricator shall maintain fusion procedure specifications for shop joints for the Purchaser’s review, including qualification testing requirements, and any limitations on the procedure related to ambient conditions of temperature and cleanliness. The general procedures in ASTM D2657 provide a suitable basis for such procedures.
 - 3. Pipe bending shall comply with ASME B31.1 Paragraph III-5.2 for piping exposed to internal pressure. Flattening shall not exceed 8%.
- G. Fittings
 - 1. Molded Butt Fusion Fittings: Fittings made by the molded process shall result in strength and durability equal to or greater than straight pipe sections of the same DR. PE3408 molded fittings shall be manufactured in accordance with ASTM D3261 and shall be marked so. PE100 fittings shall be Asahi/America Air-Pro butt fusion sweep bends.
 - 2. Fabricated Butt Fusion Fittings: Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure at least equal to the pressure rating specified in the description. Fabricated fittings made

from heavier DR piping or fittings shall have the fitting ends machined to match the lighter pipe DR where specified.

3. Pipe Bends: Pipe bend radius of curvature shall be approximately 3 times the pipe OD. Pipe bends shall be manufactured by Pipestar International, Inc. or equal approved by the Purchaser. Pipe bend tolerances shall be +3/4 in. overall dimensions and +2° for bend angle. Dimension shall be measured at 65°F to 75°F.
4. Molded Socket-Fusion Fittings: PE 100 Socket Fittings shall be injection molded and rated for 230 psi at 68° F.

H. Branch Connections

1. Full size tees shall be molded or 3-segment mitered construction.
2. Reduced branch tees shall be branch saddle type. Straight reducing branches shall not be used. Pipe pups shall be added to the branch saddle to extend the branch length unless the branch is flanged.

I. Flanges

1. Flanges shall be two piece components consisting of a polyethylene flange adapter or stub-end and a ductile iron back-up ring. The two components shall be specifically designed for use together.
2. Loose flanges for field installation shall be packaged and shipped as a unit i.e. the back-up ring together with the matching flange adapter.
3. Flange adapters and stub-ends shall have a serrated finish suitable for gasketing on the flange mating face.
4. Back-up rings shall be of a convoluted design sized and drilled to match steel flanges conforming to ASME B16.5 Class 150. The minimum back-up ring pressure rating shall be 267 psi up to 14" nominal size and 160 psi from 16" to 24" nominal size.
5. The back-up ring bore shall be chamfered or radiused to accept the flange adapter or stub-end radius.
6. Back-up rings shall be epoxy coated with a thermosetting fusion bonded dry epoxy resin powder, then heated and cured in accordance with the manufacturer's specification. The minimum lining thickness shall be 12 mils. The coating specification shall meet AWWA C116. The coating specification including surface preparation and inspection requirements shall be submitted to the Purchaser.
7. Carbon steel blinds shall be ASTM A105 with exterior surfaces epoxy coated in accordance with AWWA C213.

- J. Pipe Manufacturer's Quality Control. The pipe manufacturer shall have an ongoing Quality Control program for incoming and outgoing materials. High-density polyethylene (HDPE) resins for manufacturing of pipe shall be checked for density, melt flow rate, and contamination. The manufacturer of the HDPE resin shall certify the Cell Classification as indicated in paragraph 2.3C. These incoming resins shall be approved by plant Quality Control and verified to be approved by NSF before being converted to pipe.

Pipe shall be checked for outside diameter, wall thickness, length, roundness, and surface finish on the inside and outside and end cut.

- K. Fittings Manufacturer’s Quality Control. The fitting manufacturer shall have an ongoing quality control program for incoming and outgoing materials. The resin shall be checked as indicated in paragraph 2.3C. Pipe for fabricated fittings shall be checked as indicated in paragraph 2.3D. Molded fittings shall be inspected for voids and knit lines. All fabricated fittings shall be inspected for joint quality and alignment. All fabricated welds shall be made using a DataLogger. A record of the temperature, pressure and graph of the fusion cycle shall be maintained by the fitting manufacturer.
- L. Permanent Records. The Manufacturer of the pipe and fittings shall maintain permanent QC and QA records. DataLogger records shall be maintained on fabricated fittings.
- M. Butt Fusion Joining
 - 1. Plan end pipe and fittings shall be made using butt fusion. The butt fusion procedures shall be in accordance with the manufacturer of the PPI. The fusion equipment operator shall receive training using the recommended procedure. The Contractor shall be responsible to verify that the fusion equipment is in good operating condition and that the operator has been trained within the past twelve months. The operator shall have 200 FT of experience welding at the given pipe size or larger. The fusion equipment shall be equipped with a Datalogger. Records of the welds (heater temperature, fusion pressure, and a graph of the fusion cycle) shall be maintained for five (5) years. Fusion beads shall not be removed.
 - 2. Heat Fusion Training. The supplier of the pipe and fittings shall provide a person certified by the pipe manufacturer and the fusion equipment manufacturer to train contractor fusion equipment operators and inspectors representing the Owner.
- N. Other Joining Methods
 - 1. Mechanical Joining. Polyethylene pipe and fittings may be joined together using Flanges or Mechanical Joint (MJ) adapters. These fittings shall be made from PE 3408 HDPE, with a Cell Classification of 345464C as determined by ASTM D3350-02. Flanged and MJ adapters shall have a manufacturing standard of ASTM D3261. They shall have a pressure rating equal to the pipe unless otherwise specified on the plans.
 - 2. Flanged and Mechanical Joint Adapters – Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D-3350. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D-3261. Fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans.

2.4 INSTRUMENT AND CONTROL PIPING

- A. General Instrument and Control Piping: Piping shall be furnished and installed as per the materials and in the sizes, grades and locations indicated on the plans and/or designated in the specifications. The Contractor shall be responsible for the adequacy of all piping supports and anchors and shall provide necessary clearances and flexibility so that the piping and equipment is not subject to undue stresses either during erection or operation.

1. Shop drawings showing sizes, materials, locations, dimensions, supports, anchors and hanger details, as well as the complete piping layout, shall be submitted to the Engineer for approval prior to fabrication or installation of the piping.
 2. The word "piping" in this paragraph of the specification is in reference to the instrument tubing.
- B. Materials: All materials incorporated in the final work shall comply with the latest issue of the following specifications, but in all cases instrument tubing shall be furnished in accordance with ANSI B31.1, Code for Pressure Piping.
1. Copper Tubing

Copper tubing, type DHP	ASTM B68 and B75
Copper pipe, seamless tubing	ASTM B75
Copper pipe, solder-joint fittings	ANSI B16.22
Copper bronze solder-joint fittings for copper pipe	ANSI B16.18
 2. Steel Tubing

Steel tubing	ASTM A17
Seamless steel tubing	SAE 1030
 3. Aluminum Tubing

Drawn seamless tubes	ASTM B210
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 4. PVC Piping

Pipe and fittings shall be as specified above.
- C. Fabrication and Installation: All piping shall be fabricated and installed by skilled and qualified craftsmen in accordance with specified methods, manufacturer's recommendations, and standard practices. Workmen shall be provided with suitable tools and appliances, adequate scaffolding, and protective devices.
1. Flared ends and threaded ends shall be protected. Great care shall be taken during handling and erection to prevent damages to these parts. Should any part become damaged, it shall not be used and the end shall be cut off, making sure that the tube is cut square across the end to allow the end to be joined properly.
 2. Piping shall not obstruct openings, passageways, hoist, and dismantling spaces.
 3. Piping connected to equipment shall be supported completely independent of the equipment. Pipe supports shall be installed as specified herein. Piping passing through walls and floors shall be installed in sleeves.
- D. Screwed Joints: Pipe threads shall be cut and conform to USAS B21. Pipe shall be accurately cut to length and reamed to full diameter. Joints shall be made with an approved joint compound applied to the male threads only. Valves and fittings shall be made up with care to ensure that there is no distortion or damage to these parts.
- E. Flared Tubing and Fittings
1. Aluminum and Copper Tubing: Aluminum and copper tubing shall have SAE 45 degree flare. Fittings shall be of two piece construction and shall be either extruded from solid brass parts or parts machined from solid brass.
 2. Aluminum and Copper Tubing (200 psig and below): The application of a compression type joint with a compressing ring may be used.

3. Aluminum and Copper Tubing (above 200 psig): Fittings shall have an inverted flare. In limited space application and in all other cases, standard long nut shall be used as the union connection.
4. Steel Tubing and Fittings: Steel tubing and fittings shall be fabricated to SAE 37 degree flare as recommended by the joint industry conference, hydraulic standards, for industrial equipment.
5. Steel Tubing (150 psig and below): Fittings shall be of the 3-piece type, the nut, body, and the additional sleeve, retained by the shoulder of the nut.
6. Steel Tubing (above 150 psig): Fittings shall be of the 2-piece type, the nut and body only.

F. Welded Joints: Welded joints shall be in strict accordance with the provisions of the ASME Boiler Code and/or ANSI B31.1, Code for Pressure Piping. The Engineer shall approve Contractor's welding procedures and workmen's credentials before welding is performed under this contract. The Engineer shall have the right at anytime to call for and witness welding tests or designate samples to be taken and tested from joints already welded. All materials, labor, tests, and repairs to work shall be at the Contractor's expense.

2.5 FLEXIBLE CONNECTOR

- A. Contractor shall provide Proco Style 240 Single Sphere Connectors, equal flexible connectors as manufactured by The Metraflex Company, Chicago, Illinois, or equal flexible connectors by other approved manufacturers. Provide a minimum of two control rods for each flexible connector.
- B. The flexible connectors shall be pressure rated for 225 psi at 230-degrees F. The flexible connectors shall meet or exceed the pressure, movement and dimensional rating of the "Spool" Arch Types as shown in the Rubber Expansion Joint division, fluid Sealing Association "Technical Handbook- Sixth Edition Table V".
- C. Connectors shall be furnished complete with plated carbon steel flanges for corrosion protection and shall be tapped to ANSI 150 pound standards.
- D. Cover elastomer and tube elastomer shall be EPDM. The flexible connectors shall be suitable for use conveying domestic sewage.

2.6 COUPLINGS

- A. Couplings shall be Dresser Style 153, Romac 501 or equal. Provide Type 304 stainless steel bolts and nuts. MJ anchor couplings shall be by Clow or approved equal.

2.7 LINK SEALS

- A. Provide a Link Seal by Thunderline Corporation or approved equal at all pipe wall penetrations.

2.8 HANGERS AND SUPPORTS

- A. General: Hangers and supports shall include all hanging and supporting devices of metallic construction shown, specified, or required for pipe lines, apparatus, and equipment other than electrical equipment. The Contractor's working drawings, as required herein, shall show the quantity, type, design, and location of all hangers and supports required under the various items.
- B. Materials: Materials for hangers and supports of metallic construction shall conform to the requirements specified herein and to the following standards:

Structural steel	ASTM A36 and A283
Steel bars (Grade 1022)	ASTM A107
Steel castings (Grade N-1)	ASTM A27
Wrought steel pipe	
Grade A, Schedule 40)	ASTM A53
Wrought iron	ASTM A42
Iron castings (Grade 35)	ASTM A48
Cast Iron Fittings (Class 125)	ANSI B16.1
Malleable iron castings	ASTM A47
 Bolting Materials, Steel	
Bolts, yokes, and stud bolts	ASTM A307
Nuts	ASTM A563
Physical Requirements:	
-Tensile Strength	60,000-72,000 psi
-Yield Strength	38,000-50,000 psi
-Elongation	27% Minimum
-Reduction of Area	37-55%
 Bolting Materials, Silicon Bronze	
Bolts, stud bolts, yokes and nuts (alloy A)	ASTM B98
Physical Requirements:	
-Tensile Strength	70,000 psi minimum
-Yield Strength	38,000 psi minimum
-Elongation	17% Minimum
 Bolting Materials, Stainless Steel	
Bolts, stud bolts and nuts (Type 316)	ASTM A276
Physical Requirements:	
-Tensile Strength	75,000 psi minimum
-Yield Strength	30,000 psi minimum
-Elongation	35% Minimum
-Reduction of Area	45% Minimum

- 1. Where specified or shown, bolts, stud bolts, rods, yokes, and nuts of hangers and supports shall be of silicon bronze or stainless steel as specified above with the dimensions, threads, and sizes equivalent to those specified in steel. Where submerged in process

fluids or where located in covered manholes, bolts, stud bolts, rods, yokes and nuts of hangers and supports shall be of silicon bronze.

2. Except where otherwise shown, specified, or required, hangers, supports, anchors and concrete inserts shall be of the standard types as manufactured by Crane Company, Grinnell Company, Fee and Mason Manufacturing Company, or equal, meeting the requirements specified herein. All hangers, supports and concrete inserts shall be listed with the Underwriters' Laboratory.

C. Design - Hangers and supports shall be adequate to maintain the pipe lines, apparatus and equipment, in proper position and alignment under all operating conditions and have springs where necessary. Hangers and supports shall be of standard design where possible, and be best suited for the service required, as approved by the Engineer. Where required, they shall be screw adjustable after installation. Supporting devices shall be designed in accordance with the best practice and shall not be unnecessarily heavy. Sufficient hangers and supports shall be installed to provide a working safety factor of not less than 12 for each hanger, assuming that the hanger is supporting 12 feet of pipe filled with water. On pipes 3 inches in diameter and larger which are covered with heating insulation, hangers and supports shall include proper pipe protection saddles.

D. Hangers for Piping - Overhead hangers shall be supported by threaded rod properly fastened in place by suitable screws, clamps, inserts, or bolts or by welding.

1. Hanger rod sizes shall be determined by the size of the pipe supported in accordance with the following schedule.

<u>Size of Pipe (inches)</u>	<u>Diameter of Rod (inches)</u>
3/4 to 2 inclusive	3/8
2-1/2 to 3-1/2 inclusive	1/2
4 to 5 inclusive	5/8
6	3/4
8 to 12 inclusive	7/8
Over 12	1

2. The foregoing schedule is based on Schedule 80, wrought iron and wrought steel pipe, ANSI B36.10, filled with water. When heavier pipe is to be supported, the distance between rods shall be lessened or rods of greater diameter shall be used.

E. Supports for Piping - Brackets for support of piping from walls and columns shall be made of welded wrought steel and shall be designed for three maximum loads classified as follows:

Light	750 pounds
Medium	1,500 pounds
Heavy	3,000 pounds

1. When medium or heavy brackets are bolted to walls, back plates of adequate size and thickness shall be furnished and installed to distribute the load against the wall. Where the use of back plates is not practicable, the brackets shall be fastened to the wall in such a manner that the safe bearing strength of the wall will not be exceeded. Pipe rolls or chairs, shall be of the cast iron type. Pipe rolls shall be provided with threaded rods.

F. Spacing of Hangers

1. The Contractor shall locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc. Locate hangers, supports and accessories within the maximum span lengths specified in the project manual to support continuous pipeline runs unaffected by concentrated loads. At least one hanger or support shall be located

within 2 feet from a pipe change in direction. The Contractor shall locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping. Where piping is connected to equipment, a valve, piping assembly, etc., that will require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves, and fittings.

2. In no case shall any total hanger exceed the following:

<u>Nominal Pipe Sizes (Inches)</u>	<u>Maximum Span (Feet)</u>
1	7
1-1/2	9
2	10
2-1/2	11
3	12
3-1/2	13
4	14
5	16
6	17
8	19

3. Where concentrations of valves, fittings, and equipment occur, closer spacing of supports will be required. In no case shall any total hanger load (weight of piping, insulation, and contents) exceed the following load carrying capacities for hot rolled rod ASTM A107.

<u>Nominal Rod Diameter (Inches)</u>	<u>Maximum Safe Load (Lbs.)</u>
3/8	610
1/2	1,130
5/8	1,810
3/4	2,710
7/8	3,770
1	4,960
1-1/8	6,230
1-1/4	8,000
1-3/8	9,470
1-1/2	11,630

G. Supports for Plastic Piping - Rigid plastic piping normally shall be supported for the same type of hangers used with steel pipe. Support spacing shall be based on the plastic pipe manufacturer's recommendations for the service conditions. Flexible plastic tubing or rigid plastic pipe operating at temperatures high enough to materially lower its strength, shall be supported continuously by light metallic angles or channels and special hangers.

H. Saddle Stands - Saddle stands shall be of the adjustable type. Each stand shall consist of a length of wrought pipe fitted at the base with a standard screw threaded cast iron flange and at the top with an adjustable saddle or roll. The base flange shall be bolted to the floor or foundation. Stanchions shall be of similar construction to the saddle stand, except that they shall be fitted at the top with cast iron pipe saddle supports or with pipe stanchion saddles with yokes and nuts. Where adjustable supporting devices are not required, pipe lines 3 inches in diameter and smaller may be supported on approved cast iron, malleable iron, or wrought steelhooks, hook plates, ring or ring plates.

- I. Anchors - Anchors shall be furnished and installed where specified, shown or required for holding the pipe lines and equipment in position or alignment. Anchors shall be designed for rigid fastening to the structures either directly or through brackets. The design of all anchors shall be subject to approval by the Engineer.
 - 1. Anchors for piping shall be of the cast iron chair type with wrought steel straps, except where anchors form an integral part of pipe fittings or where an anchor of special design is required.
- J. Inserts - Inserts for concrete shall be furnished galvanized and shall be installed in the concrete structures where required for fastening supporting devices. They shall be designed to permit the rods to be adjusted horizontally in one plant and to lock the rod nut or head automatically. Nail slots shall be provided in the exposed flanges of the insert. Inserts shall be designed to carry safely the maximum load that can be imposed by the rod which they engage.

2.9 WALL PIPES

- A. Wall pipes shall be furnished for pipe penetration walls 6” and thicker and at the locations shown on the Drawings. Wall pipes shall meet the requirements of cast iron pipe as previously defined. Wall pipes shall have the ends as shown and meet the requirements for joints as previously defined. Wall pipes shall have integral center flange which shall be cast in the wall.

2.10 COUPLINGS AND ADAPTERS

- A. Restrained adapter flange shall be manufactured of high strength ductile iron in accordance to ASTM A536 Grade 65-45-12 for all sizes. The restrainer portion of the device shall be of wedge type design with tongue limiting bolts to insure proper engagement of the wedge. Applicable dimensions shall conform to ANSI/AWWA C111/A21.15, C110/A21.10 and C153/A21.53. Flange ends to meet ANSI Class 125/150 and ANSI/AWWA C115/A21.15 drill pattern. The minimum working pressure shall be 250 psi and equal to Star Flange Series 3200.
- B. Flanged Adapters - Flanged adapters shall be cast iron construction and manufactured to meet ASTM A-126, Class B.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section “Earth Moving” for excavating, trenching, and backfilling.

3.2 GENERAL

- A. In shipping, delivering, storing and installing, pipe and accessories shall be kept in a sound, undamaged condition. Pipe coating shall not be injured, and no other pipe or material shall be placed inside a pipe or fitting after the coating has been applied.
- B. All pipe between structures and terminus shall be of the same size and material and shall be furnished by the same manufacturer. Each pipe length and all fittings shall be clearly marked at

intervals of five feet or less with the manufacturer's name or trademark and pipe type or strength.

3.3 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, and special fittings may be used, on aboveground piping and piping in vaults.

3.4 PIPING WITHIN BUILDINGS AND STRUCTURES

- A. Piping systems installed within the buildings and structures shall be installed essentially where and as shown on the drawings, with ample clearances and allowances for expansion or contraction; operation of all doors and windows; mechanical equipment, etc.; without blocking aisle space; and installed with provision for the weight of the pipe and contents; shall be supported at proper intervals to assure uniform alignment and all other conditions encountered; including, provisions for support connections to the structural members. These support connections are to be so applied as to relieve all structural members of undue stress or strain. PVC piping will not be allowed unless specified otherwise.
- B. It is the intent of this specification that all piping be installed "gas" and "water" tight. Any and all joints otherwise shall be repaired and faulty materials shall be removed from the project site. Test pressures shall be applied by the use of a pump or other suitable device. Pressure shall be maintained for such a time as required to permit the Owner or their representative to complete the inspection of all pipe under test and mark the location of defective joints or other items for further correction. Testing shall be as specified elsewhere in this section.
- C. The Contractor shall be responsible for the location and size of any and all sleeves or openings required for the piping systems. The Contractor shall arrange for all chases, recesses, inserts, or anchors, at proper times and at the proper elevation and location in the building construction. The failure to provide this information shall require that Contractor pay for any and all costs incurred for these corrections. Contractor shall arrange the work with all others engaged on the project, to maintain the proper relationship of this work with the work of all others.

3.5 PIPING OUTSIDE BUILDINGS AND STRUCTURES

- A. Handling Pipe: Pipe, fittings and accessories shall be handled in such a manner as to ensure that sound, undamaged pipe entirely suitable in all respects to the specific requirements of each particular fitting, pipe and accessory is provided and installed. Particular care shall be taken not to injure either the coating, the pipe, or threads. Equipment, tools, and methods used in loading, reloading, unloading, hauling, and laying pipe and fittings shall be such that no damage is done thereto or the coatings thereon. Where hooks are used for lifting, they shall have broad well-

padded contact surfaces and shall be of such design and length that they will provide uniform support for a distance back from the end of the pipe not less than one-half of the internal pipe diameter. Defective or damaged coatings or linings may be repaired, if properly done, by and at the expense of this Contractor, who may employ the pipe manufacturer to make such repairs, but in any case, all such field repairs shall be made under the direct supervision of a representative of the pipe manufacturer. No field repair work may be done on any damage, including pipe coating or lining, without prior approval of the Owner's Representative.

- B. Cutting, Cleaning, and Inspecting Pipe: The cutting of pipe for closure pieces or for other reasons shall be done in a neat and workmanlike manner by a method which will not damage the pipe. Unless otherwise approved by the Owner's Representative, all cutting of such pipe shall be done by means of mechanical cutter of an approved type. Wheel cutters shall be used wherever practical. After cutting, the interior of the pipe shall be thoroughly swabbed or cleaned of all foreign matter and shall be kept clean during and after installation.
- C. Systems installed outside the buildings and structures shall be installed essentially where and as shown on the drawings, with ample clearance and allowances for expansion or contraction; operation of all doors and windows; mechanical equipment, etc. It is the intent of this specification that all piping be installed "gas" and "water" tight. Testing shall be done as herein specified in this section.
- D. Piping shall be laid to the elevation shown on the plans. Piping without specific elevations that conflicts with other piping that has specific elevations shown on the plans shall be varied in depth or necessary fittings shall be used to avoid the piping with specific elevations shown on the drawings.
- E. All ductile iron buried piping shall have a mechanical joint not more than 2 feet and as close as practical to any building or structure it enters or exits. The next joint shall not be more than 6 feet or less than 4 feet from the first joint. The balance of the piping shall continue with standard laying lengths, or as shown on the plans. The first joint of buried piping (greater than 3 inches) going through a floor slab shall be equipped with a mechanical joint retainer gland.
- F. Where restrained joint piping is required, the joints shall lock in place but be able to be deflected. Joint shall consist of a restraining locking ring bolted over a steel ring welded to the plain end of the pipe. Other types of restraining joints may be used with approval of the Engineer.
- G. PVC pipe shall be installed in accordance with the requirements of ASTM D 2774 and pipe manufacturer's recommendations.
- H. Water pipe shall be laid to the line and grade shown on the Drawings with all valves and hydrants located as shown on the Drawings.
- I. Protection shall be afforded to all underground and surface structures using methods acceptable to the Owner's Representative. This protection shall be furnished by the Contractor at the Contractor's own expense.
- J. Subsurface explorations shall be made by the Contractor at the direction of the Owner's Representative where it is necessary to determine the location of existing pipes, valves, or other underground structures.

- K. When the pipe is assembled at the trench surface, proper support of the pipe using backhoes, cranes, rope, band slings, etc. shall be provided where the pipe is snaked from the trench bottom to trench surface. The Contractor shall not roll the pipe into the trench.
- L. After the foundation has been properly graded, bedded when applicable, and the bell holes dug, the pipe and accessories shall be carefully lowered into the trench by approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe and accessories shall be properly repaired or removed from the job. Damaged pipe shall be replaced at the expense of the Contractor.
- M. Pipe shall be swabbed clean before it is laid, and any pipe which cannot be cleaned with a swab shall be removed and cleaned with suitable apparatus. Any pipe showing evidence of oil, tar or grease shall be permanently marked and removed from the job. This pipe shall not again be brought on the job site until it has been cleaned to the satisfaction of the Owner's Representative.
- N. Connections to existing facilities shall be made where shown on the plans or directed by the Owner's Representative. All connections shall be witnessed by the Owner's Representative. Wet taps, using tapping sleeves and valves, shall generally be made; except as otherwise directed or planned in which case the main shall be cut and the connections made with fittings and valves. In no case shall the Contractor shut off the water or operate the fire hydrants or gate valves in the existing systems without the expressed permission of the Owner. In event such instructions or permissions given by the Owner delays the cutoff, such instructions shall be followed without recourse.
- O. In making connections to the existing pipe valves shall be set as shown on the Plans, or at such designated places as the Owner's Representative may direct. If due to unforeseen conditions, these locations have to be changed or additional valves or fittings added, the Contractor shall install the valves or fittings at the new locations.
- P. Install yard hydrants as indicated on the Drawings. Yard hydrants shall be set plumb with the nozzle facing away from structure. Finish grade surrounding the hydrant shall be generally flat and clear for a distance of 3 feet surrounding the hydrant. Hydrants shall be field tested upon completion of installation.

