Technical Specifications for Wastewater Treatment System Upgrade & Expansion (Phase 1)

Allen Harim Foods, LLC.
Harbeson, Delaware

August 21, 2015

JOHN HAGER REID
LICENSE
No. 6580
DELAWARE
PROFESSIONAL ENGINEER
8/21/15

Prepared by:

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The Earth is the Lord's...
Reid Engineering
Psalm 24:1

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SECTION 00 11 13
ADVERTISEMENT FOR BIDS

FROM:

1.01 THE OWNER (HEREINAFTER REFERRED TO AS OWNER):

Allen Harim Foods, LLC

18752 Harbeson Road

Harbeson, DE, 19951

1.02 AND THE ENGINEER (HEREINAFTER REFERRED TO AS ENGINEER):

Reid Engineering Company, Inc.

1210 Princess Anne Street

Fredericksburg, VA 22401

1.03 DATE: SEPTEMBER 2, 2015

1.04 TO: POTENTIAL BIDDERS

A. Your firm is invited to submit an offer under seal to Owner for construction of a facility located at the above address before 2:00 pm local standard time on the 2nd day of October, 2015, for:
   1. Wastewater Treatment System Upgrade and Expansion Phase One project.
      a. The Project consists of the construction of the following:
         1) Replacement and Upgrade of the Raw Wastewater Pump Station,
         2) A new DAF FEB Tank and associated aeration and pumping equipment,
         3) Modifications to the existing DAF Pretreatment system,
         4) Modifications to the existing DAF Effluent Pump Station,
         5) A new Anoxic Reactor Effluent Pump Station,
         6) Demolition of the existing Live Shed,
         7) A new Final Clarifier No. 2,
         8) A new UV Disinfection System,
         9) Modification to the existing RAS Pump Station, and
         10) associated piping and electrical work
   2. A bidders conference has been scheduled for 11:00 a.m. on the 10th day of September, 2015 at the location of the facility - 18752 Harbeson Rd., Harbeson, DE 19951.
   3. The following requirements will be required for this project:
      a. Bidders must comply with the President's Executive Order No. 11246 which prohibits discrimination in employment regarding race, creed, color, sex or national origin.
      b. Subpart A - Delaware Prevailing Wage Regulations
         1) Davison Bacon Act provisions
      c. Subpart B - Equal Opportunity Clause (41 CFR 60-1.4)
      d. Subpart C - Certification of Non-segregated Facilities (41 CFR 60-1.8)
      e. Subpart E - Civil Rights Act of 1964
      f. Subpart F - Section 13 of PL 92-500; Under the Federal Water Pollution Control Act; Rehabilitation Act of 1973; PL 93-112; and age Discrimination Act of 1975.
      g. Subpart G - Required Provisions of 40 CFR Part 31 Subpart G
      h. Subpart H - Suspension and Debarment and Other Responsibility Matters
   4. The American Iron and Steel provisions of the Clean Water Act shall apply to this project.
   5. This project is to be funded by a Clean Water State Revolving Fund (CWSRF)loan.
   6. A Bid Bond, Payment Bond and Performance Bond shall be required for this project.
   7. Due to the critical time frame of this project Liquidated Damages shall apply for this project.

B. All bidders are required to prequalify to the requirements described in Document 00 21 13 - Instructions to Bidders.

C. Bid Documents may be obtained from the Engineer's file share web site free of charge. Contact Adam Zimmerman at azimmerman@reidengineering.com.
   1. When contacting the Engineering provide the following information:
      a. Name
      b. Company
      c. Phone Number
      d. Email Address (Sharefile access will be sent to this email address)

D. Refer to other bidding requirements described in Document 00 21 13 - Instructions to Bidders and Document 00 31 00 - Available Project Information.
   1. Sealed Bids shall be submitted on or prior to the required date and time. Bids will be publically opened and read.

E. Submit your offer on the Bid Form provided. Bidders may supplement this form as appropriate.

F. Your offer will be required to be submitted under a condition of irrevocability for a period of 30 days after submission.

G. The Owner reserves the right to accept or reject any or all offers.

END OF BID SOLICITATION

SECTION 00 21 13
INSTRUCTIONS TO BIDDERS

SUMMARY

1.01 RELATED DOCUMENTS

A. Document 00 11 13 - Advertisement for Bids.
B. Document 00 31 00 - Available Project Information.
C. Document 00 41 00 - Bid Form.
D. Document 00 43 01 - Bid Form Supplements Cover Sheet.
E. Document 00 43 22 - Unit Prices Form.
F. Document 00 43 23 - Alternates Form.
G. Document 00 43 73 - Proposed Schedule of Values Form.
H. Document 00 43 33 - Supplement H - List of Major Equipment.
I. Document 00 51 