3.6 PIPING INSTALLATION

- A. Install PVC, AWWA pipe according to ASTM F645 and AWWA M23.
- B. Install ductile-iron piping according to AWWA C600 and AWWA M41.
- C. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:
 - 1. Install tapping sleeve on pipe to be tapped.
 - 2. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect piping.
- D. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

- E. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie rods and clamps.

- F. Equipment Pipe Connections - Care shall be taken in bolting flanged joints, so that there is no restraint on the opposite end of the pipe or the fitting which would prevent uniform gasket pressure at the connection or would cause unnecessary stresses in the equipment flange. Bell and spigot joints shall only be yarned or otherwise packed until all flange joints affected thereby shall have been hand tightened without strain. Bolts shall be tightened gradually at a uniform rate and in a program that will result in uniform gasket compression over the entire area of the joint. Special care shall be taken when attaching suction and discharge piping to pumping equipment so that no stresses are transmitted to or imposed on the pump. All pumping connection to pumps or other equipment shall be so installed and so supported that accurate matching of the bolt holes and uniform contact over the entire area of abutting pump or equipment flange and connecting pipe line flange is obtained prior to the installation of any bolt in any flange. In addition, the pump connecting or equipment piping shall be free to move in all directions parallel to its longitudinal centerline when and while the bolts in the pump connection flange are tightened. Pumps or equipment shall not be grouted prior to the initial fitting and alignment of the pipes connected thereto. They shall, however, in each case be level, aligned and wedged in place in position. The pumps or equipment shall be grouted prior to the final bolting of the connecting piping in accordance with the provision of this paragraph. To provide the maximum flexibility and ease of alignment, the pump or equipment connecting piping shall be assembled with the gaskets in place with only a portion of the flange bolts, not less than four per joint, installed and with the bell and spigot joints yarned but not leaded. After aligning and bolting, the pump or equipment connection shall be tested by loosening the flange bolts, if the piping is properly installed, there should be no change in the relationship of the piping flange to the pump or equipment connecting flange.

- G. Lining Up Bell and Spigot Pipe - Pipe lines or runs intended to be straight shall be so laid. Deflections from a straight line or grade, made necessary by vertical curves or horizontal curves or offsets, shall not exceed that recommended by the manufacturer of the pipe or approved by the Engineer. If the specified or required alignment requires deflections in excess of those stipulated above, the Contractor shall provide either special bends as approved by the Engineer, or pipes in shorter lengths in such length and number that the annular deflections at any joint, as required by the specified maximum deflections, are not exceeded.

Maximum horizontal deflections for ductile iron pipe shall be as follows for an eighteen foot joint of pipe:

MAXIMUM DEFLECTION IN INCHES

<u>Size Pipe</u>	<u>MJ</u>	<u>Push-on-Joint</u>
2", 4", 6"	27"	19"
8"	20"	19"
10"	20"	19"
12"	20"	19"

Maximum horizontal deflections for PVC pipe shall be per manufacturer's recommendations. The Contractor shall obtain the maximum deflection information from the PVC manufacturer prior to construction. The Contractor shall give copies of the information to the Owner and Owner's Representative.

- H. Laying Pipe in Trench - Each pipe length, having been properly cleaned and tested, shall be laid on the previously graded trench bottom after the bell hole has been dug; after proper joint cleaning, the joint gasket or rubber ring, if used, shall be placed on the pipe spigot as recommended by coverage, supports, and such additional pertinent data as will be required by future contractors for the replacement of any buried facility.

Where conditions are, in the opinion of the Owner's Representative, unsuitable for laying pipe because of weather or trench conditions, the Contractor shall be required to cease work until permission is given by the Owner's Representative for work to commence again providing such conditions have been corrected.

1. Only proper and suitable tools and appliances for the safe and convenient handling and laying of pipes and fittings shall be used. Pipe, fittings, and valves shall be carefully handled and lowered into the trench. Under no circumstances shall any pipe or fittings be dumped or rolled into trench or be allowed to drop against the pipe or fitting already in the trench. Great care shall be taken to prevent the pipe lining and coating from being damaged, and any lining or coating damaged in any way shall be repaired by the Contractor to the satisfaction of the Engineer. Before being lowered and while suspended, the pipe shall be inspected for defects and ductile iron pipe rung with a light hammer to detect cracks. Defective, damaged, or unsound pipe will be rejected.
2. The interior of the pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during laying operations by means of plugs or other approved methods. The pipe shall not be laid in water or when the trench or weather conditions are unsuitable for such work. When work is not in progress, open ends of pipe and fittings shall be closed securely so that no trench water, earth, or other substances will enter the pipe or fittings.
3. The full length of each section of underground pipe shall rest solidly upon the pipe bed, and any defects due to settlement shall be made good by the Contractor at their own expense. The ends of pipe shall abut against each other in such manner that there shall be no shoulder or unevenness on the inside of the main. Bell holes shall be dug sufficiently large to ensure the making of proper joints. Special precautions shall be exercised to prevent any pipe from resting on rock.
4. Any pipe that has the grade or joint disturbed after laying shall be taken up and re-laid. Any pipe, pipe fittings, or appurtenance found defective after installation shall be replaced without additional expense to the Owner.

5. Except where otherwise necessary in making connections or closures, or as authorized by the Engineer, bell-and-spigot pipe shall be laid with bells facing in the direction of flow for pressure pipe and bells on upstream for gravity pipe.
6. Where pipe cutting is necessary, it shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise authorized, cutting shall be done by means of an approved type of mechanical cutter which will leave a smooth end at right angles to the axis of the pipe and not otherwise damage the pipe or lining. Wheel cutters shall be used when practicable.
7. Jointing
 - a. Mechanical joints and push-on joints on ductile iron and PVC pipe and fittings shall be made in accordance with the recommendations of the joint manufacturer, as approved.
 - b. Permissible Deflection at Joints
 - 1) No spring of joints to effect a change in direction will be allowed except by permission or direction or as shown on the drawings.
 - 2) Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, the amount of deflection shall not exceed that recommended by the pipe or joint manufacturer.
 - 3) If the required alignment necessitates greater deflections, special bends approved by the Engineer or shorter lengths of pipe to provide angular deflections within acceptable limits shall be furnished.
 - 4) Alternate methods of jointing pipe will be considered by the Engineer if the Contractor furnishes satisfactory evidence that the proposed alternate method has been used successfully and is acceptable to the manufacturer of the pipe and agreed to by the Owner.
8. Pipe excavation shall be kept free from water and no joint shall be made under water. The Contractor shall be careful during backfilling to prevent damage to or disturbing of joints and to protect the watertight integrity of the pipes at all times. There shall be no walking on or working over pipe until backfill is over pipe. Backfilling shall be commenced by depositing and tamping earth layers not more than 4 inches thick around and over the pipe to a point not less than 1 foot in depth over the top, after which backfilling of the remainder of the trench may proceed.
9. Sheet piling and shoring shall be in accordance with construction methods established in the Associated General Contractors of America Safety Code. The Contractor shall follow this AGC Manual in determining whether or not sheet piling and shoring is required and shall follow the AGC recommended procedure for installation.
10. Thrust Blocks
 - a. Plugs, caps, tees, and bends, vertically or horizontally, on force main shall be provided with thrust blocking along with restraint fittings.
 - b. Thrust blocking shall be concrete, minimum 2,000 psi.
 - c. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown on the drawings or directed by the Engineer.
 - d. Blocking shall be placed so that the fitting joints will be accessible for repair.

NOTE: Mechanical joint restraint and rodding may be used in lieu of thrust blocks when shown on the drawings or approved by the Engineer, on a case by case basis.

3.7 BEDDING, INITIAL AND INTERMEDIATE BACKFILL

- A. Regardless of the bedding type specified, the pipe barrel shall be supported uniformly throughout its length. Bell or coupling holes shall be provided such that no pipe loads are supported by bells or couplings.
- B. Unless shown otherwise on the drawings, bedding and initial backfill for PVC and DIP shall be as shown on the detail drawings, when subgrade is stable (as determined by the Engineer) and trench width at the top of the pipe does not exceed that specified.
- C. Material for initial and intermediate backfill (as defined on the drawings and below) shall be selected barrow material, granular material as defined under Division 31 or selected trench material free of organics, refuse, stone larger than one inch and frozen material.
- D. Initial backfill is that which is placed from the pipe bedding material up to the centerline of the pipe. Initial backfill shall be hand placed and carefully tamped under pipe haunches.
- E. Intermediate backfill is that which is placed from the initial backfill to 1 foot above the top of the pipe. Intermediate backfill shall be hand placed and tamped. Material shall be placed and tamped in layers not exceeding 6” thick when compaction required exceeds 80% of maximum dry density.
- F. The following minimum requirements shall be met. Where permit or special agreement conditions exceed these requirements they shall be met.
 - 1. Minimum compaction:
 - Class 2 – unimproved areas
 - Class 1 – roadways, road shoulders, driveways, walkways and slopes greater than 20%

<u>Pipe</u>	<u>Backfill Zone</u>	<u>% of Maximum Dry Density</u>	
		<u>Class 2</u>	<u>Class 1</u>
PVC	Initial	90%	95%
DIP	Initial		
	Intermediate	80%	90%

3.8 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - 2. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

3.9 ANCHORAGE INSTALLATION

- A. Install anchorages for tees, plugs and caps, bends, crosses, and valves. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
- B. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.
- C. Installing anchorages does not eliminate the requirements of restrained fittings.

3.10 TESTING, INSPECTIONS AND DOCUMENTATION

- A. Examinations and Testing of Pipe and Fittings
1. Examinations, testing and acceptance criteria, for manufactured pipe and fittings shall be in accordance with the applicable AWWA or ASTM standards and pipe and fitting manufacturer's instructions and recommendations. These include material tests for melt index, density and % carbon, dimensional checks, examination for visual defects, and ring tensile strength of piping. The results of all material and strength tests shall be available for review by the Purchaser.

3.11 HYDROSTATIC TESTING

- A. General
1. The Contractor shall be required to perform leakage tests on newly constructed mains as outlined herein. The Contractor shall furnish the gauges, pump, pipe, connections, and all other necessary apparatus, and shall furnish the necessary assistance to conduct the tests. The Owner or Engineer shall approve the gauges and measuring device used in the tests.
 2. Leakage tests shall be performed on sections of line as indicated on the drawings. Testing shall be conducted as the work progresses unless otherwise directed.
 3. The Contractor may, for their benefit, perform the pressure tests and initial leakage test with pipe joints left exposed and pipe sections backfilled one foot over the pipe as specified under the Earthwork Section of this specification. Testing at that time will be permitted, provided that sufficient time is allowed for miscellaneous concrete in the trench to develop adequate strength prior to testing and trenches left open during this period do not constitute a nuisance or hazard to the public. However, the pressure and leakage tests required in this specification shall not be performed until final backfill and compaction has been completed.
 4. All testing for record shall be performed in the presence of the Owner or their Engineer or their representative.
- B. Test Procedures
1. Where any section of a main is provided with concrete thrust blocking or encasement, hydrostatic testing shall not be performed until at least five days have elapsed after the concrete was installed. If high-early strength cement is used in the concrete for thrust blocks and encasement, the hydrostatic tests shall not be performed until at least one day has elapsed unless otherwise directed by the Owner or their Engineer.
 2. After completion of preparation and after test connections are made in a manner satisfactory to the Owner or their Engineer, each section of pipe shall be slowly filled with water and pressurized. All pressure shall be based on the elevation of the lowest points in the test section and corrected to the elevation of the test gauge.
 3. All air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so the air can be

expelled as the line is filled with water. After all air has been expelled, the corporation cocks shall be closed and testing begun.

C. Leakage Test

1. After all air has been expelled from a test section, all connections made and other preparations completed, the test section shall be subjected to leakage test pressure. This test pressure shall be sustained by a pump, and the quantity of water delivered to the system by the pump for a specified duration of time, shall be measured. At the end of the designated time period, the quantity of water delivered to the test section shall be equal to or less than the allowable leakage computed for the test section.
2. If any test of the pipe disclosed leakage greater than that specified, the Contractor at their own expense shall locate and repair defective joints and/or material until the leakage is within the specified allowance.
3. The Owner shall be furnished a written report of the results of the leakage test that identifies the specific length of pipe tested, the pressure, and the duration of these tests, the amount of actual leakage, and the leakage allowance. The report shall be signed by the Contractor and the Owner or their Engineer.

D. Hydrostatic Test Pressure, Duration and Allowance for Pressure Mains

1. Pressure and leakage test:
 - a. The design working pressure (P) shall be calculated for the lowest point in a test section using the following equation:
 Design Working Pressure (P) PSI = (Design Pressure Elevation (ft) – Elevation at Point (ft) 0.4333 PSI/ft
 Design Pressure Elevation = 499 Ft (for potable water)
 Design Pressure Elevation for Pumping = the pump shut off head in feet plus the suction water level elevation (ft) time 0.433 PSI/ft
 Test pressure shall be performed at 1.5 times the design working pressure with the following expectations:
 - 1) Test pressure shall not exceed pipe or thrust-restraint design pressure.
 - 2) Test pressure shall not cause the working pressure of any valve or other appurtenance to be exceeded.
 - 3) Test pressure shall not exceed 150 psi along the test section.
 - b. The duration of the acceptable pressure and leakage tests is two hours for potable water mains and thirty minutes for wastewater force mains. The test pressure shall not vary by more than +/-5 PSI for the duration of the test.
 - c. Once the Contractor has filled the water lines and air has been expelled, the Contractor shall pump water into the water line until the specified test pressure is met. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe on any valved section thereof to maintain the specified test pressure. Water line pressure shall be maintained within 5 PSI of the specified test pressure during the duration of the test. If the pressure drops below the allowable range, the Contractor shall inject water into the test section until the specified test pressure is reset. The volume of water injected into the test section shall be monitored and recorded in the presence of the Owner and the Engineer or Representative. If the pressure does not drop below the specified range, no water needs to be injected into the test section until the end of the test period. Again, the volume of water injected in the test section to obtain the specified test pressure shall be monitored and recorded in the presence of the Owner or hid Engineer or Representative.

- d. The allowable leakage for a test section shall be 11.65 gallons per day per mile of pipe per inch of nominal diameter based on a pressure of 150 psi.
- e. The allowable leakage is determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

Where:

L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage tests, in pounds per square inch (gauge)

3.12 DISINFECTION PROCEDURE WHEN CUTTING INTO AN EXISTING POTABLE WATER MAIN

- A. The following procedures apply primarily when the existing mains are wholly or partially dewatered. After the tee in has been completed, the existing main may be returned to service to the completion of bacteriological testing in order to minimize the time customers are without water.
 - 1. Trench treatment: Liberal quantities of hypochlorite shall be applied to open trench areas in order to lessen the danger of pollution. Tablets provide an advantage in this situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.
 - 2. Swabbing with hypochlorite solution: The interior of pipe and fittings (particularly coupling and sleeves) used in connection shall be swabbed or sprayed with a 1 percent hypochlorite solution before they are installed.
 - 3. Flushing: Thorough flushing is the most practical means of removing contamination introduced during tie in. If valve and hydrant locations permit, flushing toward the new pipe work is recommended. Flushing shall be performed as soon as the connection is completed and shall continue until discolored water is eliminated.
 - 4. Bacteriological samples following procedures in 3.8 shall be taken after connections are completed to provide a record for determining the procedure's effectiveness.

3.13 WATER FOR TESTING

- A. Water for the work outlined in this section of the specifications shall be provided in accordance with Section 011000 "Summary".
- B. Water for testing non-potable water piping and force main can be obtained from the wastewater treatment facility effluent.
- C. The water used for testing potable water piping shall be taken from an approved potable water source (i.e. a waterworks holding a valid waterworks operation permit).

3.14 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground PVC piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

END OF SECTION 333400

SECTION 400000 – GENERAL REQUIREMENTS FOR INSTRUMENTATION 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. This section includes general requirements to provide a complete, functional process control, instrumentation, communication, and signal systems for the City of Eden WWTP. The requirements of this section are applicable to all work specified in Division 40 of the Specifications.
- B. Instrumentation And Control System Description Of Work:
 - 1. The facility control system, shall be upgrades to include installing a new PLC-WNAB in the new blower building for monitoring of systems for relay to existing WWTP SCADA system. The SCADA system shall be expanded to include new process control screens for monitoring of signals as shown in the contract P&IDs. This project does not include installation of new SCADA software, however if the existing software is not capable of expansion to monitor new signals, the software package shall be upgraded at no additional cost to the City.
 - 2. The new high speed blower system will include its own PLC/control system for controls and operation of the high speed turbo blowers. Output signals will be routed to the new PLC-WNAB for monitoring by the plant SCADA system.
 - 3. The system integrator shall provide HMI, OIT, and PLC programming as specified and shown on the Contract P&IDs and as necessary to implement the Control Strategies described in Section 400010. The new SCADA system is designed with future development in mind. Monitoring and automatic control via SCADA for plant systems shall be incorporated as specified in Section 0010. All stand-alone equipment shall have the ability to operate from field or MCC rooms in HAND without control from the plant SCADA system.
 - 4. The Systems Integrator shall supply all instruments as shown in the P&ID drawings not provided by equipment manufacturers. Instrument List shown on sheet I7 and I8. Instrument surge suppression, and outdoor mounted instrument sunshades shall be provided as specified. Intrinsically safe installations shall be coordinated for all classified locations per NFPA 820.

5. PLCs, OIC and operator workstation provided under division 40 shall be protected with true online double conversion UPSs with 30 minutes of backup power in the event of power loss.
6. All programming software and programs shall be provided to the Owner and best procedures for SCADA PLC or workstation failure shall be addressed during training provided by the Integrator. Provide plant staff with training of all control equipment relating to the plant upgrades under this contract and maintenance thereof shall be provided as specified under Sections 400990 and 017823.
7. Provide all installation and field testing as specified.
8. The Systems Integrator shall provide a one (1) year extended service contract to extend beyond final completion. The contract shall include four (4) site visits spaced equally over the contract for one 8 hour day (each visit) on site (not including travel time) to address items identified by Owner, periodic equipment maintenance and check calibration of instrumentation. Total service contract shall include 32 hours.
9. The Systems Integrator shall provide 24 extra man hours beyond the work required in the specifications to accommodate unforeseen system changes, contract document omissions or redesign during construction.
10. Testing will be considered substantially complete and accepted by Owner when PLC work is verified, meets the design intent and runs continuously for 7 calendar days without failure due to the work performed herein.
11. Once testing has been accepted as substantially complete, the Owner shall document operating issues with the plant control system that will require the service of the Systems Integrator. At the end of a 60 day period (or sooner if necessary), the Systems Integrator shall address and correct all identified action items associated with; installation of the new SCADA system, control upgrades of existing equipment under this contract, or issues relating to the integration of vendor supplied equipment with the plant SCADA system.

1.3 REFERENCES

- A. References to documents below shall mean the documents in effect at the time of bids. If referenced documents have been discontinued, references to those documents shall mean replacement documents, where there are no replacement documents, the latest version of the document before it was discontinued will govern.

1. IEEE 100 Standard Dictionary of Electrical and Electronics Terms
2. ISA S5.4 Instrument Loop Diagrams
3. ISA S20 Specification Forms For Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
4. ISA S51.1 Process Instrumentation Terminology

- 5. ISA TR20.00.01 Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations
- 6. NEMA ICS 1 General Standards for Industrial Control and Systems

1.4 QUALITY ASSURANCE

- A. Control system and instrumentation integration including, instrument calibration, testing, start-up, operational testing, and training shall be performed by a Systems Integrator staffed with qualified personnel, experience in performing similar installations.
- B. The components, modules, devices, and control system equipment shall be recognized industrial quality products.
- C. The application software packages shall be latest versions available.
- D. Systems Integrator
 - 1. The Contractor shall provide, through the services of a single Control Systems Integrator (CSI), all components, system installation services, programming, testing, start-up and commissioning in connection with providing a Process Instrumentation and Control System, as described herein and in other sections of Division 40 of the contract documents. All instrumentation and control systems shall be provided under the supervision of a single CSI, which is regularly engaged in the design, installation, programming, testing, start-up and commissioning of such systems of similar complexity. The scope of this project includes integration of new control functions and equipment with existing control functions and equipment. The work under this project shall not alter, limit, or impair the function of existing processes in any way, unless specifically described in the Contract Documents. The Contractor is responsible to the owner for final performance of all systems. The Control Systems Integrator shall be:
 - 1) MG Newell Corporation;
 - 2) CITI, LLC;
 - 3) Custom Controls Unlimited, Inc.; or
 - 4) Approved Equal
 - 2. In order to be an approved System Integrator, the system supplier must meet all the following criteria without exception. Being pre-approved does not eliminate or discount any of the following requirements:
 - a. Must have a minimum: ten (10) years of experience providing similar operational systems, provide upon request; five (5) projects shall have been completed within the previous three (3) years. Two previous project submittals, O&M's, and drawings, that meet the requirements specified herein, must be submitted as proof of prior experience. References, from the consulting engineer and end user, for the same project must be provided.
 - b. Must have been in business a minimum of ten (10) years, operating under the same company name with a minimum of ten (10) full time personnel specifically for SCADA systems, pump control systems, and instrumentation.
 - c. Must have degreed engineers, service engineers, and technicians that are full time employees of the System Supplier, whose headquarters or local engineering office

is located within a 100-mile radius of project location. No contract or part-time employees shall be used for any portion of this Project.

- d. Submit organization chart and resumes for proposed project personnel.

1.5 FUNCTIONAL REQUIREMENTS

A. General

- 1. The instrumentation and control system functions are shown on the drawings and specified in subsequent sections of Division 40. The Systems Integrator drawings and integration practices shall be as defined in IEEE 100, ISA S51.1, and NEMA ICS 1.

B. Submittal Drawings

- 1. General: The drawings included in the project manual are functional in nature and do not show exact locations of equipment or interconnections between equipment. The Contractor's Systems Integrator shall prepare detailed installation drawings as specified below:
 - a. Drawings prepared in AutoCAD with borders and title blocks identifying the project, system, revisions to the drawing, and type of drawing. Each revision of a drawing shall include the date and description of the revisions. Drawing prints shall be 11" x 17" with a minimum lettering size of 1/8".
 - b. Diagrams shall carry a uniform and coordinated set of wire numbers and terminal block numbers in compliance with panel wiring and Section 400010, to permit cross-referencing between contract documents and the drawings prepared by the Contractor.
- 2. Connection Diagrams: Show components of a control panel in an arrangement similar to the actual layout of the panel including internal wiring between devices within the panel. Show terminal blocks used for internal wiring or field wiring, identified as such. Indicate insulation color code, signal polarities, and wire numbers and terminal block numbers.
- 3. Interconnection Diagrams: Show panels, panel devices, and field devices with wire numbers, cable numbers, raceway numbers, terminal box numbers, panel numbers, and field device tag numbers.
- 4. Network Block Diagram: A network block diagram is a diagram of the overall SCADA system, with annotated boxes to show the primary network components (controllers, hubs, switches, computers, displays), and annotated interconnecting lines that show the system communication media and communication protocols.

1.6 SUBMITTALS

A. Provide the following information to confirm compliance with specifications:

- 1. Detailed product literature, showing product specifications, model number breakdown, and marked to denote features and options. Include only the applicable pages.

2. Manufacturer’s installation manual excerpts, as to be used for this project:
 - a. Installation details/drawings
 - b. Electrical connection diagrams
 - c. Calibration procedures
3. Drawings and diagrams specified in Section 400000.
4. Nameplate list with material, tag number and description as specified herein.
5. Systems Integrator Evidence of Experience (if required).

PART 2 - PRODUCTS

2.1 General

A. Materials and quality:

1. Equipment material shall be new, free from defects, and industrial-grade, as specified. Each type of instrument, instrument accessory, and device used throughout the work shall be manufactured by one firm, where possible.

B. Enclosures:

1. Table 2.1 specifies the instrument and control panel enclosure material and minimum

Location	Enclosure Material and NEMA Rating
Indoor: Electrical Room / Finished Area	NEMA 12: mild steel
Indoor: Process Areas	NEMA 4X: 316 stainless steel
Indoor: Corrosive Area	NEMA 4X: corrosion-resistant (Fiberglass)
Outdoor: Corrosive Area	NEMA 4X: corrosion-resistant (Fiberglass)
Outdoor: Non-Corrosive Areas	NEMA 4X: 316 stainless steel
Corrosive Area (Hypochlorite)	NEMA 4X: non-metallic
Hazardous Areas	NEMA 7: galvanized malleable iron or aluminum or NEMA 4X and UL listed or FM approved for the hazardous area
Hazardous and Corrosive Area	NEMA 7: iron or aluminum with factory applied corrosion resistant coating or NEMA 4X and UL listed or FM approved for the hazardous area

2.2 NAMEPLATES

- A. Nameplates shall be provided for all field mounted instrument, analyzer, or equipment specified in Division 40. Nameplate lettering shall include the equipment or instrument loop title and the instrument or equipment tag number, where nameplate engraving is not specified or shown. Nameplates shall be machine engraved black phenolic with white 5/32-inch high lettering, as minimum, unless otherwise specified or shown.

2.3 PRODUCT DATA

- A. Record drawings and the schedules included in Division 40 shall be provided in the latest AutoCAD format and PDF format on CD.
- B. Provide record drawing prints of all drawings following project start-up, but prior to acceptance of the work showing the final constructed state of the instrumentation and control systems.
- C. Operating and maintenance information shall be provided in accordance with Section 017823.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

- 1. Equipment shall be installed in locations that are accessible for operation and maintenance services. Equipment not accessible shall be reinstalled at no cost to the Owner.

B. Field Equipment

- 1. Equipment shall be provided with ports and adjustable items accessible for in-place testing and calibration. Install equipment between 48 inches and 60 inches above the floor or permanent work platform. Equipment shall be mounted to avoid shock or vibration that may impair operation. Equipment shall be mounted for unobstructed access and walkways. Equipment support systems shall not be attached to handrails, process piping or mechanical equipment.
- 2. Instruments and cabinets mounted to concrete walls shall be offset by 5/8 inch by framing channel between instrument or cabinet and wall. Block wall shall have additional installation supports, as required, to avoid damage to the wall. Equipment supports shall be hot-dip galvanized after fabrication or shall be 316L stainless steel.
- 3. In wet or outdoor areas, conduit penetrations into instrument housing shall be made through the bottom (preferred) or side of enclosures to minimize water entry. Provide conduit hubs for connections and waterproof mastic for moisture sealant.

C. Signal Connections

- 1. Equipment electric signal connections shall be made on terminal blocks or by locking plug and receptacle assemblies.
- 2. Jacketed flexible conduit shall be used between equipment and rigid raceway systems. Flexible cable assemblies may be used where plug and receptacle assemblies are provided and the installation is not subject to mechanical damage in normal use.

END OF SECTION 400000

SECTION 400010 – CONTROL STRATEGIES

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. These control strategies herein offer a guide for programming, start up, checkout and describe how the system is to operate, but do not necessarily include all components required to make the system function.
- B. For the purposes of this section, "Existing" refers to equipment, devices, or items which were a part of the system prior to the work done under this Contract.
- C. Control strategies describe sequential and interlocking control functions, analog control functions, color-graphic video display HMI Computers and Operator Interfaces and alarm and event logging. The System Programmer will provide all necessary software and applications programming to implement the control strategies. All control functions shall be programmed in the PLCs. The Operator Interface and HMI computers shall perform supervisory functions.
- D. The System Integrator will configure Operator Interface and HMI computer screens to match with the existing HMI process graphic displays where applicable, equipment status and alarming requirements for the abnormalities of the process and malfunctions of equipment. Equipment status and alarming requirements for the abnormalities of the process and malfunctions of equipment shall be identical to the existing style or as otherwise directed by the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTROL STRATEGIES

- A. The following control strategies are included in this section and describe general control features for all systems. All existing functional controls at the Boydton WWTP that are not addressed in this contract shall remain.

Control
Strategy
Section

Title

- 3.2 Discrete Point Status
- 3.3 Analog Point Status
- 3.4 General Ready, Running and Failure System
- 3.5 SCADA Inputs and Outputs Distribution and Control Requirements
- 3.6 General Recording System
- 3.7 General Contact/Logic System
- 3.8 General Process Control Function (Analog) System
- 3.9 Trend Plots
- 3.10 Color Notation for Dynamic Objects on Control Graphic Display Screens
- 3.11 Discrete Alarm System
- 3.12 Discrete Status System
- 3.13 South Basin Transfer Pump
- 3.14 North Basin Sump Pumps

3.2 DISCRETE POINT STATUS

A. Reference Drawings:

1. All P&IDs

B. System Components:

1. In accordance with P&IDs

C. Description:

1. The status of all discrete input points and logical discrete points shall be recorded and stored in the SCADA system database. Logical discrete points are points which depend upon the status of one or several discrete input points (i.e., values determined by the PLC utilizing programmed logic statements).

D. SCADA:

1. Calculate and maintain the status of all discrete and logical discrete status points in the SCADA system database.

END OF CONOTROL STRATEGY 3.2

3.3 ANALOG POINT STATUS

A. Reference Drawings:

1. All P&IDs.

B. System Components:

1. In accordance with Contract P&IDs

C. Description:

1. Analog input points shall be checked for the following status conditions:
 - a. Failed: Point value is less than or greater than the specified value range, typically less than 3.6 milliamps (mA) and greater than 21.6 mA.
 - b. Low Alarm: Point value is equal to or less than a predetermined alarm value.
 - c. High Alarm: Point value is equal to or greater than a predetermined alarm value.
 - d. Normal: Point value is within the predetermined low and high alarm values.
2. An analog point which is in alarm status shall not be changed to normal status until the point value changes by the predetermined deadband value for the point.

D. SCADA:

1. Failed, high alarm, low alarm, and deadband values shall be maintained in the SCADA system database. These limits may be changed only by the SCADA programmer.
2. Point status shall be maintained in the SCADA system database. Discrete alarm outputs shall be driven from the point status.

END OF CONTROL STRATEGY 3.3

3.4 GENERAL READY, RUNNING AND FAILURE SYSTEM

- A. Each motor-driven piece of equipment shall have a running status input to the SCADA system. If the equipment is equipped with one or more HAND-OFF-AUTO switches, the equipment shall have an input for AUTO status. If a “RUNNING” input status occurs and the “AUTO” status does not occur, the SCADA system shall identify that the motor is operating in the HAND mode.
- B. The run time shall be calculated and stored for all equipment being monitored. This function shall be equivalent to a conventional elapsed time meter. Run time for all equipment shall be displayed at the Operator’s Workstation for monitoring and operational scheduling of each piece of equipment to ensure even wearing of all equipment.
- C. The failure of driven equipment shall be monitored by the SCADA system. Equipment shall be considered failed under the following conditions:
 - 1. The equipment is in AUTO and the SCADA system attempts to run the equipment and it does not respond within the specified time period.
 - 2. The equipment is in AUTO and running and stops for any reason other than a signal from the SCADA system signaling equipment to “STOP”.
 - 3. In addition, specific equipment is equipped with discrete monitoring devices which provide “Trouble”, “Fault”, or other specific alarm inputs to the SCADA system. If any of these signals are received, the SCADA system shall enunciate an alarm status at the Operator’s Work station.
- D. The SCADA system shall be used to the extent that it shall facilitate sequencing of the equipment. The plant operator shall be able to bypass the sequencing and START/STOP the equipment and OPEN/CLOSE valves and gates on a “MANUAL” procedure from the local and remote hand switches when desired. Interface to the SCADA system shall be through I/O points or workstations or laptops, as applicable to the installation.

END OF CONTROL STRATEGY 3.4

3.5 SCADA INPUTS AND OUTPUTS DISTRIBUTION AND CONTROL REQUIREMENTS

A. Reference Drawings:

1. All contract P&IDs.

B. Description:

1. SCADA system I/O assignment shall be as shown on the P&IDs.
2. Upon failure of a process equipment item, the SCADA system shall start the next available unit, as described in the applicable control strategy.
3. Upon failure of a PLC input/output module, SCADA system shall skip equipment controlled by PLC input/output module and go to next process unit in the lead-lag sequence.

END OF CONTROL STRATEGY 3.5

3.6 GENERAL RECORDING SYSTEM

A. Reference Drawings:

1. All contract P&IDs

B. Description:

1. HMI workstations shall generate reports based upon process variables (pressure, flow, temperature, level and analytical) and equipment status (speed, and motor current) in real-time and from recent historical data. **The exact report requirements will be determined by the Owner and shall be configured by the System Programmer during the project construction period.**
2. All analog signals including existing plant signals shall be logged at the SCADA system and stored in the system database.
3. All motor runtimes shall be logged in the SCADA system database and displayed at the Operator's Workstation.
4. All accumulated daily, monthly, and yearly flow signals shall be logged in the SCADA system database and displayed at the Operator's Workstation.
5. All stored data shall be backed up to protect in the event of hardware failure.
6. Historical data stored in the database shall be accessible for the Operator Workstation (not including OIC/HMIs).

END OF CONTROL STRATEGY 3.6

3.7 GENERAL CONTACT/LOGIC SYSTEM

A. Reference Drawings:

1. All contract P&IDs.

B. Description:

1. All discrete/logic control functions shall be provided as required and shall include but not be limited to the following:
 - a. Discrete/Logic Functions: The ability to perform logic and sequencing functions shall be supported to provide control interlocks, event sequencing and other logic operations.
 - b. Boolean algebra requirements: AND gate, OR gate, NAND gate, NOR gate, XOR gate, and NXOR gate.
 - c. Logic requirements: Logic switch, logic compare, bi-directional time delay, and on-off with feedback.
 - d. Ladder Logic requirements: NO contact, NC contact, energize coil, latch/unlatch coil, retentive timer on/off delay, up/down counter, counter/timer reset, ladder execution control, immediate input, and immediate output.

END OF CONTROL STRATEGY 3.7

3.8 GENERAL PROCESS CONTROL FUNCTION (ANALOG) SYSTEM

A. Reference Drawings:

1. All contract P&IDs.

B. Description:

1. All analog control functions shall be provided as required and shall include but not be limited to the following:
 - a. Proportional-Integral-Derivative (PID) Control – Standard controller functions with balance-less, bump-less transfer from manual to automatic, manual overrides, external reset and output summing capabilities. Provision for cascade, ratio gain, bias, lead-lag, dead-time, feed-forward, and feedback control shall be available.
 - b. HMI display system shall have a common PID controller operator interface for all equipment utilizing PID control. Controller operator interface shall include alphanumeric and graphic indication of the following features as a minimum:
 - 1) ID of controlled equipment.
 - 2) ID of process variable input.
 - 3) Controller setpoint value.
 - 4) Process variable value.
 - 5) Controller output value.
 - 6) Setpoint adjustment interface.
 - 7) Indication if setpoint is under local or remote control.
 - 8) Local/Manual control output adjustment interface.
 - 9) Indication if control output is under local/manual control or under control of process controller.
 - c. Computational Functions: On-line mathematical functions shall be available to provide real-time computational capability of control variables for use in feed forward and other advanced control functions.
 - d. All setpoints for alarm and control shall be adjustable from password-protected HMI Computer screens. Coordinate level of security required for password protection of setpoint screens with the Owner and Engineer.
2. Appropriate control action(s) shall be provided as needed.

END OF CONTROL STRATEGY 3.8

3.9 TREND PLOTS

A. Reference Drawings:

1. All contract P&IDs.

B. Description:

1. HMI workstations shall graphically plot trends of process variables (pressure, flow, temperature, level and analytical), controller setpoints and outputs, and equipment status (speed and motor current) in real-time and from historical data. The plant operator shall be able to select the plotting interval, within the limits of the actual data collection. Provide a minimum of four trends per display view.
2. In addition to the plotted data, a trend shall include:
 - a. Time
 - b. Date
 - c. Tag number
 - d. Plotting interval
 - e. Time at start
 - f. Time at latest value
3. The Operator shall have the ability to export data from the trend plot to a standard format which can be utilized within other applications (i.e., text or Excel).

END OF CONTROL STRATEGY 3.9

3.10 COLOR NOTATION FOR DYNAMIC OBJECTS ON CONTROL GRAPHIC DISPLAY SCREENS

A. Reference Drawings:

1. All contract P&IDs and control strategies.

B. Description:

1. All dynamic objects on control graphic display screens and hardwired panel controls shall be provided with multiple-color display to identify status as tabulated below:

Equipment	Status	Required color
Motor	Running	Green
Motor	Off	Red
Valve	Open position	Green
Valve	Closed position	Red
Gate	Open position	Green
Gate	Closed position	Red
All	Abnormal condition	Amber (Yellow)
All	Power On	Blue

END OF CONTROL STRATEGY 3.10

3.11 DISCRETE ALARM SYSTEM

A. Reference Drawings:

1. All contract P&IDs, electrical control diagrams and Engineer approved vendor shop drawings.

B. System Components:

1. In accordance with contract P&IDs.

C. Description:

1. All discrete input alarms shall be provided as shown on P&IDs or called out elsewhere whether or not specific control strategies are provided. Whenever a P&ID is not shown with any On/Off, Start/Stop, Open/Close or analog modulation control, no specific control strategy will be written even if a discrete alarm system is shown on the drawing. For this condition, **Control Strategy 3.2** shall be applicable. Discrete inputs can be from field instruments (level switches, pressure switches, etc.), local control panels (relay outputs, alarm module outputs, switches), and packaged systems (designated terminals with packaged units).
2. In general, an internal discrete alarm shall be generated if a command is given and feedback is not confirmed. Such as a motor is asked to start, if the run status contact is not received within a second following the initiation of the command, an alarm shall be indicated.

END OF CONTROL STRATEGY 3.11

3.12 DISCRETE STATUS SYSTEM

A. Reference Drawings:

1. All contract P&IDs, electrical control diagrams and Engineer approved vendor shop drawings.

B. System Components:

1. In accordance with contract P&IDs.

C. Description:

1. All discrete input statuses shall be displayed on HMI screens as required by the referenced drawings and specifications **regardless whether or not specific control strategies are provided.** Each discrete input shall be shown in its appropriate process screen and/or equipment status screen. Discrete inputs can be originated from field instruments (motorized actuators, level switches, pressure switches, etc.), local control panels (relay outputs, alarm module outputs, switches), and packaged systems (designated terminals with packaged units).

END OF CONTROL STRATEGY 3.12

3.13 SOUTH BASIN TRANSFER PUMP

A. Operation

The South Basin Transfer Pump is for utilizing the South Basin as an equalization/storage tank for peak/wet weather flows coming into the facility. The basin can be pulled down 3 feet from the normal water surface. If the basin is pulled down any further, the floating pontoon aerators could potentially be damaged. The South Basin transfer pump will be energized and pump down until the low-level cutoff float turns the pump off, or the Operator deenergizes the pump.

B. Local Controls

The pump will have a local control panel with an On/Off switch. When the pump is switched to on, the pump will continue to operate until the low-level switch is engaged and the pump will no longer operate. Once the switch is engaged, the pump will no longer operate, and the Operator will need to turn the pump “On” to operate again.

C. SCADA Automatic Control Mode

No SCADA automated controls are provided for this pump. The SCADA system will monitor the operation of this pump.

D. Interlocks

The pump shall not operate if the low-level cutoff level switch is engaged.

E. Signals

Signals are as shown on the Contract P&IDs.

F. Operator Workstation

Signals shown on the P&IDs to be transmitted back to the PLC, stored in the SCADA system database and will be displayed at the Operator Workstation.

G. Trend Plots

Trend plots will include the following two graphs to be capable of being displayed at the Workstation:

1. Date/Time vs Pump “On/Off”

END OF CONTROL STRATEGY 3.14

3.14 NORTH BASIN SUMP PUMPS

A. Operation

The north basin sump pumps will be utilized to pump down either Train 1 or Train 2 to take out of service. The pumps each transfer contents to the other basin respectively. Discharge valves will need to be adjusted respectively when taking a basin out of service. When taking a train offline, the Operator will place the respective sump pump in automatic mode. This will allow the pump to continue to operate until the low-level float is reach. When the low-level float is reached, the pump will turn off. The low-level float is set so the membrane diffusers will not be exposed to sunlight. We operations is ready to perform maintenance to the diffusers; the Operator will place the pump in hand mode to pull the water surface down further to expose the diffuser heads. Once maintenance of the diffuser heads are complete, water shall be allowed to re-enter the basin to provide minimum 12” of cover to the membrane diffuser to prevent damage from UV radiation.

B. Local Controls

The pump will have a control panel in the new blower building with an HOA switch. When the pump is switched to automatic, the pump will continue to operate until the low-level switch is engaged and the pump will no longer operate. The low-level switch will turn the pumps off in automatic mode. When placed in hand mode, the pump will run. When in Off mode, the pump will not run.

C. SCADA Automatic Control Mode

No SCADA automated controls are provided for this pump. The SCADA system will monitor the operation and alarming of this pump.

D. Interlocks

The pump shall not operate if the low-level cutoff level switch is engaged.

E. Signals

Signals are as shown on the Contract P&IDs.

F. Operator Workstation

Signals shown on the P&IDs to be transmitted back to the PLC, stored in the SCADA system database and will be displayed at the Operator Workstation.

G. Trend Plots

Trend plots will include the following two graphs to be capable of being displayed at the Work Station:

1. Date/Time vs Pump “On/Off”

END OF CONTROL STRATEGY 3.15

END OF SECTION 400010

SECTION 400030 – PROCESS INSTRUMENTATION AND CONTROL SYSTEM TESTING

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 DESCRIPTION

- A. This section specifies Contractor and Systems Integrator performance testing and documentation of process instrumentation and control system materials and equipment.
- B. The term instrumentation covers field and panel instruments, analyzers, primary sensing elements, transmitters, power supplies and monitoring devices
- C. Provide all labor, tools, materials, power and services necessary to provide the process instrumentation and control system inspection and testing specified herein. Coordinate testing with Section 400990.

1.3 REQUIRED TESTING

- A. Pre-Operational Performance Testing
- B. Functional Testing
- C. System Acceptance Testing

1.4 SUBMITTALS

- A. Submittal material shall consist of the following:
 - 1. Control descriptions
 - 2. I/O interface summaries
 - 3. Testing status spreadsheets
 - 4. Test procedures
 - 5. Certified factory calibration reports
 - 6. All P&ID drawings with addenda updates included, marked to indicate requests for deviation from specification requirements.
 - 7. All applicable electrical drawing's control diagrams with addenda updates included, marked to indicate requested deviation from specification requirements.

PART 2 - PRODUCTS

2.1 CONTROL DESCRIPTION

- A. Provide a control description outlining operation for each process area's system. The Control Strategies specification 400010 can be used as a basis.

2.2 I/O INTERFACE SUMMARY

- A. Provide I/O spreadsheets for each process area's main system including the following:
 1. Signal number/tag
 2. Annotation description that may be logically abbreviated
 3. Complete physical I/O channel designation and addressing or communication I/O register designation
 4. True/False status designations for digital I/O
 5. Process Range: engineering units
 6. Signals
- B. Integrator may use P&IDs and PLC diagrams as a basis of design.

2.3 INSTRUMENT INDEX

- A. Provide a detailed Instrument Index. The Instrument Index shown on the Contract Drawing P&IDs may be used as a basis. Provide details on calibration ranges, setpoints and deadbands.

2.4 PRODUCT DATA

- A. Provide the following products after testing:
 1. Completed Test Forms documenting testing procedures, results and any issues and details on how they were resolved
 2. List of factory calibrated items and calibration certificates
 3. Documentation of network data communication notes for network type instruments, devices and VFDs
 4. Final Test Reports assembled in a three ring binder submitted at the end of testing
 - a. Test Results and Reports shall be organized by equipment item and by system loop. All deficiencies shall be acknowledged within the report and corrections made referenced.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Materials, equipment and construction included under this specification shall be inspected in accordance with this section and subsequent Sections of Division 40. Testing shall be performed by the Contractor in accordance with the Contract Documents.

3.2 QUALITY ASSURANCE PROGRAM

- A. The Contractor shall provide a Quality Assurance Manager to coordinate, manage and supervise a quality assurance program for installation of equipment, controls and all program integration within the project that includes, but is not limited to the following:
 - 1. Testing plan and schedule describing the sequence of Work meeting Work Restriction requirements described in Section 011000
 - 2. Calibration program for all instruments and analyzers
 - 3. Documentation program that records all test results
 - 4. Performance testing of all equipment and programmed systems

3.3 WITNESSING OF TESTS

- A. The Engineer reserves the right to observe factory and field instrumentation testing and calibration procedures. The Engineer shall be notified prior to testing, as specified herein.

3.4 PRE-OPERATIONAL PERFORMANCE TESTING

- A. In general, the test shall include the following:
 - 1. Wiring Tests: Electrical power and signal cable ring-out and resistance testing. Wiring tests shall not be conducted until cables have been properly terminated, tagged and inspected.
 - 2. Network and BUS Cable and Networking Devices: Prior to energizing, all network cables and devices shall be inspected by the industry standards and manufacturer's recommendations to confirm acceptable installation in accordance with existing site conditions. After the network system has been activated for testing, provide diagnostic monitoring and signal analysis for the BUS network system to evaluate network and BUS integrity and data transfer quality.
 - 3. Loop Testing: Loop testing shall not commence until testing and calibration of individual components has been completed and documented to the satisfaction of the Engineer. Each instrument loop shall be tested as an integrated system. Check operation from field instruments to transmitter to receiver components to the vendor panel or the Operator Workstation. Testing of loops with an interface to a PLC shall include verification of the programmable logic controller I/O assignment and verification of operation of the I/O system and processor. Inspect the data table or register in the PLC memory to verify proper operation.
 - 4. Any deficiencies identified during testing shall be corrected and retested prior to acceptance of testing and proceeding with Functional Testing.

3.5 FUNCTIONAL TESTING

- A. Process Control Strategy/Functional Testing
 - 1. Control Strategy Testing shall not commence until the Loop Testing has been completed and documented to the satisfaction of the Engineer.

2. Control Strategy Testing is performed by the Integrator to exercise and validate control strategies.
3. Provide qualified personnel to immediately correct any deficiencies in the Work that may be encountered during Control Strategy Testing.

B. Control System Closed Loop Testing

1. Closed – Loop Commissioning shall not commence until the Control Strategy Testing has been successfully completed and documented to the satisfaction of the Engineer.
2. Closed – Loop commissioning tests, performed as part of the system tests, shall demonstrate stable operation of each loop under operating conditions.
3. Where a loop is controlled under the direction of a PLC, adjustment of loop tuning parameters and setpoints shall be approved by the Engineer. Contractor shall record the loop response, adjusting final elements, and assuring total integrated loop performance as specified.

C. Functional Checkout

1. Conducted to verify the operation of discrete and hardwired control devices and the control circuits in accordance with the Control Strategies described in Section 400010.

3.6 SYSTEM ACCEPTANCE TEST

- A. System Acceptance Test shall be performed after component and subsystem tests have been completed. The test of the completed system shall be performed in full operation and shall demonstrate that all functional requirements of this specification have been met. Testing shall validate the following:
1. Each component of the system operates correctly with all other components of the system.
 2. Analog control loops operate in a stable manner.
 3. Equipment interlocks perform correctly.
 4. Process control sequences perform correctly.
 5. PLC application program performs monitoring and functions correctly.
 6. Operator interface graphics represent the monitoring and control functions correctly.

END OF SECTION 400030

SECTION 17212 – PROCESS TRANSMITTERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this Section. Should there be any conflict between provisions or requirements elsewhere indicated and the provisions of this division, request written clarification by addendum prior to submission of bid or abide by the interpretation of the Engineer.
- B. The following Specifications are related to Work described in this Specification section. This list of related specifications is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
- C. Instrument Index, Table 17000-A, appended to the end of Specification 17000.

1.2 SUMMARY

- A. This section specifies requirements for process variable transmitters.
- B. Application requirements for each transmitter are specified in the Instrument Index, Table 17000-A, appended to the end of Section 17000.

1.3 SUBMITTALS

- A. Submittals shall be provided in accordance with the requirements of Specification 17000 and the following:
 - 1. Instrument Installation Review and Certification: The instrument supplier shall review each of the instrument installation details provided on the Drawings and acknowledge in writing that the installation conditions described by the detail conform to all applicable installation requirements for the particular instrument.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of process variable transmitters of types, sizes, and ratings required, whose products have in satisfactory use in similar service for not less than 10 years.
- B. Installer's Qualifications: Firms with at least 3 years of successful installation experience on projects utilizing process variable transmitters similar to those required for this project.

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise specified, measuring elements and transmitters shall comply with the following requirements:
 - 1. Transmitters shall be provided with integral indicators. Indicators shall be calibrated in process units, and said units shall be engraved on the indicator scale plate.
 - 2. Transmitters shall be four-wire type with operating power derived from the area control center. Transmitters shall have a minimum of one (1) 4-20 mA DC output and two discrete contacts minimum as standard equipment.
 - 3. Transmitter enclosures shall be rated NEMA 250, Type 4, unless otherwise specified.

2.3 TRANSMITTER SPECIFICATION SHEETS

- A. General requirements for instruments specified in this section are listed on Transmitter Specification Sheets in paragraph 400212-3.6. Application requirements are specified in the Instrument Index, Table 400212-A, and/or on the Drawings.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which process transmitters are to be installed, and process connections to which transmitters are to be interfaced. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.2 PROTECTION

- A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 INSTALLATION OF PROCESS TRANSMITTERS

- A. Specific instrument installation requirements are specified on the respective Transmitter Specification Sheets in paragraph 400212-3.6.
- B. Raceway Connections: Final connections between rigid raceway systems and instruments shall be made with jacketed flexible conduit with a maximum length of 2 feet.
- C. Transmitters shall be provided as specified on the Drawings such that ports and adjustments are accessible for in-place testing and calibration. Where possible, equipment shall be located between 48 inches and 60 inches above the floor or a permanent work platform.
- D. Transmitters shall be mounted for unobstructed access, but mounting shall not obstruct walkways.
- E. Transmitters shall not be mounted where shock or vibration will impair its operation.

- F. Unless otherwise specified or approved by the Construction Manager, support systems shall not be attached to handrails, process piping or mechanical equipment except for measuring elements.
- G. Instrument stands shall be provided for supporting transmitters as detailed on the Drawings.
- H. Transmitters supported directly by concrete or concrete block walls shall be spaced out not less than 5/8 inch by framing channel between instrument and wall.

3.4 FIELD ADJUSTMENTS AND TESTING

- A. Calibration and Testing: Transmitters shall be calibrated and tested in accordance with the manufacturer's instructions.
- B. Cleaning: Touch-up scratched or marred enclosure surfaces to match original finishes. Remove all dust, debris, paint, and other foreign material from the transmitter enclosure.

3.5 TRAINING

- A. The Contractor shall provide the services of a factory-trained instructor for the purpose of training the Owner's personnel in the proper operation and maintenance of process transmitters where specified on the respective Transmitter Specification Sheet. Training shall address instrument theory of operation and installation and application guidelines. Instruments shall be provided for hands-on demonstration and exercises. Training instructors shall be in the direct employment of the instrument manufacturer or manufacturer-authorized representative.

3.6 TRANSMITTER SPECIFICATION SHEETS

- A. The following Transmitter Specification Sheets are included in this section:

<u>Transmitter Designation</u>	<u>Transmitter Description</u>	<u>Transmitter Function</u>
FTD	Thermal Mass Flow Metering System	Flow Measurement

TRANSMITTER SPECIFICATION SHEET – FTD

Transmitter Type:	FTD
Transmitter Function:	Flow measurement
Transmitter Description:	Thermal mass flow metering system
Power Supply:	120 volt, 60 hertz nominal
Signal Input:	Process
Signal Output:	As specified in paragraph 17212-2.1
Process Connection:	1” MNPT Fitting
Product Requirements:	<p>Flow metering system shall consist of an insertion type mass flow sensor and electronic transmitter. Sensor shall consist of two matched platinum resistance temperature elements. Sensor shall have all wetted materials as 316L stainless steel. Gas flow shall pass directly over sheathed elements without need for any torturous path. Element shall be suitable for gas flow velocities from 0.5 to 200 feet per second, gas temperatures of -40 to +130 degrees C, static pressures from full vacuum to 290 psig. Probe length shall be as required to position sensing element at the center of the process pipe.</p> <p>Electronic transmitter assembly shall convert resistance difference to gas flow with a maximum error of 1.5% span over a flow range of 10% to 100% of full range value. Transmitter assembly shall feature a backlit two line 16 character (per line) LCD indicator calibrated in process engineering units. Electronics shall be housed in a powder coated aluminum NEMA 4 enclosure. The transmitter shall display flow rate and totalized flow. Transmitter shall be integral unless indicated as remote in Instrument Index.</p> <p>Adjustments shall be possible via local pushbuttons on the transmitter.</p> <p>Flow metering systems installed in piping that does not provide the manufacturers recommended upstream and downstream unobstructed runs shall be provided with integrated flow conditioning plates. Flow metering systems requiring flow conditioning plates shall be indicated on the Instrument Index.</p>

Flow metering system shall be factory calibrated using a gas representative of the application.

Accessories:

Low Pressure Hot Tap:

Low pressure hot tap shall consist of a ball valve, hot tap packing gland, threadolet, restraining cable, and all required ancillary fittings to permit the instrument to be removed from the pipeline without taking the process out of service. Hot tap assembly shall be furnished by the instrument manufacturer.

Acceptable Manufacturers:

Endress+Hauser T-Mass 65I or approved equivalent.

Execution:

Installation:

Instrument shall be installed in accordance with the manufacturer's instructions as detailed on the Drawings.

Application:

Application and setup shall be in accordance with manufacturer's recommendations and as specified in the Instrument Index.

Test and Calibration:

In accordance with specification 17030.

Training:

1-hour training session covering the setup, calibration, maintenance, and troubleshooting of the flow measurement system.

- END OF SECTION -

SECTION 400216 – PROCESS 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. Requirements for float switches provided under this Contract to be integrated into the controls system.

1.3 SUBMITTALS

- A. Provide the following information to confirm compliance with the specifications:
 - 1. Installation details for the float switches and mounting accessories to be provided.
 - 2. Electrical and signal connection drawings for switches.
- B. Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

- A. Equipment furnished under this Section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five (5) years.
- B. Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled, Certified Technicians specified in Section 400000, who are regularly engaged in such activities involving systems of similar complexity.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Process switches and devices shall comply with the following requirements:
 - 1. Contact outputs used for alarm actuation shall be normally-closed or normally-opened as required by the process condition to open to initiate the alarm.
 - 2. Contact outputs used to control equipment shall be normally-opened and shall close to start the equipment.

3. Contacts monitored by solid state equipment such as programmable logic controllers (PLCs) or annunciators shall be hermetically sealed and rated for switching currents from 20 to 100 mA at 24 volts DC.
4. Contacts, monitored by electromagnetic devices such as mechanical relays, shall be rated as NEMA ICS 2, designation B300.
5. Double barriers provided between switch elements and process fluids such that failure of one barrier will not permit process fluids into electrical enclosures.
6. Switch electrical enclosures rated as NEMA 250, Type 4 minimum.
7. Switch range shall be selected so that the specified set point is at least 30 percent but not more than 70 percent of the span, between the upper range limit and the lower range limit.
8. Switches shall be mercury free.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be as specified in Section 400000.
- B. Level switches in classified areas shall require intrinsically safe protection.

3.2 INSTRUMENT SPECIFICATIONS

Instrument:	Level Switch
Identification:	LS
Instrument Function:	Level Measurement
Instrument Description:	Float Switch, Free-floating
Power Supply:	N/A
Signal Input:	Process
Signal Output:	Contacts, in accordance with specification herein.
Process Connection:	N/A
Product Data:	Switch shall be free-floating type, suspended from an oil resistant waterproof cable. The cable designed to support the weight of the float without additional strain relief and permanently sealed where it enters the float body.

The conductors shall be a minimum size of 18 AWG. The switch shall be a single pole double throw dry contact type and rated at not less than 10 amperes at 120 Vac. The float shall have a PVC or ABS corrosion and impact resistant shell.

Approved Manufacturers: Warrick series M, or approved equal.

END OF SECTION 400216

SECTION 400310 – PROGRAMMABLE LOGIC CONTROLLER (PLC)

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: Programmable logic controllers (PLC) designed to execute discrete and continuous control logic with high reliability for operation of automated controls and remote monitoring at the WWTP.
- B. Related Sections
 - 1. Division 01 – Section “Submittals Procedures” for products, operation and maintenance manuals.
 - 2. Division 40 – Section “General Requirements for Instrumentation and Control “for general requirements and other related Sections.
- C. PLC Schedule
 - 1. Integrator shall confirm compatibility of all PLCs, SCADA software and field devices prior to ordering PLC equipment.

Panel No. (Location)	Testing	Spares
PLC – WNAB (New Blower Building)	Factory Acceptance	One (1) Required

1.3 SUBMITTALS

- A. Provide the following information to confirm compliance with the specifications
 - 1. Individual specification or descriptive sheets
 - 2. Electrical and mechanical connection diagrams
 - 3. Complete list of deviation from the drawings and specification. Provide copies of drawing(s) showing all required changes as part of the submittal package.
 - 4. I/O loop diagram drawings
 - 5. Internal power distribution schematic diagram drawings
 - 6. PLC power supply loading calculations
 - 7. Factory acceptance test schedule and forms
- B. Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of twenty (20) installations of like or similar application with a minimum of five (5) years of service.
- B. All components furnished under this section shall be of a design and manufacture that has been used in similar applications, and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by the manufacturer specifically named herein.
- C. All components must strictly conform to the requirements herein. If there are any exceptions they must be clearly listed. If the components are approved for use on this project and are found at any time in the future that exceptions were not listed, the Engineer shall have the right to reject the components or require the manufacturer to modify the equipment to bring it into compliance at no cost to the Owner.

1.5 WARRANTY

- A. Equipment shall be warranted for a minimum of 12 months from date of substantial completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. MATERIALS: PLC shall conform to NEMA IA 2.2, and include required memory and functional capacity to perform specified sequence of operation with scheduled input and output points.

2.2 PROGRAMMABLE LOGIC CONTROLLER

- A. Acceptable Manufacturer: Allen-Bradley ControlLogix 5580
 - 1. Existing PLCs are Automation Direct DirectLogic 205 by Koyo. A module to communicate with the existing system shall be included and fully integrated into the existing SCADA system.
- B. Controller TUV SIL 2 Certified
- C. NEMA IA 2.3 and IEC 61131-3 compliant program editor with program written in Ladder Logic or Function Block Language. Program to be written using the same type of software as is specified below.
- D. Networking Connections: Provide all communication interfaces, network cables, taps, terminators, power supplies, and accessories for a complete operating network as shown on the Contract P&IDs and described in the Specifications. A minimum of one Ethernet port is required per processor module. Processor module shall be connected to both the blower control panel PLC and the plant network using Ethernet. The System Integrator shall coordinate with the blower system manufacturer to ensure compatibility and programming of communications between the blower PLC and the Plant PLC.

- E. Processor: Serial port dedicated solely for programming use, and battery-backed solid-state RAM memory for storage of the control program. Provide additional serial communications adapters required for other serial interfacing. RAM memory size shall be provided so that 50% is available after program is tested.

- F. Input and Output Modules:
 - 1. Discrete Inputs: 120 Vac, as shown on the Contract P&IDs
 - 2. Discrete Outputs: 120Vac solid state as shown on the Contract P&IDs isolated with an associated interposing relay installed for each channel as necessary
 - 3. Analog Inputs: 4-20 mAdc/1-5 Vdc, isolated channel-to-channel, as shown on the Contract P&IDs
 - 4. Analog Outputs: 4-20 mAdc, isolated channel-to-channel, as shown on the Contract P&IDs
 - 5. Communication Input/Output: Modules shall be provided as necessary supporting protocols such as Ethernet/IP, Modbus TCP, and Modbus RTU to communicate with the plant and other devices to be connected. The System Integrator is responsible for both coordinating the modules required, and programming them into the PLC.
 - 6. Spare Input/Outputs: The greater of a minimum one channel or 25 percent of each type provided per control panel
 - 7. I/O Chassis spare slots: Minimum 1 per chassis
 - 8. Manufactured I/O Cables for all modules:
 - a. Cable pre-attached to connector compatible with I/O module
 - b. Discrete Input: Cable pre-attached to DIN rail mounted terminal block assembly with one fused terminal with LED for each group of 8 inputs, one spare terminal for powering each input, one terminal for each input, and one common terminal for each group of 8 inputs. Cable with one wire for each I/O module terminal, ready for insertion into separate terminal blocks for field connections
 - c. Discrete Output: Cable pre-attached to DIN rail mounted terminal block assembly with one fused terminal with 120 Vac LED for each output, two terminals for each relay output, and one common terminal for each output. Cable pre-attached to DIN rail mounted terminal block assembly with one fused terminal with 120 Vac LED for each group of 8 outputs, one spare terminal for powering each output, one terminal for each output, and one common terminal for each group of 8 outputs. Cable with one wire for each I/O module terminal, ready for insertion into separate terminal blocks for field connections.
 - d. Analog Input: Cable pre-attached to DIN rail mounted input, two terminals for each input, and one common terminal for each input. Cable with one wire for each I/O module terminal, ready for insertion into separate terminal blocks for field connections.
 - e. Analog Output: Cable pre-attached to DIN rail mounted terminal block assembly with one fused terminal with LED for each input, two terminals for each input, and

one common terminal for each input. Cable with one wire for each I/O module terminal, ready for insertion into separate terminal blocks for field connections.

f. Verify cable length required prior to ordering.

G. Power Supplies

1. Processor and I/O Chassis: Single, 120 Vac input.
2. External 24VDC equipment power supplies installed in PLC cabinets for Network switch power, etc shall be redundant and shall alarm the nearest PLC upon power supply failure.

H. Miscellaneous: Provide all cables, taps, terminators, power supplies, and accessories for a complete operating PLC system as necessary to provide operation of the system as shown on the Contract P&IDs and described in Section 400010.

2.3 PROGRAMMING SOFTWARE

A. Programmable Logic Controller Software

1. Acceptable Manufacturers:
 - a. Allen-Bradley RSLogix 5000, RSLinx, and network module software, or equal
2. Licenses: Programming license shall be provided to the Owner.

2.4 SPARE PARTS

A. The following Spare parts shall be provided as shown in Paragraph 1.2.C:

1. One of each unique processor card:
 - a. Processor card
 - b. Communication card
 - c. Power supply
 - d. Pre-fabricated cable
 - e. One (1) I/O card per type for every ten (10)

2.5 CONTROL PANEL FABRICATION

A. Terminate all used and spare I/O wiring to terminal block

B. Create wire markers with “to-from” component name, PLC slot/base, or terminal column number and terminal number information identical at each end. The cable bundle shall also be labeled with “to-from” PLC slot number and terminal column number information identical at each end.

C. Provide terminal Blocks for field connections to PLC Discrete Inputs:

1. One fused terminal with LED for each group of 8 inputs, connected to control power.
2. Fused terminal connected to eight terminal blocks to provide power to each field input circuit.
3. One terminal per PLC input.
4. One common terminal for each group of 8 inputs, connected to control power common.

D. Provide terminal Blocks for field connections to PLC Discrete Outputs:

1. One fused terminal with LED for each output, connected to control power.
 2. Provide interposing relay for each solid-state PLC output. Connect output and control power common to relay coil. Provide two terminals for relay contact, normally opened unless otherwise noted.
 3. One common terminal for each output, connected to control power common.
- E. Provide terminal Blocks for field connections to PLC Analog Inputs:
1. One fused terminal with LED for each input, connected to +24 Vdc.
 2. Two terminals per PLC input.
 3. One common terminal for each input, connected to 24 Vdc common.
 4. One ground terminal for each input shield, connected to signal ground bus.
 5. Two surge protecting terminals for each field mounted instrument or equipment, grounded to the frame ground bus.
- F. Provide terminal blocks for field connections to PLC Analog Outputs:
1. One fused terminal with LED for each output, connected to +24 Vdc.
 2. Two terminals per PLC output.
 3. One common terminal for each output, connected to 24 Vdc common.
 4. One ground terminal for each output shield, connected to signal ground bus.
 5. Two surge protecting terminals for field mounted equipment, grounded to the frame ground bus.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Connect input and output devices to the PLC via control panel terminal blocks, not directly to the PLC.

3.2 FIELD REPRESENTATIVE SERVICES

- A. Provide services of an experienced, competent and authorized representative of Manufacturer or supplier of equipment to perform the following:
1. Inspect the PLC installation, including I/O and network systems, hardware configuration switch and jumper settings.
 2. Monitor all PLC system diagnostic indicators, both hardware and software, and certify that the PLC system performance meets or exceeds the Manufacturer's published specifications.
 3. Assist in all testing. The Systems Integrator will provide testing for all PLC I/O points.
 4. Modify PLC programs as required.
 5. Certify in writing to the Construction Manager that the PLC system has been installed and configured in accordance with the Manufacturer's published guidelines. Equipment Manufacturer certification requirements are per the associated equipment Specification.
- B. Furnish to Owner, through Engineer, a written report prepared by equipment supplier certifying that equipment:

1. Has been installed properly
2. Has been operated as it was intended and that is operated satisfactorily

3.3 ACCEPTANCE TEST

- A. Investigate and confirm all faults and/or trouble conditions have been resolved by the Contractor to the satisfaction of the PLC supplier.

END OF SECTION 400310

SECTION 400315 – PROCESS CONTROL SYSTEM DEVELOPMENT AND PROGRAMMING

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. General requirements applicable to the development and programming of the process control system graphical operator interface, historical data management system, and process control logic are described.

1.3 QUALITY ASSURANCE

A. IMPLEMENTATION PLAN MEETINGS

1. The Systems Integrator shall include as scope of services two (2) meetings to be held at the project site. The primary function of the meetings shall be to solicit input from the Owner regarding the implementation of the process control system and to facilitate preparation of the Process Control System Implementation Plan specified herein, including proposed screen shots.
2. The Systems Integrator shall hold two (2) progress meetings with the Engineer to discuss SCADA system development. Location and time of progress meetings shall be determined at a later time.
 - a. System Integrator shall provide three (3) additional 8-hour days, not including travel time for modification to the display screen and control procedures.
 - b. System Integrator shall provide two (2) additional 8-hour days after system has been in operation for 30 days, not including travel time, for modification to the display screen and control procedures.

1.4 SUBMITTALS

- A. Provide the following to confirm compliance with the specifications:
 1. Submit as specified in Division 01 including the following:
 - a. Process Control System Implementation Plan
 - b. Process Control System Developer's Guidelines
 - c. Process Control System Configuration Report

PART 2 - PRODUCTS

2.1 PRODUCT DATA

A. PROCESS CONTROL SYSTEM DEVELOPER'S GUIDELINES:

1. The Process Control System Implementation Plan shall be modified and updated during the course of development of the process control system control logic and graphical operator interface to reflect the conventions and standards used in the final system development. Upon final acceptance of the work, the updated implementation plan shall be re-published and submitted as the Process Control System Developer's Guidelines for use in future improvements.

B. PROCESS CONTROL SYSTEM CONFIGURATION REPORT

1. Report shall include the following:
 - a. Hardware Configuration: Final switch settings and jumper positions shall be documented for all process control system components including processors, communications adapter modules, motor controllers and adjustable frequency drives, power metering systems, etc.
 - b. Process Control Logic: Bound hard copy of the annotated process controller program listing. The program listing for each processor shall be separately bound and shall have tab dividers for each program file listing. Program listing shall include cross references.

PART 3 - EXECUTION

3.1 PROCESS CONTROL SYSTEM IMPLEMENTATION PLAN

- A. General: The Systems Integrator shall prepare an implementation plan for the process control system development and programming work. The implementation plan shall establish guidelines meeting the below listed standards where indicated for development of the graphical operator interface, the historical data management system and the programmable logic controller (PLC) process control logic and shall ensure the consistent application of conventions and methods through the course of development.
- B. Tag Database Structure and Configuration: The implementation plan shall define how the tag database will be organized to logically associate tags with specific input/output types, functions, or process areas. In addition, the plan shall prescribe guidelines for configuration of tag alarm handling and annunciation and tag data logging.
- C. Tag Naming Conventions: A tag naming convention shall be established which provides a structured organization to the tag database facilitating tag searches and substitutions during system development and provide for effective and efficient design, management and operation of the process control system. The tag naming convention shall be developed to take full advantage of the capabilities of the process control system software and not impose any artificial constraints in the operation or management of the process control system.

- D. Graphical Operator Interface Standards: The configuration and development of the graphical operator interface shall be based on standards prepared specifically for this application. The interface standards shall specifically address the following topics:
1. Graphical Display Type: The user interface will be comprised of various types of graphic displays including schematic overviews, control panels, faceplates, utility displays, and trend displays. The content and layout of each type of interface including navigational and utility features shall be defined by the standard. The standard shall also define the naming conventions for graphic display files.
 2. Symbolology: The programmer developed symbolology standard used in the preparation of the graphical interfaces in this project shall include the following requirements:
 - a. Symbols shall be representative of process equipment, structures, piping, and systems.
 - b. System shall be easily navigable.
 - c. System shall include dynamic data display objects including numeric displays, bargraphs, indicating lights, text labels, etc. where required
 - d. System shall include usable control objects including pushbuttons, selector switches, slider bars, setpoint entry, etc. where required to allow remote controlling of equipment as described in Section 400010.
 3. Colors: The color standard shall define the foreground, background, and border colors used to indicate dynamic conditions (run, stop, alarm, trouble, ready, etc.), process-specific applications (sewage, nonpotable water, chemicals, etc.), graphic display backgrounds, dynamic data objects, text, control objects, etc.
 4. Visibility: All objects and texts shall be displayed in an easily viewable layout utilizing colors which are conducive to clearly displaying information.
 5. Terminology: All terminology used to annotate the graphical interface shall be defined by these standards.
 - a. Descriptive names shall be used to identify the treatment processes, systems, structures, equipment, process variables, etc.
 - b. Units of measurement for all process variables shall be indicated
 - c. Alarm condition descriptors shall be displayed with each alarm
 - d. Abbreviations, when used, shall be standardized and consistent with the Wastewater industry standard
 6. Navigation: The navigation standard shall define the organization of the user interface and the features of the navigational system. This standard shall address all techniques used to implement the navigation system and where and how the navigation system is accessed including button bars, shortcut icons, hot links, continuation labels, and graphic menus.
- E. Process Control Logic Configuration: Guidelines shall be developed defining the organization and structure of the process control logic and data memory within the process controller. These guidelines shall address the following:

1. Structure of the control logic including the use of subroutines and the allocation of memory to accommodate modifications and expansion of the control logic.
 2. Methodology for handling common control functions shall be standardized such that similar functions are implemented in a consistent manner across the entire project.
 3. Assignment of data storage memory including data formats and method of documenting memory mapping.
 4. Methodology for implementing peer to peer communications including allocation of memory or register addresses is such a way as to organize data for optimum efficiency of data exchanges between peer processors.
- F. Process Control Strategies: Process control strategies shall be reviewed with the Owner and refinements made as agreed to by the Systems Integrator. Modifications to the control strategies that are determined to be a change in scope will be addressed by change order approved by the Engineer. The final process control strategies shall be incorporated into the Implementation Plan.

3.2 TAG DATABASE DEVELOPMENT

- A. General: The process control system tag database development shall include the definition of all devices, derived and soft tags and the required alarm processing and data logging and archiving definitions for each tag.
- B. Tag Definition: The definition of tags in the tag database shall comply with the Process Control System Implementation Plan.
- C. Tag Types: Tags shall be classified as either device tags, derived tags or soft tags. Device tags shall be those tags which have a physical device as the data source. Derived tags are those tags whose value is calculated or otherwise derived from another tag. Derived tags have no data source address. Soft tags are those tags whose value is obtained from another process software application.
- D. Tags shall be defined for each of the following tag data sources:
1. Physical I/O process variables derived from the process control input/output subsystems
 2. Control and status data derived from the process control logic required to fully implement the process control strategies specified in Section 400010
 3. Operating, fault and diagnostic data derived from the external systems
 4. Operating, fault and diagnostic data derived from the solid-state adjustable frequency motor speed controllers
- E. Data Logging: Tags representing variables defined in Section 400010 for historical trending shall be tagged as such for historical data logging. This data shall be utilized to provide historical and real-time dynamic trending functions.
- F. Alarm Handling, Annunciation and Logging: All discrete tags representing alarm or trouble conditions shall be defined in the tag database to be processed as alarms. All analog tags shall have alarm thresholds defined in the tag database. The value of the alarm thresholds shall be defined by the Owner during the preparation of the Process Control System Implementation Plan. The tag database shall be configured to implement alarm processing and annunciation as defined by the Process Control System Implementation Plan. Each tag's alarm definition shall

prescribe whether the occurrence of the alarm condition is logged to journal, printed, or audibly annunciated or any combination thereof.

3.3 GRAPHICAL OPERATION AND INTERFACE DEVELOPMENT

- A. General: The process control system graphical operator interface development shall include the preparation of the specified graphic displays in accordance with the Process Control System Implementation Plan, Contract P&IDs and the requirements of this specification. The Systems Integrator shall prepare additional graphic displays as may be required to provide a comprehensive process and system management graphical operator interface.
- B. Development Guidelines: The graphical operator interface shall be developed in accordance with recognized usability practices (i.e., learnability, efficiency and memorability) to insure efficient and effective use of the process control system.
- C. Graphic Design: The layout and organization of each graphic display shall be consistent among the graphic display types.
- D. Graphic Display Types: Graphic displays shall be categorized as either schematic overview, control panel, faceplate, trend or utility.
 - 1. Schematic Overview: The schematic overview graphic display shall be presented as a process flow diagram and shall represent major process piping, major equipment, process variable data, and process alarm and status data. Overview shall represent the existing site layout of the plant. Schematic overview displays shall be prepared in accordance with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:
 - a. Numeric display objects shall be provided to indicate the instantaneous value of all analog process data associated with the process. In addition, dynamic fill shall be used to indicate analog process data representing level.
 - b. Dynamic equipment symbols shall be provided to indicate run, off, and fault conditions for all major equipment associated with the process.
 - c. An alarm summary object indicating only those alarms related to the associated process shall be provided at the bottom of the display.
 - d. Continuation labels shall be provided to access associated schematic overview displays.
 - e. Hot links shall be provided on equipment symbols to provide access to an associated control panel display or faceplate.
 - f. Hot links shall be provided on numeric display objects to access associated trend displays.
 - g. Navigational and utility button bars shall be provided.
 - h. Schematic overview shall be a full screen display.
 - 2. Control Panel: The control panel graphic display shall be presented as a virtual control panel providing a point of operator interface for control of a specific equipment item or system. Control panel graphic displays shall be prepared in accordance with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:

- a. Graphical control objects representing selector switches, pushbutton, slider bars, etc., shall be provided to initiate the appropriate control function.
 - b. All pertinent operating status data associated with the equipment or system controlled by the panel shall be indicated.
 - c. Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.
 - d. Control panels shall be configured as pop-up graphic displays.
3. Trend Display: The trend graphic display shall present a graphical trend object with the associated controls to adjust the time scale and scroll the time axis. Trend graphic displays shall be prepared in accordance with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:
- a. A pen legend shall be provided which associates the trend plot to a process variable description through the use of color.
 - b. Y-axis shall be graduated and labeled in the appropriate engineering units.
 - c. Controls shall be provided to adjust the time scale and to scroll the X-axis backwards and forwards.
 - d. Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.
 - e. Trend graphic displays shall be configured as pop-up graphic displays.
 - f. Trend displays shall be capable of displaying up to four trend plots on a single display simultaneously.
4. PLC System Status Display: The PLC system status graphic display shall present all pertinent data associated with the process PLC system itself. The PLC system status graphic display shall provide a diagnostic interface for troubleshooting, monitoring and management of the PLC system. No control is associated with the PLC system status graphic displays. PLC system status graphic displays shall be prepared in accordance with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:
- a. Provide a schematic representation of the PLC system where specified.
 - b. Provide detailed displays for each PLC processor showing the processor status, including diagnostic and fault codes. Display shall include communication status of Ethernet, I/O bus and any additional communication links associated with the processor.
 - c. Status of all discrete I/O points shall be indicated by dynamic text or colored graphical object. Status and raw data value of all analog I/O points shall be indicated by dynamic text.
 - d. Dynamic symbols or labels shall be provided to indicate current condition of the processor and its components.
 - e. Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.

3.4 PROCESS CONTROL LOGIC DEVELOPMENT

- A. The process control system control logic development shall include the preparation of control logic required to implement the specified control strategies described in Section 400010 and support the specified operator interface functions.

- B. **Organization:** The control logic shall be organized in a hierarchical structure which correlates to the actual process relationships. Individual control logic program files shall be prepared for each system or equipment item and shall be organized by process area. Data table files shall be similarly organized by process area. Data types shall be consistently applied throughout the control logic in accordance with the Process Control System Implementation Plan. The control logic and data table organization shall facilitate the addition of future control logic.
- C. **Documentation:** All control logic shall be completely annotated down to and including the instruction level. Each rung or statement of control logic shall be provided with annotation specific to its function. Each program file shall have a title and a detailed description of the control strategy represented by the control logic. Terminology consistent with the Process Control System Implementation Plan shall be applied throughout.
- D. **Control Logic Implementation:** The project control strategies outline the general control requirements of the treatment process and associated utility systems. In addition to the requirements of the control strategies, the following control features shall be implemented in the process control logic:
1. **Fail to operate:** All automatically operated equipment shall be monitored for failure to respond to control requests from the process control system. Upon a call to start, stop, open, close, etc., a fail timer shall be initiated. If the appropriate equipment status signal (run, off, full open, full closed) is not reported back to the process control system within the time duration defined by the fail timer, an alarm shall be initiated through the process control system HMI/Workstation.
 2. **Time based control:** Process control logic for all equipment and processes controlled on the basis of time duration shall provide for operator access to the pre-set value of the time function through the HMI/Workstation and report back to the HMI/Workstation the instantaneous value of the time function associated value.
 3. **PID Regulatory control:** Every PID regulatory control function implemented in the process control logic to adjust system operation shall be interfaced with the HMI/Workstation to provide the following functions:
 - a. Report to the HMI/Workstation the instantaneous values of the process variable, setpoint, and control variable.
 - b. Report to the HMI the current operating mode, high/low limiting in effect, deadband in effect, cascade mode in effect, etc.
 - c. Provide operator control of the operating mode, setpoint value, and the control variable in manual mode.
 - d. PID tuning parameters shall be accessible via password protected screens. Supervisor level access is required for modification of tuning parameters.
 4. **Control Setup Control functions** which are described in the control strategies as operator initiated or invoked through the process control system HMI shall be interfaced with the HMI to permit operator manipulation of that control function and to report back the current status of the control configuration. Functions of this type include manual start/stop, lead/lag selection, hand/off/automatic selection, enable, setpoint adjustment, etc.

- 5. Real Time Data Server Communication: Control logic shall be implemented to facilitate and optimize the communication of data between the process control system real-time data server and the process controllers. Control logic shall be implemented as required to make the specified real-time data available to the tag database. Control logic shall also be provided to support optimization of the communication between the process control system, HMI real-time data server and the process controllers. Data of similar format (binary, integer, floating point, string, etc.) shall be grouped in data tables designated a communication buffer files. All tags defined in the tag database shall be addressed to the designated communication buffer files.

3.5 HISTORICAL DATA MANAGEMENT SYSTEM

- A. The historical data management system development shall include the preparation of extracts to enter the following real-time process variable types and associated attributes into the historical database.
- B. Other process variables to be stored within the historical data management system are defined within the Control Strategies Section 400010 and as necessary to develop all defined trend plots.

Table 3.5

Process Variable Type	Sample Interval	Attribute			
		Total	Average	Maximum	Minimum
Flow	Hourly		X	X	X
	Daily	X			
Level	Daily		X	X	X
Pressure	Daily		X	X	X
Equipment Run	Daily	X			
Water Quality Analysis	Hourly		X	X	X

3.6 TESTING AND COMMISSIONING

- A. The graphical operator interface shall be tested and commissioned in accordance with Specification 400030.

END OF SECTION 400315

SECTION 400990 – CONTROL SYSTEM PROGRAMMING DOCUMENTATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Programming the control systems, progress tracking, testing, and documenting the work for the Plant SCADA System to be conducted by the Contractor and Integrator/Programmer.
- B. Related Sections:
 - 1. Division 01 – Section “Submittals Procedures” for submittal procedures.
 - 2. Division 40 – Section “Control Strategies” for system control logic.

1.3 DEFINITIONS

- A. Control System: Controller and any associated Operator Interfaces
- B. Controller: Programmable Logic Controller (PLC)
- C. Operator Interface: All Workstations, OICs, OITs and HMIs
- D. Process Area: Area comprised of one or more process system
- E. Process System: Packaged equipment system or subsystem.
- F. Input and/or output (I/O) signals: All hard-wired, network received and RTU communicated signals
- G. Programming Software: Operating system/application manufacturer’s software used to program Controllers, Operator Interfaces and HMIs
- H. Application Software: Operator Interface and/or Computer software used to display the process and alarms, create reports, enable communications, dial-out alarms, or otherwise enhance Operator Interface functionality.
- I. Application Programs: Programs created using Programming Software and/or Application Software for control and interface specific to this project.

1.4 SUBMITTALS

- A. Provide the following information to confirm compliance with the Specifications:
1. Initial schedule of operational testing for each process area and system

1.5 QUALITY ASSURANCE

- A. Contractor and/or qualified specialist shall manage, coordinate, and supervise the Programmer's programming work including but not limited to the following:
1. Definition of process areas and systems, with programming executed on an area by area basis, as shown on the P&ID drawings.
 2. Scheduling of programming for each process area.
 3. Regularly update programming status.
 4. Regularly update separate programming documentation.
 5. Regularly update application program software media.

PART 2 - PRODUCTS

2.1 PROGRAMMING DOCUMENTATION

- A. The following documentation shall be provided by the Programmer:
1. Documentation Records: Develop a records keeping system to document progress and completion for each task in each process area or system with the following kept current and available for inspection on-site at all times at an approved location by Engineer.
 - a. List of names of project programmers, and normal and emergency contact telephone numbers
 - b. Programming Status spreadsheet, with percentage complete on each programming task
 - c. Programming Documentation Volumes as described in Paragraph 2.1.A.2.
 - d. Application program media as described in Paragraph 2.2.
 2. Documentation Volumes: Develop and maintain programming documentation for each process area kept current and available for inspection on-site at all times at an approved location by the Engineer. Volumes shall include the following as a minimum:
 - a. Three-ring binder with front cover and spine labeled: "Programming Documentation For (applicable) Process Area / Process System" including Project Labeling.
 - b. Table of Contents with same labeling as the volume cover with tabs for each section:
 - c. Section 1 – Control Description
 - d. Section 2 – I/O Interface Summary
 - e. Section 3 – Graphics
 - f. Section 4 – Reports (as described in Paragraph 2.1.A.3)

3. Reports: The Integrator shall coordinate with the Owner the necessary requirements for content and format of reports. The Integrator shall provide report format as requested for up to three separate reports. The Integrator shall include training on how to change report content and format using the specified report generation software.

2.2 SOFTWARE MEDIA

A. Programming Software

1. Controller and Operator Interface manufacturer's original programming software media and documentation shall be kept complete and on-site.
2. Upon receipt from the Manufacturer, the warranties and registrations shall be provided to the Engineer for completion by the Owner.
3. All programming software shall be licensed to the Owner.

B. Application Software

1. Additional Operator Interface and/or Computer manufacturer's software media and documentation shall be kept complete and on-site.
2. Upon receipt from the Manufacturer, the warranties and registrations shall be provided to the Engineer for completion by the Owner.
3. All application software shall be licensed to the Owner.

C. Application Programs

1. The software application programming shall be kept current and on-site at all times. Storage media that shall be DVD/CD-ROM or Flash Drive.
2. Media shall be permanently labeled "Application Programs For (applicable) Process Area/Process System" including Controller or operator interface manufacturer's programming software used name; model; and revision/version, and Project Labeling.

PART 3 - EXECUTION

3.1 SCHEDULING

- A. The Programmer shall coordinate scheduling and programming activities with the Contractor's Quality Control Manager.
- B. Modification to Programming: The Contractor shall provide copies of the pertinent contract correspondence which may affect control system changes to the Programming Manager.
- C. Temporary Facilities: The Contractor shall provide temporary power, network connections, and personal communication devices such as radios, work surfaces, and chairs as required for Programmer.

3.2 PROGRAMMING

- A. The Programmer shall coordinate with the Contractor to ensure programming is executed in order of process area completion schedule and in accordance with the Work Restrictions discussed in Section 011000.

3.3 TESTS

- A. Programmer shall perform Loop Tests, Functional Tests, and Operational Tests and any errors discovered shall be corrected during testing. Programmer shall coordinate the scheduling for testing to ensure the Engineer will be available to witness testing.

3.4 TRAINING

A. Training Schedule

1. The Systems Integrator shall conduct application program / process operation training course content as listed below. A minimum of eight (8) man-hours on-site including training materials and expenses shall be provided for minimum of two Operators. Documentation of the topics covered under system applications training shall be submitted as part of the shop drawing review process to both the Engineer and the Owner.
2. The Systems Integrator shall conduct application program maintenance, modification, and re-loading including course content as listed below. A minimum of eight (8) man-hours on-site including training materials and expenses shall be provided for up to three maintenance personnel. Documentation of the topics covered under maintenance training shall be submitted as part of the shop drawing review process to both the Engineer and the Owner.
3. The Systems Integrator shall conduct graphical interface training. Training shall address the use of each graphical interface display and the underlying control logic associated with each control and monitoring function as well as the use of all system utilities. Graphical interface training shall include all SCADA HMI screens as well as OIC/OIT interface screens. Training shall consist of eight (8) hours of classroom training conducted in up to two 4-hour sessions. Documentation of the topics covered during graphical interface training shall be submitted as part of the shop drawing review process to both the Engineer and the Owner.

B. Course Content

1. System Integrator course content shall be inclusive of the items below:
 - a. Control System Overview and capabilities
 - b. Use and configuration of SCADA software
 - c. Database overview
 - d. Graphic screens overview
 - e. Overview of HMI software for Operators
 - f. Historical data collection, manipulation, and display
 - g. Real time and historical trending, creation of trends, viewing, and printing
 - h. Report configuration generation and customization
 - i. Alarm configuration and management
 - j. System Security
 - k. System backup and recovery

- l. System optimization
- m. System operating procedures for all system programs
- n. Database maintenance
- o. Normal and abnormal operating conditions
- p. Response to failures and alarms
- q. Operating procedures for each area and item of equipment under this contract
- r. Overview of all control strategies under this contract
- s. Use of diagnostic test equipment and procedures used to detect system faults
- t. Procedure for replacing failed modules, CPU's, Hard drives, OIT's, surge suppressors and all electronic equipment and devices under this contract
- u. Calibration and routine maintenance procedures for all instruments
- v. Step by step written procedures shall be provided for all preventive maintenance tasks and for identifying hardware faults (Manufacturer's O&M shall be acceptable if all necessary information is provided)
- w. Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview
- x. Discuss purpose and plant function of the equipment
- y. Provide a working knowledge of the operating theory of the equipment
- z. Demonstrate start-up, shutdown, normal operation, and emergency operating procedures, including discussion on system integration and interlocks, if any.
- aa. Identify and discuss safety items and procedures
- bb. Demonstrate routine preventative maintenance
- cc. Required equipment exercise procedures and intervals

END OF SECTION 400990

SECTION 431100 – HIGH SPEED TURBO BLOWER (HSTB)

PART 1 GENERAL

1.01 SUMMARY

- A. Work Included: Furnish, and test, Quantity three (3) UL Listed, factory assembled high speed, air foil or magnetic bearing, turbo blower systems. The packaged blower systems shall be complete, including SS316 or carbon steel housing/enclosure, blowers, motors, variable frequency drives, integral harmonic filters, control panels, programmable logic controllers, inlet air filter/silencers, blow-off valves, check valves, discharge valves, flexible connectors and other appurtenances as specified herein, and as needed for a complete and operational blower system. Nuts, bolts, pipe spools & elbows, washers, lock-washers and gaskets needed to install the loose appurtenances are not part of the scope of supply.
- B. Blowers shall be complete pre-packaged units consisting of Induction Motors or Permanent Magnet Synchronous Motors, integrated air filters, variable speed drive, Local Control Panels, and Main Control Panel.
- C. The equipment shall be furnished by a single manufacturer.
- D. It is the intent of the Owner and Engineer to review the HSTB submittals, including efficiency and projected operating conditions, prior to determining which HSTB will be selected. **The HSTB with the lowest total sum of capital cost and 20-year operating cost will be selected.**

1.02 SYSTEM DESCRIPTION

- A. The system shall include factory assembled high speed turbo blowers with integral variable frequency drives and programmable logic controllers in a complete package that does not require lubrication of the bearings for operation.
- B. All equipment including controls and drives specified herein shall be specifically designed for this service and the environment encountered in this installation.
- C. Equipment shall be designed and capable of either continuous or intermittent operation.
- D. All equipment, supports, anchors and fasteners shall be of adequate strength to withstand loads associated with starting, turbulence, thrusts, thermal expansion and contraction and other loads encountered under normal operating conditions.
- E. The equipment, sizes, materials, and arrangements described in this specification section are based on recommendations by equipment manufacturers and shall be considered minimum limits of acceptability. The equipment manufacturer shall be responsible for design, arrangement, and performance of all equipment supplied under this section. Arrangements other than those shown on Drawings shall be subject to the Engineer's approval.

1.03 SUBMITTALS

- A. Product Data: Provide construction details, material descriptions, dimensions of individual components and profiles and finishes for each component.

B. Shop Drawings: Provide plans, elevations, sections, details and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Manufacturer and model number of all equipment within this specification and an itemized list of components being furnished.
3. Layout drawings and equipment cut sheets showing dimensions, clearances, sizes, arrangement, and size of connections, supports, anchors and total weights of the product.
4. Detailed specifications and data describing the materials of construction.
5. Wiring Diagrams: For power, signal, and control wiring diagrams, including terminals and numbers.
6. Motor requirements in accordance with Paragraph 3.04.
7. Equipment weights and lifting points.
8. Filter information.
9. Information requested in Paragraph 1.04.B.

C. Information Submittals

1. Factory functional and performance test reports.
2. Special shipping, storage, protection, and handling instructions.
3. Manufacturer's instructions for installation.
4. Manufacturer's equipment installation report.
5. Location of nearest stocking distributor for spare parts.
6. Suggested spare parts list to maintain the equipment in service for a period of two years. Include a list of special tools required for checking, testing, parts replacement and maintenance with current pricing information.
7. List special tools, materials and supplies furnished with equipment for use prior to and during start-up and for future maintenance.
8. Warranty certificate.
9. Efficiency and power demand of the HSTB(s) at each design point listed in Paragraph 2.02.B of this specification. The manufacturer shall provide input power and efficiencies for each operating point (Paragraph 2.02.B) with efficiency calculated as defined by ASME PTC-13 (latest version).

D. Initial Equipment Proposal. Submit initial equipment proposal including capital cost, information requested in Paragraphs 1.03.A, B, C, and F, and Paragraph 1.04. Initial equipment proposal shall include guaranteed power numbers for each operating point listed in Paragraph 2.02.B. Guaranteed power numbers listed in the initial proposal will be compared to the certified blower curves submitted at a later date. Initial proposal shall also include projected 20 year maintenance costs for the equipment. Submit documentation per Paragraph 1.04.F. Power costs for 20 years will be computed utilizing the power information submitted for each operating point in Paragraph 2.02. Annual energy costs will be calculated utilizing the percent operation and the horsepower

estimates provided by the manufacturer. The most recent 20-year nominal discount rate issued by the United States Office of Management and Budget (OMB) Circular No. A-94 will be utilized on all annual costs (power and maintenance).

All three initial equipment proposals shall be submitted with the General Contractor's bid.

- E. Performance Data: Blower certified performance test reports for each blower included in the blower system. This shall be submitted once a manufacturer has been selected and is not required in the initial submittal. Performance data shall include (at a minimum) certified blower curves showing pressure, capacity, horsepower demand, and blower efficiency over the entire operating range of the blower. The equipment manufacturer shall also indicate separately the pressure, capacity, horsepower demand, and efficiency required at the operating conditions listed Paragraph 2.02.B. Performance testing shall be per the latest ASME PTC-13. Provide copy of PTC-13 in submittal. Certified test report data will be compared to the guaranteed power information provided in the initial equipment submittal.

Manufacturer shall pay a penalty of \$30,000 per hp for an increase in annual weighted horsepower usage between the initial equipment proposal and the certified performance test report. Any penalties will be enforced/collected by reducing the overall Contract Price. Annual weighted horsepower usage will be calculated using the energy information provided by the manufacturer for each operating point (Paragraph 2.2.B) and the percent operation listed in Paragraph 2.2.B.

- F. Maintenance Data: Submit documentation showing all maintenance costs associated with a minimum of five installation in the US. Installations should be of similar size and have been in operation for a minimum of five years. Provide contact information for each installation.
- G. Submit complete instruction manual for operation and maintenance of the equipment in accordance with this section. Include the following data:
1. Alignment, adjustment, and repair instructions.
 2. Manufacturer's installation and operation instructions.
 3. Assembly diagrams.
 4. Troubleshooting guide.
 5. Recommended spare parts lists and predicted life of parts subject to wear.

1.04 QUALITY ASSURANCE

- A. The packaged blower systems, including blower, motors, controls, and all appurtenances to form an integrated system, shall be supplied by one manufacturer who shall provide all the equipment and appurtenances regardless of manufacturer.
- B. Manufacturer Qualifications
1. Manufacturer shall be experienced in manufacturing high speed turbo blowers similar to those indicated for this Project and have a record of over Seven (7) years successful in-service performance in Canada and/or USA for similar municipal wastewater treatment applications.

2. Manufacturer must have blowers permanently installed and operational in at least thirty (30) wastewater treatment facilities in North America. Manufacturer shall submit a reference list with contact information for at least ten (10) installations in North America of the same or larger power consumption as specified.
 3. Manufacturer shall have a history of manufacturing, providing and service this equipment for at least five (5) years in North America.
 4. A list of similar installations shall be furnished, to show conformance with article 1.4 B.1 to B.3, with the manufacturer's bid as well as with the shop drawing submittal, including names and telephone numbers of contacts.
- C. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units is required for this Project.
- D. Equipment units of each type specified in this section shall be supplied by a single manufacturer.
- E. Acceptable Manufacturers
1. List of acceptable manufacturers is provided below
 - a. APG-Neuros
 - b. Sulzer-ABS
 - c. Aerzen USA
 2. Engineer Approved Equal: **NO ALTERNATE MANUFACTURERS WILL BE ALLOWED UNLESS LISTED BY NAME IN THIS SPECIFICATION OR IN AN ADDENDUM AND NO ALTERNATE MANUFACTURERS WILL BE CONSIDERED AFTER BID OPENING NOR WILL THEY BE ALLOWED ON THE PROJECT.**
 3. It is the intent of the engineer and owner to select the blower manufacturer after the bid. The evaluation and selection shall be based upon information submitted per Paragraphs 1.01.D, 1.03.A, B, C, D and 1.4.B to the Engineer.
- F. If an alternate manufacturer is allowed, it shall be the responsibility of the Contractor to perform any required redesign and coordination associated with, but not limited to, mechanical equipment layout, electrical wiring, conduit and controls and structural/architectural work at no additional cost to the Owner. The proposed redesign shall be subject to review and approval of the Engineer.

1.05 DELIVERY, STORAGE AND HANDLING

- A. The equipment, material and spare parts shall be shipped complete except where partial disassembly is required by transportation regulations or for the protection of components.
- B. Spare parts shall be packed in containers bearing labels clearly designating contents and pieces of equipment for which they are intended.
- C. The Contractor shall unload, store and safeguard equipment, materials, and spare parts in accordance with the Manufacturer's recommendations.

1.06 WARRANTY

- A. The equipment shall be warranted be as specified in Specification 11 00 00.
- B. Cost for the removal, shipment, repair, and installation by the Contractor shall be included in the warranty and include the correction of defective work.

1.07 SPARE PARTS

- A. Furnish a list of recommended spare parts with the Operations and Maintenance manual.
- B. Furnish one set of special tools required for complete assembly or disassembly of blower system components for each type or size of blower specified, together with a storage box (or boxes) for the same. This tool kit shall be sufficiently complete to permit normal repair and maintenance of all equipment furnished under this project.

PART 2 EQUIPMENT

2.01 EQUIPMENT PERFORMANCE

- A. Aeration Blowers shall meet the following design conditions. Blowers will be evaluated based on the data in the table below. Guaranteed wire power table must be supplied with the bid. Failure to complete and submit guaranteed wire power table with the bid will result in immediate rejection.

Total Number of Blowers	
Method of Operation	In parallel, continuous, alternating start
Blower Type	High Speed Turbo
Blower Core Bearing Type	Bump Foil Air or Magnetic Bearing
Drive Type	Direct
Design Site Elevation (FASL)	525
Design Discharge Pressure (PSIG)	8.6
Discharge Flange (ANSI 150 lb.) (in)	10
Maximum Power Consumption (wire to air) at Design Blower Capacity and design conditions (kW)	110
Minimum Total Efficiency (wire to air) at Design Blower Capacity and design conditions (%)	See Note
Primary Air Source	Ambient
Maximum Motor Horsepower (VFD Rated)	150
Available Power Voltage	480
Available Power Phase	3 phase
Maximum Noise at 3 Feet	80 ± 2 dBa
Allowable Vibration Level	< 4 mm/sec

Note: Per Paragraph 1.3.D the equipment manufacturer shall indicate the efficiency required per the design points listed in Paragraph 2.2.B. The efficiency performance criteria will be evaluated

by the Engineer. The Engineer will choose the selected equipment manufacturer during the submittal process.

2.02 OPERATING CONDITIONS

- A. Supply air for all of the blowers will be drawn from the outside through high-efficiency filters. Outside ambient temperatures are expected to range between 0 and +110 degrees F. Outside relative humidity is expected to range between 30 and 90 percent. Condition A is the design blower capacity. Condition B is the minimum design blower capacity.

Environmental Condition	Operating Condition	
	A	B
Intake air temperature, degrees F dry bulb	110	0
Intake air relative humidity, percent	90	30
Ambient Barometric Pressure (psia)	11.6	11.6

- B. Operating Requirements: The blower system furnished under this Section shall meet the following operating requirements:

Criteria	Value
Quantity of Blowers (two duty, one standby)	3
Maximum Rated flow, Discharge SCFM, ea.	2,900
Minimum Rated flow, Discharge SCFM, ea.	1,600

Operating Conditions (Evaluation Criteria)						
Condition	Environmental Condition (2.2.A)	Percent Annual Operation	Number of Blowers Operating	Air Flow, SCFM, per Blower	Wire to Air kW, per Blower ¹	Weighted Wire to Air kW, Total ¹
Maximum Summer	A	10	2	2,900		
Maximum Winter	B	10	2	2,800		
Average Summer	A	30	2	1,750		
Average Winter	B	30	2	1,600		
Minimum Summer	A	10	1	2,200		
Minimum Winter	B	10	1	2,100		

¹ The wire to air power consumption (in kW) per blower and total shall be values provided in the manufacturer’s submittal based on the operating conditions provided above.

- 1. The blowers to be installed under this Section shall be suitable for continuous service and installation indoors in a forced air ventilated (non-cooled/conditioned) environment and shall be capable of delivering their rated flow at their rated discharge pressure while operating under environmental conditions listed. The electric motor driver for each blower shall not overload with the blower operating continuously at the rated flow

against the rated discharge pressure under the specified environmental conditions. The blower shall have, as a minimum, a 0.50-psig pressure rise to surge from the rated discharge pressure. The blower shall have its first critical speed greater than 1.2 times the operating rpm.

2. ICFM calculations shall take into account temperature, humidity, and altitude changes from standard conditions. Standard atmospheric conditions shall be taken as 68 degrees F, 14.7 psia, and 36 percent relative humidity.
3. In the event that the blower factory testing as specified herein demonstrates that the actual power consumption is greater than the requirements of Paragraph 2.01.A, then the Engineer may elect to reject all equipment specified in this Section.
4. It is up to the manufacturer to determine the optimum blower configuration to achieve the best efficiency and lowest energy required to meet the operating points in Paragraph 2.02.B.
5. Noise performance shall be expressed as sound pressure levels (SPL) in decibels as read on the "A" scale (dBA) of a standard sound level meter; all measurements shall be made in relation to a reference pressure of 0.0002 microbar.

2.03 GENERAL

- A. Blower core bearing shall be of the Bump Foil Air or Magnetic type and shall not require oils or lubricants for adequate operation.
- B. Blowers shall be capable of variable speed operation with a minimum turndown of fifty percent (50%) from its maximum flow capacity and shall use an integral variable frequency drive. Each blower shall be capable of operating continuously and satisfactorily at any point between the minimum and maximum flows without any surge, vibration, hunting, or excessive heating of bearings or motor.
- C. Blowers shall be designed to operate at optimum specific speed in order to maximize adiabatic efficiency and reduce motor speed.
- D. Complete blower packages shall be UL & CSA Listed, with no exception. UL & CSA Listing nameplate to be on package exterior. UL & CSA listing must be for the complete package.
- E. Blowers shall be factory tested per the draft ASME PTC-13 Performance test to verify flow and wire power at design conditions as well as blower maximum conditions. The acceptance criteria are 4% tolerances on flow regardless of the size of the machine.
- F. Neither special foundations nor anchoring shall be required for installation.
- G. All elastomeric materials for couplings, valves, etc., shall be rated for a minimum 250° F temperature.
- H. System components shall be designed for continuous operation in an environment with conditions as follows:
 1. Temperature 0 to 110 degrees F
 2. Relative Humidity 30 to 90 percent

3. Ambient Pressure 11.6 psia

2.04 HIGH SPEED BLOWERS

- A. Each blower shall be designed to maintain a minimum rise-to-surge of 3.0 psig at the maximum flow point for the given design pressure.
- B. Blower impellers shall be of the backswept three dimensional high efficiency configuration designed using Computational Fluid Dynamics (CFD) milled from forged aluminum alloy Type 7075 (cast impellers or stainless steel impellers are not permitted), with first lateral critical speed at least 120 percent of the maximum allowable operating speed. The impeller shall be mounted directly to the motor shaft and shall be statically and dynamically balanced. The use of dual impellers is not permitted.
- C. Bearings shall be sized for a minimum of expected ten (10) years between major overhauls.
- D. Each blower shall be supplied with a 316 Stainless Steel or epoxy coated Carbon Steel sound enclosure covering the entire blower package. The sound enclosure shall be designed for easy inspection and maintenance of all blower package components. Quick release panels shall provide easy and quick access for routine maintenance of the blower and the package components. The blower package enclosure shall protect against falling water, condensation, and dust.
- E. The currently designed blower system layout is based on blowers that do not require separate exhaust connections for ventilation air. If the Alternate Approved Equal blower being provided requires separate exhaust for ventilation air this airflow must be routed to the outside of the building using insulated piping or ductwork. The alternate Blower Manufacturer shall advise the contractor if additional piping is required. The Contractor shall be responsible for any required design modifications to accommodate exhaust of the ventilation air to the building exterior including but not limited to the design of any additional piping/ducting, pipe/duct supports, controls, and redesign of the structure to accommodate the pipe or duct penetrations. The cost for these changes shall be included in the bid price.
- F. Blower and integral VFD shall not require any external cooling devices such as cooling fans or external glycol cooling.
- G. Each blower shall be supplied with integrated instrumentation allowing for direct measurement of vibration, and the temperatures of the motor and air bearing.
- H. Each blower shall be supplied with built in vibration isolating mounts. The blower manufacturer shall be responsible for attenuating noise and vibration in the blower package such that no special installation base shall be required nor shall any vibration from the blower package be transmitted to the floor or intake and discharge base or the piping.
- I. Blowers may be placed on a concrete equipment pad as shown on the drawings and may be anchored to the pad using 316 SS anchor bolts or threaded rods if necessary. Manufacturer shall provide the specification for anchor bolt or threaded rod for the Contractor's information. Contractor shall furnish and install the Manufacturer specified anchor bolts.

2.05 APPURTENANCES

- A. Each blower package shall include a 10” EPDM flexible connector to be installed on the discharge aeration piping prior to the main air header. The flexible connectors shall be sized for a standard pipe diameter and shall prevent the transmission of noise and vibrations and allow for slight misalignments on the pipe-work between the blower package and the piping. The flexible connector shall be suitable for the maximum operating temperature and pressure ratings of the equipment in the air stream.
- B. Each blower shall be supplied with one 10” size wafer-style, dual plate check valve that shall be installed on the discharge line. Check-valve will be carbon steel body, Aluminum Bronze or Stainless Steel Disc, Stainless Steel 316 Spring and Viton Seat. Check valve shall meet API 594 standard, ANSI 150 lb.
- C. Each blower shall be supplied with a 10” manually operated discharge valve. Valve shall be lug or wafer type, cast iron body, Stainless steel 316 disc, Stainless Steel 316 Stem, with EPDM or Viton seat, as suitable for air service and temperature requirements.
- D. Each blower shall be equipped with an integrated electro-pneumatic blow-off valve actuated by blower pressure.
- E. The blow-off valve discharge shall be supplied with a properly sized blow-off silencer.
- F. Each blower shall be provided with an integrated combination intake/inlet filter/silencer system. Intake, filter and silencer performance losses shall be included by the blower vendor in the blower performance calculation. The intake/inlet filter/silencer system shall be integrated into the overall blower and enclosure design and shall fit within the enclosure.
- G. The filter media must have an efficiency of 90% by weight per ASHRAE 52-76 with synthetic dust equivalent to separation > 95% @ 10 microns. Filter element shall be removable without disconnecting the inlet duct and shall be cleanable by maintenance personnel as a preventative maintenance procedure.
- H. Each blower shall be equipped with the following integrated instrumentation.
 - 1. Inlet differential Pressure sensors for filter monitoring
 - 2. Discharge differential Pressure sensor
 - 3. Inlet and Discharge Temperature sensors
 - 4. Bearing Temperature sensor
 - 5. Motor Temperature sensor
 - 6. Vibration sensor

2.06 MOTORS

- A. Each blower shall be supplied with a high speed Induction Motor or Permanent Magnet Synchronous Motor (PMSM) driven by a variable frequency drive operating on 460/480 Volts, 3 Phase, 60 Hertz input power.
- B. The maximum allowable motor horsepower shall be as specified.

- C. The motor shall have a 1.15 service factor. The motor shall be able to start under the starting conditions required. Blower manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor. Certified tests shall be submitted to the Engineer prior to shipment of the equipment.
- D. Each blower motor shall be of the Induction Motor or permanent magnet synchronous motor (PMSM) type that has no physical connection between stator and shaft, therefore eliminating brushes, slip rings or break resistors. The Induction Motor or PMSM must be combined with a Sine Wave Filter (Sinus Filter) and Input Line Reactor.
- E. Additional requirements for the blower motors are:
 - 1. Enclosure: Totally Enclosed (TE).
 - 2. Stator Temperature monitoring: internal thermocouple embedded in motor windings
 - 3. Maximum Ambient temperature: 50° C.
 - 4. Minimum Ambient temperature: -35° C.
 - 5. Duty: Continuous.
 - 6. Bearings: Bump-Foil type Air or Magnetic Bearings.
 - 7. Grounding: There shall be a grounding lug attached to the blower scroll.

2.07 INVERTER/VFD

- A. Each blower shall be equipped with a high efficiency UL listed Variable Frequency Drive (VFD) with 97% efficiency at full rated motor speed and power.
- B. Each VFD shall have an operation in the USA for manufacturing, support, and provision of replacement parts.
- C. Each VFD shall be supplied with a passive harmonic filter that reduces the Total Harmonic Distortion (THD) in compliance with IEEE 519 rating. The harmonic filters shall be supplied by Artech, Mirus International or approved equal. Harmonic filter shall be mounted inside the blower room or MCC or inside the blower enclosure.
- D. Each VFD shall have a sinusoidal filter on its output consisting of an L (inductor) and C (capacitor) filter.

2.08 CONTROLS AND INSTRUMENTATION

- A. General
 - 1. All components in the local panel shall be completely factory wired and shall include all necessary controls for both the manual/local and automatic/remote operation as indicated on the Drawings and Specifications.
 - 2. The incoming power provided to the local panel shall be 480 volt, 3 phases. A suitable thermal-magnetic main circuit breaker sized no less than 125% greater than the connected load shall be provided along with all transformers, relays, etc. necessary to make the panel fully functional. Surge protective devices (SPD) shall be provided to protect the electrical and control components from excessive voltage and current: type 1 SPD to

protect the 480V loads (VFD) and Type 2 SPD to protect the 120V loads (PLC controller box). The SPD locations shall be strategically selected to have surge immunity and the MCOV shall be not less than 115% of nominal voltage.

3. Wiring shall comply with UL/CSA and the Canadian National Electrical Code.
4. All electrical connections to external devices and equipment shall be provided by the Contractor.
5. Equipment and controls furnished by other manufacturers shall be provided in accordance with their instructions, where applicable.
6. The system shall have an Allen-Bradley CompactLogix PLC-based control system for the operation, adjustment, and monitoring of the system equipment and appurtenances. No similar or equal shall be accepted.
7. The system shall have an Allen-Bradley HMI touchscreen. No similar or equal shall be accepted.

B. Miscellaneous Electrical Devices

1. A 120 VAC to 24 VDC power supply shall be provided to power the programmable controller inputs and other 24 VDC powered devices. The power supply shall be properly sized for the LCP total load.
2. Provide noise filter to provide clean, noise-free power to programmable controllers.

C. Operator Interface: Provide the following indicators on the operator interface:

1. Blower Status (RUN/STOPPED)
2. Operator Mode Selection
3. System pressure display
4. Blower Local / Remote Control
5. Blower Speed Indication Status
6. Blower Run Times (hours)
7. Blower Amp Draw (amps)
8. System Pressure
9. System Flow

D. Operator Interface Device

1. The device shall include the following displays:
 - a. History: displays history of sequential alarms with date and time of occurrence.
 - b. Status: One-touch access to display current system operating status. When the system is running, the display shall show the set point pressure, actual pressure, flow, and speed (0-100%).
 - c. Alarm Information: Last alarms recorded in memory are displayed with related detailed information on the alarm including time of occurrence, date, and blower's main operating parameters at the time of alarm and how to correct the

alarm condition. Each log shall include individual blower run status, VFD mode, flow, and alarm type.

- d. Alarm List: One-touch access to an Alarm List of all possible alarms and their current status.
 - e. Daily Log/Total: Displays the individual equipment run times and run times since last reset.
 - f. Scroll Key: Used to scroll up and down through data.
2. Provide Setup Menu system for adjusting all alarm set points, dead band, delays, etc. Display and adjust flow, pressure set points, and time delays. Set equipment alternation to manual or automatic. Set the hour of the day for automatic alternation. Restore all factory defaults. Protect adjustable settings with a password.

E. Alarm Systems

- 1. Local indication of alarm conditions shall be provided on the face of the control panel via a general amber alarm light. Specific alarm messages shall be provided on the operator interface screen.
- 2. All alarm conditions shall be displayed at the operator Allen-Bradley PanelView 600 or PanelView Plus 7 HMI touchscreen terminal and shall provide output capability to display all alarm conditions at future SCADA system. No other similar or equal HMI will be acceptable.

F. Instrumentation

Probes and controllers shall be provided by Hach, Endress Hauser, Thermo Fisher, or approved equal. Probes and controller shall be provided by the same manufacturer. Probes must be easily removable without interrupting service. Sensor and controller construction must be suitable for operation in the monitored medium. The controller must be provided with a minimum of three sets of dry contacts rated in accordance with NEMA ICS 1. The first set of contacts must close when the lower (warning) detection level has been exceeded. The second set of contacts must close when the upper (alarm) detection level has been exceeded. The third set of contacts must close when a controller malfunction has occurred, including loss of power or loss of sensor input. The alarm levels must be individually adjustable. The controller must be provided with an audible warning horn that sounds when the upper detection level has been exceeded, and a warning horn silence button. The controller must provide a 4-20 mA dc output signal to the programmable logic controller, proportional to the measured parameter. The controller must be provided with an internal battery to maintain operation for a minimum of 12 hours if power is lost. One (1) Hach SC4500 or equal, controller shall be provided for each individual DO or ORP probe (2 total).

1. ORP Meter

The sensor shall be submersible type. Sensor shall have a range of plus or minus 1500 mV and shall have an accuracy of plus or minus 0.5 percent of sensor span. The sensor shall automatically compensate for temperature over the temperature range. The sensor body shall be stainless steel and suitable for immersion. The sensor shall be submersible. The sensor shall automatically compensate for temperature over the temperature range. All mounting and

retrieval hardware shall be provided by the manufacturer and made of corrosive resistant materials.

2. DO Meter

The dissolved oxygen sensor must provide continuous measure of dissolved oxygen. Wetted materials must be stainless steel or PVC. Sensor must be rated for continuous use to a depth of 18 feet and must be automatically temperature compensating over the temperature range. Sensor must be capable of measuring dissolved oxygen level of from 0-12 mg/L. The sensor must have an accuracy of plus or minus 1 percent of full-scale reading, repeatability of ± 0.05 and response time of 25 sec to 63% of final reading at 77 degrees Fahrenheit.

G. SCADA System

1. The following outputs shall be provided to the plant PLC and SCADA system via Ethernet/IP communication.
 - a. All alarms
 - b. All equipment status (On/Off, In Remote/Not in Remote, Off)
 - c. All parameters displayed at the operator interface (blower PLC)
 - d. Motor speed
 - e. Airflow
 - f. Discharge pressure
 - g. Blower run: output
 - h. Blower stop: output
 - i. Blower fault: output
 - j. Remote on: output, enabled when touch screen is placed in remote

H. System Function

1. Each blower shall be equipped with an integrated PLC control system physically located inside the blower enclosure with the following:
 - a. True Programmable Logic Controller:
 - 1) Allen-Bradley PLC with Multifunctional Display capability.
 - 2) The PLC shall provide control, monitoring, and diagnostic capability.
 - b. Blower controls shall provide real time monitoring via discharge pressure vs. suction air flow graph indicating current operating point and boundaries.
 - c. Each blower shall have the ability to be controlled in four different modes: constant speed, constant pressure, constant flow, or dissolved oxygen (DO).
 - 1) The intended operation of the aeration control system is to operate at a constant dissolved oxygen in each aeration zone. Airflow to each aeration zone shall be independent of the airflow to the other zones or trains. DO concentration in each aeration zone shall be read continuously. Each air control valve shall be modulated to maintain the

DO concentration as measured by the DO probe in its respective basin. Valve modulations shall be made at an operator adjustable timeframe with a default value of 30 minutes. If the DO level falls below the setpoint level, the respective air control valve will be opened incrementally. If the DO level rises above the setpoint level, the valve will be closed incrementally. The incremental valve adjustment shall be an operator adjustable setpoint with a default value of 5%.

- 2) Operation of the aeration system shall utilize a most open valve (MOV) principle with cascading pressure control loop to control blower airflow. The designated MOV valve shall have a setpoint value of 80% full open.
 - 3) Aeration pressure setpoint shall be operator adjustable.
 - 4) Each control valve and flow meter associated with each aeration drop shall have the capability of operator input of airflow as a percentage of the upstream air flow meter for operator flexibility in control.
 - 5) Manufacturer control logic shall be made available to Owner if requested.
- d. Each blower LCP shall automatically perform dynamic adjustments to the blower operating range during seasonal temperature variations such that attainable maximum and minimum flow is always optimized. Such dynamic adjustments shall not expose the blower to surge. For micro-communicator, CPU, setting input current for flow and pressure shall not be permitted as an alternative to dynamic adjustment.
 - e. Blower controls shall include intuitive, user friendly fault menus for ease of monitoring diagnostics and troubleshooting.
 - f. Each blower shall include built in automatic surge protection.
 - g. Blower controls shall include built in measurement for the following parameters:
 - 1) Flow
 - 2) Speed (calculated)
 - 3) Rotor vibration
 - 4) Rotor bearing temperature
 - 5) Pressure
 - 6) Amperage
 - h. Integrated control system shall control the blow-off valve for each blower.
 - i. Integrated control system shall be accessible through a touch screen control panel.
 - j. All integrated controls shall be enclosed in a sub-panel.
 - k. Turbo Blower PLC shall be capable for communication through Ethernet/IP communication protocol.
2. Master Control Panel
 - a. Master Control Panel (MCP): Provide a Master Control Panel to monitor and control the blower system in accordance with 43 11 00 – 2.08(G)(1). MCP shall

govern operation of blower system to maximize efficiency and reduce power consumption. MCP shall be a standard product of the blower manufacturer and must be capable of communicating with the individual blower control panels and the Plant SCADA system via Ethernet/IP. MCP shall provide total blower system control (local and remote) and monitoring of information (number of blowers in operation, individual blower run times, system pressure, combined flow, amp draw, power, alarms, blower speed, individual blower information, etc.). MCP shall house an Allen Bradley PLC and a PanelView 600 or PanelView Plus 7 HMI in a NEMA 12 enclosure.

2.09 SHOP PAINTING

- A. The blower enclosure shall be painted in manufacturer's standard color. Painted cast iron and carbon steel shall be Alkyd Resin or Zinc primed and final coat with a total dry film thickness of 4 mils dft. Sound enclosure shall be powder coated polyester or a dual powder base with a total dry film thickness of 4 mils dft. Surface preparation shall be SSPC 10 or better.

2.10 FACTORY TESTS

- A. All equipment shall be factory tested, in presence of the Engineer, in accordance with the following tests for compliance with the operational requirements specified herein. All costs associated with the trip to send the Engineer to the factory during factory testing shall be borne by the Contractor. Factory testing shall be performed per the latest version of ASME PTC-13.
- B. Tests shall be performed on the actual assembled unit being supplied for this project. Prototype model tests and calculated values based on previous model testing will not be acceptable.
 - 1. Blower Motor Test:
 - a. Mechanical Test: Blower(s) shall be given a factory mechanical test to assure mechanical integrity. If the test indicates that adjustments are necessary to ensure conformance with specifications, such adjustments shall be made prior to shipment. Unless otherwise specified, a certified report of a mechanical test of each blower furnished shall be provided. The mechanical test shall consist of operating the units at or near design conditions for a minimum of one (1) hour. Test data shall include duration of the test, motor/bearing temperatures, speed, brake horsepower, pressure and temperature rise and vibration level.
 - b. Performance Test: A certified report of a performance test of the blowers furnished shall be submitted to the Engineer for review. The performance test shall be performed in accordance with the latest version of the ASME-PTC-13 Power Test Code for Blowers and shall demonstrate the durability with the applicable performance criteria specified.
 - C. In the event the blower fails to meet the performance requirements specified, the Engineer shall have the right to require the manufacturer to modify or replace the blower to meet the performance requirements specified.
 - D. The second test, if required and any subsequent tests as may be necessary to ensure compliance with these Specifications shall be performed at no additional cost to the Owner.

- E. Blower Package Testing: On completion of final assembly of the blower package and prior to shipment, each packaged blower shall be mechanically run for a minimum of 30 minutes to ensure functionality and operability of the blower system and its LCP (local control panel).

PART 3 EXECUTION

3.01 GENERAL

- A. Install and adjust equipment in accordance with the Drawings, approved shop drawings and the manufacturer's instructions. Do not operate the equipment until the installation is approved by the manufacturer's representative.
- B. Manufacturer's Services
 - 1. Provide a trained, experienced representative for the following onsite tasks after the Pre-Start-Up meeting with the manufacturer to verify proper blower installation, Start-Up schedule & Intent.
 - 2. Each day shall consist of eight (8) hours at the project site excluding travel time and breaks. Provide services at no additional cost to the Owner.
 - a. Equipment check out and start-up – One (1) day per blower
 - b. Training of Owner's personnel – One-half (1/2) day
 - c. Operation review (6 months later) – Two (2) day

3.02 ASSEMBLY AND INSTALLATION

- A. Do not cut or weld any component in the field. Only bolted connections will be allowed in the field.
- B. Check installation prior to start-up for conformance to manufacturer's instructions. Adjust or modify equipment to ensure proper operation.

3.03 FIELD QUALITY CONTROL

- A. Prior to equipment start-up, the Contractor, with the assistance of the manufacturer's representative, shall again inspect all equipment for proper assembly, installation, and alignment, for quiet and proper operation.
 - 1. All components shall operate without alarms or shut downs, except as intended, for eight consecutive hours to be considered ready for start-up.
 - 2. Equipment shall operate through the design performance range consistent with available flows. Adjust, balance, calibrate and verify that the equipment, safety devices, controls and process system operate within the design conditions. Response shall be checked for each equipment item and alarm.
- B. In the event the blower equipment fails to meet the performance requirements specified, the Engineer shall have the right to require the Manufacturer to modify or replace the blower equipment to enable said system to meet the performance requirements specified.

- C. The second test, if required and any subsequent tests as may be necessary to ensure compliance with these Specifications shall be performed at no additional cost to the Owner.
- D. The Manufacturer/Contractor shall notify the Engineer and Owner at least 14 days prior to conducting the factory performance tests.
- E. A copy of all information from functional tests, including data, worksheets, and other materials shall be turned over to the Owner at the completion of the testing program.
- F. Prior to final acceptance, the manufacturer's representative shall furnish a letter certifying that the units furnished have been installed, aligned, lubricated, and tested in exact accordance with the manufacturer's recommendations.

3.04 FIELD TESTS

- A. Testing shall be conducted in accordance with Section 01 91 13. The equipment furnished under this Section shall be subject to the following field performance test:
 - 1. Field Tests: The field performance test shall be conducted by the Contractor and Manufacturer, in the presence of the Engineer, subsequent to certification by the Contractor that the equipment has been properly installed. All costs of testing, except power, shall be developed by the Contractor in accordance with the provisions contained in the Conditions and shall, as a minimum, contain the following features:
 - a. The performance testing in the field will use amperage, measured environmental data (temp and humidity), discharge pressure, and air flow. The performance in the field shall be within $\pm 10\%$ of the horsepower and efficiency of the certified blower curve.
 - b. Not less than 24 hours of continuous operation at full load.
 - c. Additional field testing shall be performed by the Owner and Engineer during the warranty period to confirm performance of blower. Testing will consist of monitoring power demand, discharge air flow and pressure, air temperature and humidity, and blower operating data. Testing and procedure to be agreed to by the Engineer and Manufacturer during the submittal process. Data will compared to certified blower curves. Data not within $\pm 10\%$ of the horsepower and efficiency of the certified blower performance test information will need to be addressed by manufacturer.

3.05 MANUFACTURER'S SERVICES

- A. Provide the service of a qualified, factory trained representative of the manufacturer to check and approve each part of the installation before it is placed in operation. The manufacturer's representative shall instruct the plant personnel in operation, care and maintenance of the blower equipment and supervise initial operation.

END OF SECTION

SECTION 462030 – SLIDE, STOP, WEIR AND SLUICE 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:
 - 1. The Contractor shall provide and install slide gates, stop gates, weir gates and guides as shown on the plans. The gates shall include all appurtenances necessary to be complete and ready for use.

1.3 SUBMITTALS

- A. Provide the following information to confirm compliance with the specification:
 - 1. Complete description of all materials including the material thickness of all structural components of the frame and slide.
 - 2. Installation drawings showing all details of construction, details required for installations, dimensions and anchor bolt locations.
 - 3. Maximum bending stress and deflection of the slide under the maximum design head.
 - 4. The location of the company headquarters of the principle manufacturing facility. Provide the name of the company that manufactures the equipment if the supplier utilizes an outside source.
- B. Owner's Manuals:
 - 1. Operations and maintenance information and gate maintenance summary sheets shall be furnished for the gate specified herein.

1.4 QUALITY ASSURANCE

- A. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20 years experience designing and manufacturing water control gates. The manufacturer shall have manufactured water control gate for a minimum of 50 projects.
- B. The gates and appurtenances shall be supplied in accordance with the latest edition of AWWA C563 Standard.

1.5 PRODUCT DELIVER, STORAGE AND HANDLING

- A. Handle all gates and appurtenances with care.

- B. Any gates which are damaged will not be acceptable.
- C. Protect threads, flanges, stems and operators from damage.
- D. Store material to permit easy access for inspection and identification.
- E. Store all gates and appurtenances on timbers, planks, or a flat even surface to prevent distortion.
- F. Ship all gates with suitable packaging to protect products from damage.

1.6 WARRANTY

- A. The manufacturer and Contractor shall warrant the gates being supplied to the Owner against all defects in materials and workmanship for twelve (12) months from date of start-up or eighteen (18) months from date of shipment.
- B. Manufacturer shall provide a 25 year warranty against failure due to corrosion.

PART 2 - PRODUCTS

2.1 STOP AND WEIR GATES

- A. Manufacturer: The stop gates, weir gates, and guides shall be all aluminum as manufactured by the Washington Aluminum Company, Inc., Baltimore, MD; Waterman Industries, Inc.; Ashbrook Corporation; or approved equal.
- B. Materials
 - 1. Guide Frame - The wall mounted or embedded guide frame shall be extruded aluminum alloy 6061-T6 incorporating Allied Chemical ultra-high molecular weight Polymer (UHMW) bearing bars having an intrinsic viscosity of greater than 14 by test. The UHMW bearing bars shall reduce the coefficient of friction to .125 from that of metal to metal contact thus reducing the wear on the gate and the effort required to manually lift the gate. The guide frame shall have factory welded mitred corners and shall have a weight of not less than 1.5 pounds per foot for embedded frames and 2 pounds per foot for wall mounted frames. Guide frames built up from plate or structural shapes will not be acceptable. All necessary anchor bolts will be stainless steel and furnished by the gate manufacturer.
 - 2. Gate - The gate or sliding member will be of 1/4" aluminum plate, alloy 6061-T6. The gate will be reinforced as required so that the plate will not deflect more than 1/360 of the span of the gate under the designed head.
 - 3. Handles - Hand lift gates shall be provided with a single handslot for gates up to 3 feet in width or dual handslots if wider than 3 feet. Handslots shall be provided unless otherwise shown on the contract drawings.

All material will have a standard mill finish. The gate manufacturer shall provide a heavy coat of bituminous paint where the wall mounted or embedded guide frame will be in contact with concrete.

2.2 SLIDE GATES

- A. Manufacturer - The slide gates and guides shall be aluminum AR series as manufactured by the Washington Aluminum Company, Inc.; Waterman Industries, Inc.; Ashbrook Corporation; or approved equal.
- B. Guide Frame - The wall mounted or embedded guide frame shall be extruded aluminum alloy 6061-T6 incorporating ultra-high molecular weight Polymer (UHMW) bearing bars. The UHMW bearing bars shall reduce the coefficient of friction to .125 from that of metal to metal contact thus reducing the wear on the gate and the effort required to manually lift the gate. The guide frame shall have keyways to lock the frame into the concrete and shall have a weight of not less than 4 pounds per foot. The guides shall be sufficiently strong so that no further reinforcing will be required where the gates extend above the operating floor. All necessary anchor bolts will be stainless steel and furnished by the gate manufacturer.
- C. Gate - The gate or sliding member will be of 1/4" aluminum plate, alloy 6061-T6. The gate will be reinforced as required so that the plate will not deflect more than 1/360 of the span of the gate under the designed head.

All material will have a standard mill finish. The gate manufacturer shall provide a heavy coat of bituminous paint where the wall mounted or embedded guide frame will be in contact with concrete.

2.3 OPERATORS

- A. Manually operated lifting mechanisms shall be as indicated on the plan drawings or in the gate schedule. Handwheel type lifts shall be without gear reduction. The crank operated type shall have either a single or double gear reduction, depending upon the lifting capacity required. Each type shall be furnished with a threaded bronze lift not to engage the threaded portion of the stem. The lift nut shall be flanged and supported on non-metallic thrust washers, ball or roller bearings to take the thrust developed during opening and closing of the gate.
- B. Gears, where required, shall be provided with machine cut teeth designed for smooth operation. The gearing and lift nut shall be mounted in a housing which in turn shall be mounted in a housing which in turn shall be mounted on the yoke of the gate, or separately supported on another structure or pedestal. Lubrication fittings shall be provided to permit lubrication of all gears and bearings.
- C. The stems shall be type 316 stainless steel of suitable length and ample strength for the intended service. The stem diameter shall be capable of withstanding twice the rated output of the operator at 40 pound pull, and shall be supported such that L/r ratio for the unsupported part of the stem shall not exceed 200.

2.4 SLUICE GATES

- A. Tapered-Wedge Aluminum Gates

This section covers Wedged Aluminum Gates and Operators. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full

conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer. Gates and operators shall be supplied with all the necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.

B. Approved Manufacturers

Gates supplied under this section shall be Model GH-27 Tapered-Wedge Aluminum Gates as manufactured by Golden Harvest Inc. or engineer approved equal.

C. Governing Standards

Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of AWWA-C561 standards.

D. Quality Assurance

The manufacturer shall have 5 years experience in the production of substantially similar equipment, and shall show evidence of satisfactory operation in at least 10 installations. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of AWS Sections D1.1, 1.2 and 1.6.

The fully assembled gates shall be shop inspected, tested for operation and leakage, and adjusted before shipping. There shall be no assembling or adjusting on the job sites other than for the lifting mechanism.

E. Submittals

1. The manufacturer shall submit for approval by the purchaser, drawings showing the principal dimensions, general construction and materials used in the gate and lift mechanism.

2. The manufacturer shall submit for approval by the purchaser, complete engineering design calculations in compliance with AWWA standards latest edition.

F. Performance

Leakage: Sluice gates shall be substantially watertight under the design head conditions. Under the design seating head, the leakage shall not exceed 0.005 US gallons per minute per foot of seating perimeter. Under the design unseating head, leakage shall not exceed 0.01 US gallons per minute per foot of perimeter.

G. General Design

Gates shall be either self-contained or non self-contained of the rising stem or non-rising configuration as indicated on the gate schedule. All parts of the gate shall have a minimum thickness of 1/4 inch.

H. Frame

The gate frame shall be aluminum and designed for maximum rigidity. The frame configuration shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the wall or wall thimble.

I. Slide

The slide shall consist of aluminum plate reinforced with 'U' shaped aluminum extrusion welded to the plate to limit its deflection to 1/720 of the gate's span under the design head.

The head guide angles shall be attached to the slide in such a way to place the slide in an angle corresponding to the seating surface of the spigot.

J. Guides and Seals

The guides shall be provided with ultra high molecular weight polyethylene seats on both sides of the slide and shall be of such length as to retain and support at least one half (1/2) of the vertical height of the slide in the fully open position. Guide frame shall not weigh less than 5 lbs. per foot.

The seating face of the frame shall be oriented at an angle to the plane of the mounting flange to effect a wedging action upon closure.

Side and top seals shall be frame mounted. Seals shall be EDPM or neoprene D-seal with a stainless steel retainer bar and shall be fully adjustable.

The flush bottom resilient neoprene seal shall be mounted to bottom of disc and seal against the invert portion of the frame. Frame mounted invert seals will not be considered.

K. Yoke and Pedestal

The yoke, to support the operating bench stand, shall be formed by two structural members welded at the top of the guides to provide a one piece rigid frame.

Self-contained gates shall be provided with a yoke to support the operating bench stand. The yoke shall be formed by two structural members welded at the top of the guides to provide a one piece rigid frame. The maximum deflection of the yoke shall be 1/360 of the gate's span.

Non-self contained gates shall be provided with pedestal mounted lifts. Pedestal shall be cast iron or mild steel and provided with shop coating.

L. Lifting Assemblies

1. Stem and Couplings

The operating stem shall be of stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lb effort on the crank or handwheel.

The stem shall have a slenderness ratio (L/R) less than 200. The threaded portion of the stem shall have Acme type cold rolled threads with a maximum surface of 16 micro-inches.

Where a hydraulic, pneumatic or electric operator is used, the stem design force shall not be less than 1.25 times the output thrust of the hydraulic or pneumatic cylinder with a pressure equal to the maximum working pressure of the supply, or 1.25 times the output thrust of the electric motor in the stalled condition. Stems in more than one piece shall be joined together by solid couplings.

Gates having a width equal to or greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft.

M. Stem Guides

Stem guides shall be fabricated from stainless steel. Stem guides shall be equipped with a UHMWPE bushing. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendation. The L/R ratio shall not be greater than 200.

N. Stem Cover

Rising stem gates shall be provided with a clear butyrate stem cover. The stem cover shall have a cap and condensation vents and a clear mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.

O. Lifting Mechanism

Operators of the types listed in the schedule shall be provided by the gate manufacturer. Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 lb on the crank or handwheel, and shall be able to withstand, without damage, an effort of 80 lb.

Gearboxes shall be provided when required to maintain the operating force below 40 lb. All bearings and gears shall be totally enclosed in a weather tight housing. Operator housing shall be cast steel or cast iron. The pinion shaft of crank-operated mechanisms shall be supported by roller bearings. The operating shaft shall be fitted with a 2 inch square operating nut and removable crank. The crank shall be fitted with a corrosion-resistant rotating handle. The maximum crank radius shall be 15 inches and the maximum handwheel diameter shall be 24 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Thoroughly clean and remove all shipping materials prior to setting.
2. All gates shall be installed by skilled workers in accordance with the plans and specifications, and in full conformity with the instructions and recommendation of the equipment manufacturer.
3. The Contractor shall review the installation drawings and installation instruction prior to installing the gates.
4. The gate assemblies shall be installed in a true vertical plane, square and plumb.
5. Fill void in between the gate frame and the wall with non-shrink grout as shown on the installation drawing and in accordance with the manufacturer's recommendations.

6. Operate all gates from fully opened to totally closed.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Provide the services of an experienced, competent, and authorized representative of manufacture or supplier of equipment to visit site of work and inspect, check, adjust if necessary, and approve equipment installation.
- B. Assure that equipment supplier's representative is present when equipment is placed in operation.
- C. Verify that equipment supplier's representative revisits job site as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory, in the opinion of the Engineer.
- D. Furnish to Owner, through Engineer, a written report prepared by equipment supplier certifying that equipment:
 1. Has been properly installed.
 2. Gates operate without binding.
 3. The torque required to open and close the gates do not exceed that specified.
 4. Confirm that the leakage is within the limit specified.
- E. The equipment supplier shall provide a factory representative for up to one (1) eight (8) hour day for gates installation inspection, certification, start-up, corrective adjustment and to instruct the operating personnel. The factory representative shall provide instruction pertaining to operation, maintenance and cleaning procedures, as well as providing a full functional demonstration of the system.
- F. After installation, all gates shall be field tested in the presence of the Engineer and Owner to ensure that all items of equipment are in full compliance with this Section. Each gate shall be cycled to confirm that they operate without binding, scraping, or distorting. The effort to open and close manual operators shall be measured, and shall not exceed the maximum operating effort specified above. Each gate motor actuators shall function smoothly and without interruption. Each gate shall be water tested by contractor, at the discretion of the Engineer and Owner, to confirm that leakage does not exceed the specified allowable leakage.

END OF SECTION 462030

SECTION 464125 - LARGE BUBBLE MIXING SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish, install, and test large bubble mixing system for the Secondary Process Basins. Provide large bubble mixing system in the, Anoxic Zones of each of the (2) treatment trains of the Secondary Process Basins.
- B. This section covers the furnishing of a compressed gas mixing system for the Anoxic Zones including compressors, receivers, master control panel, valve modules, header supply piping, nozzle headers, nozzles, auxiliary equipment and accessories as specified herein.
- C. The system shall intermittently and sequentially inject compressed air through fixed nozzles located on the tank floor to create large bubbles which mix the tank contents using no moving parts located within the tank with negligible oxygen transfer from the mixing system to the bulk liquid.

1.02 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00. The following additional submittals shall be provided in accordance with Section 01 33 00:
 - 1. Catalog data or illustrations showing principal parts and materials.
 - 2. A complete set of all layout drawings and details including complete assembly and installation drawings including overall equipment layout and piping interconnection drawings.
 - 3. Complete electrical schematics and field termination drawings.
 - 4. Complete data for accessory items.
 - 5. Detailed specifications and data including the following:
 - a. Compressors
 - b. Motors
 - c. Particulate and Coalescing Filters, as applicable.
 - d. Compressor support locations and loads transmitted to bases and foundations.
 - e. Compressor electrical schematics and field termination wiring.
 - f. Qualifications of field service engineer.
 - g. Test or performance data that the system does not contribute measurable dissolved oxygen into the process stream.

1.03 REFERENCES

A. ASTM International (ASTM)

1. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications.
2. A276, Standard Specification for Stainless Steel Bars and Shapes.
3. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipe
4. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

B. Definitions

1. Tank: The structure within which mixing occurs
2. Header Supply Pipe: Piping between a valve module and respective nozzle headers.
3. Nozzle Header: Continuous (i.e. not branched) horizontal piping with nozzle offsets, with single inlet connection to header supply pipe and outlet offset connections to nozzles.
4. Nozzle Drop Leg: Piping branching off nozzle header trunk piping which connects to nozzles either at a 90-degree angle (offset drop leg) or vertically (straight drop leg).
5. Nozzle: Floor-anchored, large bubble-emitting device.
6. Standard Cubic Feet per Minute (scfm): Air at 68° F, 14.7 psia, and 0 percent relative humidity as defined by the Compressed Air & Gas Institute.
7. Actual Cubic Feet per Minute (acfm): Flow rate of air at the standardized reference condition (ISO 1217) delivered to the terminal point of the compressor package.
8. Master Control Panel (MCP): Control panel that controls the mixing system including the solenoid-actuated air control valves (ACVs) in one or more remote VMs.
9. Valve Module (VM): Enclosure with solenoid-actuated air control valves controlled remotely by the MCP controller or locally by a VM harsh-duty factory programmed controller. Valves are in a common manifold which receives and distributes compressed air bursts intermittently to header supply pipes.

1.04 QUALITY ASSURANCE

A. Manufacturer's Experience

1. Manufacturer shall be one who has been regularly engaged in the business specified herein for at least 5 years. The equipment and all ancillary shall be designed, supplied and warranted as a unit item by a single manufacturer or vendor.
2. Full scale test results from a minimum of ten (10) U.S. compressed gas mixing system installations demonstrating that the compressed gas mixing system achieved homogeneous mixing as substantiated through statistical analysis of Total Suspended Solids (TSS) samples yielding a Coefficient of Variation (Cv) of 10%.

B. Warranty

- 1. As specified in Section 11 00 00.

1.05 EQUIPMENT SCHEDULE

Item	Equipment Number	Location
Compressors	C-300 C-301	Blower Building
Air Receiver Tank	C-302	Secondary Process Basins
Valve Module	C-303	Secondary Process Basins

1.06 SERVICE CONDITIONS

- A. Fluid temperature is expected to range from 35 to 75 degrees Fahrenheit.
- B. The equipment will be installed at a wastewater treatment plant in Eden, North Carolina at an elevation of approximately 525 feet above mean sea level.

PART 2 PRODUCTS

2.01 ACCEPTABLE PRODUCTS

- A. Reference to a manufacturer's name and model number or catalog number is for the purpose of establishing the standard of quality and general configuration desired. Acceptable manufacturers EnviroMix, Pulsair, or Engineer-approved equal, modified to meet the requirements of this specification.

2.02 GENERAL

- A. The system shall intermittently and sequentially inject compressed air through fixed nozzles located on the tank floor to create large bubbles which mix the tank contents using no moving parts located within the tank with negligible oxygen transfer from the mixing system to the bulk liquid.
- B. Tank mixing shall be uniform throughout the tank with effective mixing confirmed through a Field Performance Test as specified.
- C. Mixing intensity and balancing shall be sufficient to maintain suspended solids in a state of suspension over entire tank. The operator shall control firing parameters (sequence, duration, and frequency) to achieve tank mixing.
- D. Must have an operating mode that extends the solids retention time of the anaerobic or fermentation zone, resulting in volatile fatty acids production. Control parameters shall allow user to cycle periods of mixing (in hours and minutes) and periods without mixing (in hours and minutes).
- E. Firing air flow rate shall be adjustable via the throttling valve.

- F. The compressed gas mixing system equipment and piping shall be sized to thoroughly mix the contents of the tanks for which the systems are designed.

2.03 DESIGN AND PERFORMANCE REQUIREMENTS

A. Tank Design Information

Parameter	Anoxic Zone 1	Anoxic Zone 2	Anoxic Zone 3
Number of Tanks Total	2	2	2
Length, ft	39.50	39.50	78.67
Width, ft	19.50	19.50	40.0
Side Water Depth, ft	18	18	18
Design Solids Concentration, %	0.5	0.5	0.5

B. Large Bubble Mixing System Design

Parameter	Anoxic Zone 1, per Train	Anoxic Zone 2, per Train	Anoxic Zone 3, per Train
Number of Nozzle Headers	2	2	2
Number of Nozzles per Nozzle Header	6	6	11
Minimum Total # of Nozzles	12	12	44
Minimum Nozzle Density, ft ² /nozzle	64.2	64.2	75.5
Minimum Nozzle Header Diameter, inches	2	2	2

C. Performance Requirements

1. The compressed gas mixing system Manufacturer shall be responsible for sizing and selecting all system components to meet the requirements of the field mixing performance test specified herein. The compressor size, number of nozzles and piping size specified herein and shown on the Drawing are minimum. Any increase in the number and size of system components to meet the requirements of the field mixing performance test shall be at no additional cost to the Owner.

2.04 MATERIALS OF CONSTRUCTION

A. Header Supply Piping

1. Provide threaded connections only where required.
2. Sch 5S, stainless steel press technology system (Victaulic, Viega, or equal), comprised of stainless steel press technology fittings, couplings, and pipe, unless specified otherwise.

3. Maximum working pressure of 150 psi.
4. Couplings and fittings: Press technology products formed of Type 304/304L stainless steel piping or tubing including self-contained o-ring seals molded of HNBR or EPDM.
5. Pipe: Type 304/304L ASTM A312 stainless steel.

B. Nozzle Headers

1. Sch 10S, 304/304L stainless steel with 1" Sch 40S, stainless steel nozzle offsets
2. Nozzle couplings: 1" NPT, 150 lb 304/304L stainless steel
3. Delivered from the Manufacturer pre-assembled to the extent practicable to minimize field assembly error and installation time.
4. Pipe: Type 304/304L ASTM A312 stainless steel.
5. Provide nozzle headers in maximum 20-ft segments with two bolt 304/304L stainless steel flexible gasketed coupling connections. Flexible couplings shall be rated for a maximum working pressure of 150 psi.
6. Provide nozzle headers with removable end caps to facilitate clean-out.

C. Nozzles

1. Top plate fabricated from 14 gauge stainless steel plate, ASTM A240/A240M, Type 304/304L with a 2D finish.
2. Bottom channels welded to the top plate and fabricated from 16 gauge stainless steel plate, ASTM A240/A240M, Type 304/304L.
3. Nozzles shall be designed with adequate strength to withstand vertical thrust of mixing air.
4. Threaded Rod Anchors: Use Hilti HIT-RE 500 adhesive or equal to be provided by the Contractor. Four 3/8" diameter threaded rods with a minimum of 3" embedment shall be installed per nozzle.
5. Nozzles shall be installed in the locations as shown on the Drawings.

D. Appurtenances

1. Miscellaneous: Nuts, bolts, washers, threaded rod, and other non-welded parts shall be stainless steel, ASTM A240/A240M, Type 304. Threaded assemblies shall be chemically treated or lubricated prior to assembling to prevent galling.

E. Fabrication

1. The piping used for the air mixing system shall be Type 304/304L stainless steel unless otherwise noted.
2. Shop fabricate welded metal parts and assemblies from stainless steel, ASTM A240/A240M, Type 304/304L with a 2D finish.

3. Shop fabricate non-welded parts and pieces from sheets and plates of stainless steel, ASTM A240/A240M, Type 304 or from bars of stainless steel ASTM A276, Type 304, unless specified otherwise.
4. Welds and Welding Procedure
 - a. Shop weld with filler wire using MIG, TIG or shield-arc, or plasma-arc welding inert gas processes. Provide a cross-section equal to or greater than parent metal.
 - b. Provide full penetration welds to interior surface with gas shielding to interior and exterior of joint.
 - c. Provide smooth, evenly distributed interior weld beads with an interior projection not exceeding 1/16 inch beyond inner diameter of nozzle header or fittings.
 - d. Field welding is not permitted.
 - e. Clean all welded stainless steel surfaces and welds after fabrication to remove weld splatter and finish clean all exterior welds, carbon deposits and contaminants by passivation per ASTM A380 Section 6.2.11.

2.05 EQUIPMENT COMPONENTS

A. Valve Module

1. Valve Module Enclosures
 - a. The VM enclosure shall be 304 stainless steel. The VM shall be designed and rated for a maximum ambient temperature of 115°F. The VM shall be built in accordance with UL standards by a UL certified panel shop and rated NEMA 4X for outdoor duty. The enclosure shall be manufactured by Hoffman, Delta Fabricating or approved equal.
2. Support Stand
 - a. VM shall be provided with an aluminum support stanchion unless wall mounted.
3. Pilot Air Filter
 - a. Each AVM shall include a 5-micron filter with ¼” NPT inlet/outlet and an automatic pulse drain to remove fine particles, condensate, and oil from the air supply. The filter shall be rated for 150 psig maximum pressure, 175 °F maximum temperature, and 24 scfm. The filter shall be Parker 14F15BB or approved equal.
4. Heater
 - a. VM located outdoors shall be provided with a 120 VAC heater designed to maintain 40° F in an ambient outside temperature of 20° F. The heater shall be equipped with a thermostat to turn the heater off at temperatures above 55° F.
5. Power Connection
 - a. VM shall accept a single source 120 VAC power connection. Lightning and surge protection shall be provided on the incoming line power.
6. VM Operator Interface

- a. The VM shall have a Local-Off-Remote (LOR) selector switch, a Frequency dial, and a Duration dial. In Local control the 'Duration' dial and the 'Frequency' dial inside the VM shall allow the operator to adjust mixing intensity locally. In Remote control, the MCP controller shall control the mixing intensity. If there is not a master control panel the remote position will function the same as the local position.
7. Valve Module Controller
 - a. VM shall be equipped with a VM Controller. The controller shall be rated for a -40°F to 176°F temperature range, Class I, Division 2 Hazardous Areas, and be submersible in up to 3 feet of water.
 - b. The controller shall be programmed to operate according to the dial settings for valve open frequency and duration when the LOR is in Local mode.
 - c. The VM Controller shall automatically take control of the ACVs based on the local settings if the discrete heartbeat signal from the MCP controller is lost and shall automatically relinquish control when the MCP controller heartbeat is restored.
 8. Air Control Valves (ACVs)
 - a. The air control valves shall be mounted to a common manifold.
 9. Nameplate
 - a. A stainless steel nameplate shall be provided on the VM. The nameplate shall be securely fastened in a conspicuous place and clearly inscribed with the Manufacturer's name, year of manufacture, and serial number.
 10. Alarm Light
 - a. A red stack light shall be mounted on the top of the VM and indicate an alarm condition specific to the VM.
 11. Control & Operation
 - a. Control shall allow mixing to be started and stopped, and mixing intensity to be adjusted at any point during operation. Control features shall be initially set according to Manufacturer recommendations.
 - b. Mixing Parameters. The operator shall be able to enable/disable mixing operation, select the firing duration and the frequency of firing. Minimum control features selected through the local interface shall include the following:
 - 1) Local-Off-Remote (LOR) Switch.
 - a) Local Position. In Local, the VM controls the VM mixing intensity. The 'Duration' dial and the 'Frequency' dial inside the VM shall allow the operator to adjust mixing intensity locally.
 - b) Remote Position. In Remote, the MCP Controller shall control the VM mixing intensity based on mixing parameters from the MCP OIT. If the system does not have an MCP, this mode will function the same as the Off position.
 - c) Off Position. In Off, the VM will be disabled locally and remotely.

- 2) Duration Dial
 - a) Length of time an individual ACV is open during a firing event. The duration shall be operator adjustable from 0.1 to 1 seconds by adjusting the dial. The duration will be the same for all ACV's in the VM.
- 3) Frequency Dial
 - a) Length of time to complete the firing sequence. Frequency shall be operator adjustable from 1 to 100 seconds by adjusting the dial.
- 4) Valve Isolation
 - a) Individual ACVs may be removed from the firing sequence at any point during operation by unplugging the solenoid from the ACV. Alternatively, the header supply pipe isolation valve can be closed.
- 5) Alarms
 - a) Each VM shall come equipped with a pressure transducer plumbed to the valve manifold which is transmitted back to the MCP. The MCP controller interprets the pressure to provide a low system pressure alarm and monitor ACV position.

B. Air Compressors

- 1. High Pressure Air Compressors
 - a. Two (2) air compressor module(s) shall be as noted in the Design Table below. Compressor shall include an inlet air filter, AC motor, air/oil separator reservoir, air cooled oil cooler, cooling fan, separator pressure relief valve, discharge check valve, moisture separator, controls, control panel, base, and unloading system.
 - b. Compressor module shall be completely factory assembled requiring only field connection of electrical power, air piping, and condensate drain tubing.
 - c. Compressor shall be of the single stage, positive displacement, oil-flooded, rotary screw type. The compressor shall be provided with an integral skid or lifting lugs for unloading and placement.
 - d. Compressor rotors shall be asymmetrical, steel or high strength ductile iron integral shafts, and dynamically balanced. Housings shall be cast iron. Rotors and housings shall be precision machined for accurate bearing positioning and running clearances.
 - e. The drive arrangement shall be a gear driven design.
 - f. Positive pressure lubrication shall be provided by an inherent pressure differential system. Lubricant shall be provided as recommended by the Manufacturer. A lubricant filter shall have a high-capacity 10-micron rating.
 - g. An air/oil separator reservoir shall be provided for each compressor. The reservoir shall be designed and constructed in accordance with the ASME Code for Unfired Pressure Vessels and shall bear the code stamp. The reservoir shall

include two-stage filtration to remove oil from air stream. Oil carry-over downstream of compressor modules shall not exceed 3 mg/m³.

- h. Air compressor module shall have automatic controls integral to the unit which open (loaded condition) and close (unloaded condition) the inlet valve to the air end to deliver appropriate volume to meet demand and maintain system target pressure. On sensing a low demand, the motor will keep running but the air end inlet valve will close, resulting in a decreased “idling” power draw on the motor. The valve shall reopen when system pressure drops below the set point.
 - i. Compressor baseplate shall be constructed of one-piece folded mild steel with structural members and shall be designed for no measurable deflection with the equipment mounted thereon and the baseplate supported around its perimeter. Base shall be designed so that all equipment bolted to it can be removed without access to the underside of the plate and with a flat top surface for ease of cleaning. Structural stiffeners shall be located under the compressors at the compressor anchor points.
 - j. Valves and piping within the enclosure shall be the compressor manufacturer's standard. Relief valves shall be provided for equipment protection on the air and coolant systems as required.
 - k. Compressor shall be provided with an integral, dry-type intake filter. Intake filters shall have replaceable filter element(s). Particle arrestance shall be not less than 99.9% efficient at 10 microns and above.
 - l. Compressor shall be supplied in a sound attenuated enclosure. The enclosure shall reduce the measured sound to a maximum of 85 decibels, as measured by ISO 8571, while the compressor is operating, and the sound level is measured a distance of three feet from the enclosure.
 - m. A high air/fluid temperature shutdown system shall be provided. The unit must have safety devices mounted and wired. Safety devices shall include motor thermal overload and high compressor discharge temperature shut-down. These systems must be designed to prevent the compressor from running in an over-temperature situation or motor from running in an overload condition.
 - n. Compressor shall feature controls capable of operating at two pressure settings, set up and selected in the controller. The controller shall allow one of two different pressure control settings to be chosen so that if the demand is greater than one unit's capacity (the lead compressor), a second compressor (the lag compressor), if installed, will automatically turn itself on until the excess demand has been satisfied. The lag compressor's motor will shut down after a set period in which it is not loaded as described in paragraph above. The lead/lag pressure settings shall be fully incorporated inside the compressor's control panel. No additional separate control sequence panels shall be required.
 - o. The compressors shall be as manufactured by Atlas Copco, Model GA22, Aerzen, Sulzer or equal.
2. Refrigerated Dryer
- a. An integrated compressor air dryer shall be provided of cycling refrigerated air type. The dryer shall produce 37-390F pressure dew point at the dryer exit when operating continuously at 100 psi and 100F inlet air ambient temperature.

- b. The dryer shall be capable of continuously drying the maximum discharge capacity of the air compressor.
 - c. The dryer shall be integral or separately mounted to the compressor package.
3. Compressor System Particulate and Coalescing Oil Filters
- a. Replaceable-cartridge primary particulate and secondary high-efficiency oil-removal filters shall be provided for the compressor package. Following both filters, the maximum particulate size removal shall be to 1 micron and coolant removal shall be to 0.1 mg/m³ at 21°C.
 - b. The filters shall be rated for the maximum discharge capacity of the air compressor.
4. Compressor System Electrical
- a. All electrical and control equipment for the air compressor module shall be furnished as required for a complete installation, requiring only field connection of a 480 VAC, three phase power supply.
 - b. The compressor electric motor shall be rated TEFC (IP55) 480 volts, 60 Hz, three-phase.
5. Compressor System Control Panel. An enclosure-integrated control panel mounted on the compressor module shall include:
- a. Each compressor electrical control cabinet shall be a NEMA 1 rated enclosure.
 - b. Wye delta reduced voltage motor starters sized as required by the Manufacturer
 - 1) Starters shall include auxiliary contacts as required.
 - 2) Magnetic motor circuit protectors shall be 3 phase, 480 volts, molded-case circuit breakers with instantaneous trip elements.
 - 3) One thermal overload relay shall be provided in each phase lead. Each starter shall be provided with an external manual reset push button for reset of the thermal overload relays. Overloads shall be bimetallic ambient compensated type, matched to motor current, and shall be provided with a manual reset pushbutton.
 - c. Control power transformers shall have both primary leads fused, one secondary lead fused, and one secondary lead grounded.
 - d. Terminal blocks for all system wiring. Internal panel wiring shall be neatly bundled and tied and shall be identified with suitable wire markers.
 - e. Controller shall be provided to indicate the following conditions; discharge pressure, compressor element discharge temperature, power on, hours of operation, operating mode.
 - f. Remote mounted fusible disconnects with time delay fuses shall be provided by Contractor.
 - g. The following I/O shall be provided at the compressor control panel and hardwired to the MCP.
 - 1) RUN status discrete output

- 2) NO FAULT discrete output
- 3) WARNING discrete output
- 4) ENABLE command discrete input
- 5) LOAD discrete output

6. Compressor Shop Painting

- a. All components of the compressed air equipment system shall be shop primed and finish painted with the Manufacturer's standard paint system prior to shipment to the site.

7. Compressor System Performance and Design Requirements

- a. The compressed air equipment shall be designed for the following operating conditions:

Parameter	Unit	Value
Ambient Conditions		
Max Air Temperature	°F	115
Min Air Temperature	°F	32
Relative Humidity	%	80
Site Elevation	FASL	525
Compressors		
Number Required	ea.	2
Maximum Discharge Pressure	psig	100
Capacity at Operating Target Pressure	cfm	158
Motor Size	HP	30
Max Free Field Noise	dB(A)	68
Filters		
Type		Particulate and Oil Removal
Number Required		1 Each/ Compressor
Integral Refrigerated Air Dryer		
Type		Cycling
Number Required		2
Target Pressure Dew Point	°F	33-39

Note: ±3 dB(A) when measured in free field conditions at a distance of 1 meter according to ISO1217

8. Pressure Transducer

- a. The compressors shall be equipped with a pressure transducer plumbed to the discharge piping or receiver to monitor the common discharge pressure from the compressors.
- b. The transducer range shall be 0-150 psi (minimum) with ¼” NPT male threaded connection, stainless steel housing, and M12x1 flange connector. Transducer shall be NEMA 4, minimum ambient -100F, and maximum ambient 150oF.

- c. The transducer shall be 4-20 mA, loop-powered from the MCP or Plant Control System. An M12 x pigtail adaptor shall also be provided for termination in a junction box adjacent to the device.
- d. The transducer shall be as manufactured by Schneider or equal.

C. Air Receiver

1. Free Standing Air Receiver.

- a. One (1) air receiver(s) shall be provided. The receivers shall be designed and constructed in accordance with the ASME Code of Unfired Pressure Vessels and shall bear the code stamp.
- b. Receiver shall be factory powder coated. One quart of touch-up paint shall be provided.
- c. Receiver shall be provided with mounting feet valve and pressure gauge.
- d. Condensate Drain Valve.
 - 1) Receiver shall be provided with a 24 VDC motor-operated ½” FNPT stainless steel ball valve with AMPSEAL connector powered, controlled, and monitored out of an adjacent MCP. A AMPSEAL x pigtail connector shall be provided

2. Receiver Design Requirements

- a. The receiver shall be designed for the following operating conditions:

Receivers	
Number Required	1
Design Pressure – psig	200
Nominal Volume - gal	1 @ 400-gallons

2.06 SPARE PARTS

- 1. Provide the following spare parts that are identical to and interchangeable with similar parts installed.
 - a. Two (2) air control valve (ACVs) and solenoid
 - b. Two (2) solenoid plug and cable assembly
 - c. Two (2) set of relays.
 - d. One (1) compressor intake air filter element per compressor provided.
 - e. One (1) compressor oil filter element per compressor provided.
 - f. One (1) each compressor separator element per compressor provided.
 - g. Any other standard recommended spare parts by the Manufacturer.

PART 3 EXECUTION

3.01 GENERAL

- A. Install items in accordance with approved shop drawings, Manufacturer's printed instructions and as indicated.
- B. All nozzles on respective nozzle header shall be level within ½-inch of a common horizontal plane.
- C. Air piping shall be internally cleaned by Contractor prior to placing system in operation. Exposed and buried air piping between compressor and VMs shall be thoroughly flushed by closing isolation valves and uncapping the blow down tee at each VM and applying 100 psi air pressure to completely remove sand, dirt, and debris to protect downstream equipment, as damage to the air control valves may occur.

3.02 TESTING

- A. After completion of the installation and manufacturer's certification, equipment shall be field tested to demonstrate compliance with the requirements specified. Testing of equipment shall be conducted in accordance with the requirements of Sections 01 91 13 and 11 00 00.

3.03 FIELD SERVICE

- A. Provide the service of a qualified representative for two (2) trips and two (2) days for installation inspection, testing, and startup.

3.04 FIELD PERFORMANCE TESTING AND GUARANTEE

- A. All mixer components shall be field tested with the respective tanks full to the maximum water surface elevation.
- B. Exposed air piping shall be tested by Contractor for leaks using soapy water on all joints and applying 100 psi test pressure. Buried air piping shall be tested using this method before the trench is filled. Air piping in the tanks may be tested by submersing the piping in non-potable water and pressurizing the piping to 100 psi, in lieu of using soapy water on all joints. Pressure testing requirement shall not apply to supply piping downstream from VM or pre-manufactured nozzle headers.
- C. The Contractor shall operate each mixing system at the maximum water surface elevation in the tanks for a continuous period of not less than 72 hours. The Contractor shall correct and resolve all operating problems, deficiencies, etc., determined as a result of the tests.
- D. After the above testing is complete, field mixing performance testing of the installed compressed gas mixing system shall be performed by the Manufacturer as described below.
 - 1. Mixing performance testing shall be conducted in the one train each of following tank(s): Anoxic 1, Anoxic 2, and Anoxic 3.

2. All personnel and equipment necessary to conduct and supervise all testing shall be provided by the compressed gas mixing system Manufacturer. Engineer/Owner shall be notified of the test to witness at their option and expense.
3. The TSS shall be in typical operating ranges specified. No flow shall enter or exit the respective tank for two hours prior to and during the test.
4. The compressed gas mixing system Manufacturer shall conduct total suspended solids (TSS) testing using a Cerlic TSS probe, or equal, suspended solids analyzer.
5. Testing Procedure:
 - a. In the mixing test, the compressed gas mixing system shall have been in normal operating mode for at least two days prior to testing and must have TSS in the typical operating range indicated above.
 - b. Four horizontal-plane sample sites for each tank to be tested shall be selected by the Engineer, and field verified as safely accessible. At each sample site, three vertical samples shall be collected as follows: 24-inches from the surface, tank sidewall mid-point and 24-inches above the tank sidewall bottom. Each sample site must be a minimum of 4 ft away from any structure within the tank. The samples for each location shall be analyzed as described above.
 - c. In the second mixing test, the compressed gas mixing system shall be shut off for a period of at least eight hours. The mixing system shall be turned on and allowed to run for two hours. After the two-hour period, the TSS shall be measured as indicated above.
 - d. The Coefficient of Variation (Cv) shall be determined for the sample set, excluding the maximum and minimum samples. The Cv shall be calculated by taking the resultant set of ten (10) samples as follows: $Cv = (100 \times \text{Standard Deviation of Ten Samples}) / (\text{Mean Value of Ten Samples})$.
 - e. If the Cv is less than or equal to 10%, then the mixer performance shall be acceptable for that location.
 - f. If the Cv is greater than 10%, then the mixer performance shall be unacceptable for that location and the Contractor and/or Manufacturer shall make all necessary improvements (at no additional cost to the Owner) and repeat the testing procedure at no additional cost to the Owner until the Cv is less than or equal to 10% for that location.

3.05 TRAINING

- A. Training shall be conducted in accordance with Section 01 79 00 and Section 11 00 00. Training shall consist of a minimum of one 2-hour session addressing the theory of operation, testing, troubleshooting, and maintenance of the system.

END OF SECTION 464125

SECTION 465133 - FINE BUBBLE DIFFUSION EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish, install, and test flexible membrane fine-bubble diffusion equipment for the aeration zones, in each of the two (2) secondary process treatment trains including all ancillary items and equipment as shown on the Drawings.
- B. Provide pipe, fittings, supports, and other air supply piping equipment in the basins down to a single drop for each diffuser zone. Each secondary process train will have 4 drops. The demarcation between Contractor and manufacturer responsibilities is indicated in mechanical drawing sections.

1.02 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 and Section 11 00 00. The following additional submittals shall be provided in accordance with Section 01 33 00:
 - 1. Test data confirming head loss through the diffuser versus air flow rate in scfm.
 - 2. Design calculations for the max and min conditions specified indicating:
 - a. Headloss from the drop pipe connection to the farthest diffuser bubble release point.
 - b. Air flow rate per diffuser, scfm/diffuser.
 - c. Manufacturer-certified oxygen transfer efficiency curve, indicating standard oxygen transfer efficiency (SOTE) in percent versus depth substantiating that the performance specified in paragraph 46 51 33-2.3A can be achieved. Diffuser density, submergence and air rate per diffuser in data provided shall be within 10% of those specified for this project. If appropriate data can not be provided, Manufacturer shall perform a clean water SOTE shop test run in accordance with the ASCE Standard for the Measurement of Oxygen in Clean Water specifically for this project. Entire cost of the test including witness travel and lodging expenses shall be borne by the Manufacturer.

1.03 REFERENCES

- A. Industry standard references shall be noted, as applicable, in this specification and shall be considered a part of this specification. This section references the latest revision of the following documents. They are a part of this section as specified and modified.
 - 1. ASTM A240-85 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - 2. ASCE 18-96 - Standard Guidelines for In-Process Oxygen Transfer Testing
 - 3. ASTM D1784-03 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

- 4. ASTM D1785-03 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- 5. ISS Type 18-8 Stainless Steel - Standard Wrought Steels Pocketbook, Relevant Section

1.04 QUALITY ASSURANCE

- A. Manufacturer’s Experience: Manufacturer shall be one who has been regularly engaged in the business specified herein for at least 5 years. The equipment and all ancillary shall be designed, supplied and warranted as a unit item by a single manufacturer or vendor.
- B. Warranty: As specified in Section 11 00 00.

1.05 EQUIPMENT SCHEDULE

Item	Location
Fine bubble diffusers	Aeration Zones 1 and 2 in Train 1
Fine bubble diffusers	Aeration Zones 1 and 2 in Train 2

1.06 SERVICE CONDITIONS

- A. Fluid temperature is expected to range from 35 to 75 degrees Fahrenheit.
- B. The equipment will be installed at a wastewater treatment plant in Eden, North Carolina at an elevation of approximately 525 feet above mean sea level.

PART 2 PRODUCTS

2.01 ACCEPTABLE PRODUCTS

- A. Reference to a manufacturer's name and model number or catalog number is for the purpose of establishing the standard of quality and general configuration desired. Acceptable manufacturers include Sanitaire 9-inch Silver Series II, Envirex 9” Flexdome Fine Bubble Diffuser, Aquarius Technologies Inc., Environmental Dynamics International, INC, or Engineer-approved equal, modified to meet the requirements of this specification.

2.02 GENERAL

- A. Fine bubble diffusion equipment shall include flexible membrane fine-bubble disc diffusers and shall be individually removable, supported by a fixed piping support system fastened to the walls and floors of the aeration tankage.
- B. Equipment furnished under this Section shall be designed to supply diffused air into wastewater treatment swing and aeration basin zones. Temperature of the air to be supplied may range from 100 degrees F to 200 degrees F at the drop pipe connection. Aeration piping and anchors shall be designed for at least 10 times the normal uplift forces.

2.03 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Performance requirements for base diffuser system, 4 grids total per train:

Criteria for Secondary Process Diffusers	Value
Total number of aeration zone basin trains	4
Air source (blower nos.)	B 200 B 210 B 220
No. of zones per swing zone basin (two aeration grids per zone)	2
No. of zones per aeration zone basin (one aeration grid per zone)	2
Aerobic Zone 1 width, ft	40
Aerobic Zone 1 length, ft	28.5
Aeration Zone 2 width, ft	40
Aeration Zone 2 length, ft	69.9
Water depth above basin floor range, ft ^a	17.7 – 18.11
Centerline elevation of manifold pipe, ft ^a	505.50
Minimum airflow, scfm/diffuser ^b	0.5
Average airflow, scfm/diffuser ^b	1
Maximum airflow, scfm/diffuser ^b	3
Minimum Standard Oxygen Requirement (SOR), ppd	4,000
Current Average SOR, ppd ^c	32,800
Design Average SOR, ppd ^c	71,700
Maximum SOR, ppd ^c	84,200
Maximum Design Airflow per aeration basin train with three basins in operation, scfm ^c	4,200
Average Design Airflow per aeration basin train with three basins in operation, scfm ^c	3,000
Minimum Current Airflow per aeration basin train with two basins in operation, scfm ^c	1,500
Minimum number of diffusers per aeration zone basin train	2,100
Number of aeration grids per train	3
Percentage of diffusers in upstream 1st diffuser grid	48%
Percentage of diffusers in 2nd diffuser grid	31%
Percentage of diffusers in downstream 3rd diffuser grid	21%
Minimum SOTE, total percent over basin water depth	30
Minimum Swing Zone drop pipe diameter, inches ^d	6
Aeration Zone Drop pipe diameter, inches	6
Maximum headloss from top of drop leg to top of diffuser at design condition, psig (including static head)	7.5
^a All diffusers shall be installed with the same top elevation in accordance with manufacturer's recommendations. The aeration basin floor is sloped as shown on the drawings. ^b At standard conditions (20 degrees C and 14.7 psia). Equivalent scfm/ft ² will be utilized for comparison if different diffuser is submitted. ^c Current average conditions are representative of 2 trains startup conditions. Design average conditions are representative of two trains in operation at future expanded condition. ^d Distribution piping shall be designed to carry at least 150 percent of the design air flow	

- B. The aeration basins, including swing zones, shall be provided with a minimum of 10 percent blank diffuser holders in each grid. The minimum blanks shall be determined based on the number of diffusers required to satisfy the specified SOTE percent. Blanks shall be uniformly distributed throughout each grid. Mounting saddles as well as the diffuser base/holder of the type to be installed by the Contractor shall be installed at each blank site, and plugged by the Contractor so that the future installation of diffusers requires only placement of the diffuser membrane. All blanks and diffusers must be in place prior to performing field tests specified in Paragraph 3.2 below.
- C. Diffuser system shall be designed to maximize oxygen transfer and to reduce energy. It is up to the manufacturer to determine the number of diffusers required to minimize energy. Manufacturer shall submit documentation showing that each diffuser grid is capable of providing a minimum of 0.12 scfm/ft² to ensure the minimum mixing requirement is provided.

2.04 MATERIALS OF CONSTRUCTION

Component	Material
Drop Piping and Distribution Manifolds and Headers	PVC, Schedule 40, ASTM D1784, with UV inhibitor (min 2% TiO ₂)
Diffuser Membrane	EPDM with UV inhibitor
Diffuser Housing	PVC, Schedule 40
Piping Gaskets	Neoprene or Natural Rubber
Piping Supports	Stainless Steel, ASTM A240, Type 304
Diffuser Mount Saddle Assembly	PVC, Schedule 80, ASTM D1785
Fasteners and Anchors	Stainless Steel, ASTM A240, Type 304
Nuts and bolts	Stainless Steel, Type 18-8 or 304

2.05 EQUIPMENT FEATURES

A. General

- 1. The aeration equipment manufacturer shall furnish the fine bubble diffusion equipment from the drop pipe connection below the low water surface down to the diffusers as indicated on the drawings. The Contractor shall coordinate with the equipment manufacturer to provide an appropriate airtight-sealing adapter to connect the Contractor's and manufacturer's pipe systems.
 - a. The air distribution piping system shall be designed for easy field installation, shall include provision for rotational adjustment of distribution headers, and shall provide for thermal expansion of all piping elements for 150 degree F temperature change. All welding shall be done in the manufacturer's shop. Field welding will not be permitted.
 - b. Components provided by the Contractor shall include all valves, air main piping, wall sleeves with seals, wall pipes, and concrete pedestals as necessary to complete the system as shown on the drawings.
 - c. Components provided by the equipment manufacturer shall include stainless steel clamp adapter from drop pipe, air manifolds and headers, diffuser assemblies, airflow control orifices, and stainless steel pipe supports.

- d. Maximum spacing between distribution headers shall not exceed 4 feet

B. Support System

- 1. The support system shall secure each drop pipe and distribution manifolds to the tank wall or channel floor as shown, and shall be designed for uplift forces per paragraph 11337-2.2B. The support system shall secure the diffusers in the aeration basins with the tank full or empty, within 1/4 inch of a common horizontal plane and at the specified elevation. The supports shall be suitably secured to floor and walls with stainless steel anchor bolts. Each support shall have a bearing surface contoured to fit the pipe being supported.
 - a. The saddle mounts shall fully encompass the air distribution header piping at the diffuser connection.
 - b. An O-ring gasket shall be provided to provide an air-tight seal between the saddle and the header pipe.
 - c. Each pipe support shall be designed to restrain the axial and rotational movement of the pipe while providing for unrestrained longitudinal movement.
 - d. Each pipe support shall be connected to basin floor by at least two (2) anchor bolts. Pipe supports shall be spaced no more than 8 feet apart.
 - e. Pipe supports shall allow leveling of the air lateral with 2-inch vertical adjustment at each support.
 - f. The invert elevation of the distribution manifolds and headers shall be the same in and between aeration zones. The end of the manifold shall have a blind flange to facilitate access inside the manifold.

C. Diffuser Assemblies

- 1. Each diffuser shall consist of a housing, diffuser support plate, replaceable membrane diffuser, retaining ring, flow control device, and check valve. The diffuser membrane slits shall close when air supply is interrupted. The diffuser membrane shall be elastic and allow openings to close. Diffuser holders shall be factory solvent welded to the crown of the distribution header. Attachment via mechanical fasteners shall not be acceptable.

D. Water Purge System

- 1. The water purge system shall be located per manufacturer's recommendations and shall be designed to remove moisture collected in air distribution piping using aeration air. Minimum size purge piping shall be 3/4-inch flexible tubing encased in a 4-inch or larger conduit column or 1-inch PVC Schedule 80. At least two purge systems shall be located in each zone.

2.06 SPARE PARTS

- A. The following spare parts shall be furnished for each part type and size specified in this Section. Spare parts shall be tagged and stored as specified in Section 11 00 00.

1. 5 percent extra diffuser membranes
2. 5 percent extra complete assembled diffuser baseplates and retainer rings
3. 5 percent extra tap plugs

PART 3 EXECUTION

3.01 GENERAL

- A. Installation, start-up and testing shall be conducted in accordance with Section 01 91 13 and Section 11 00 00.
- B. Diffuser exposure to sunlight shall be minimized, not to exceed manufacturer's recommendations. Diffusers shall be stored under cover, and installed diffusers shall be covered by a UV-blocking material until plant startup.

3.02 TESTING

- A. After completion of the installation and manufacturer's certification, equipment shall be field tested to demonstrate compliance with the requirements specified. Testing of equipment shall be conducted in accordance with the requirements of Sections 01 91 13 and 11 00 00.

B. LEVELING TESTS

1. Clear water shall be introduced into each basin to the top of the diffuser elements. The level of the diffusers shall then be checked to document that all element horizontal surfaces are within 1/4 inch of a common horizontal plane and at the specified elevation.

C. LEAKAGE AND DISTRIBUTION OF FLOW TESTS

1. After successful completion of the leveling tests, the water level shall be raised to 2 inches above the manifold. Air shall then be introduced into the system. The water surface shall be visually inspected to ensure that the airflow is uniformly distributed across the tank. Any leaks in the element holders, elements, pipes or the like shall be repaired. The test shall be repeated until the installation is essentially void of air leaks.

3.03 FIELD SERVICE

- A. Provide the service of a qualified representative for one (1) trip and one (1) day to inspect the mechanism installation, assist in start-up, and instruct plant personnel in the operation and maintenance of the mechanism.

3.04 TRAINING

- A. Training shall be conducted in accordance with Section 01 79 00 and Section 11 00 00. Training shall consist of a minimum of one 2-hour session addressing the theory of operation, testing, troubleshooting, and maintenance of the system.

END OF SECTION 465133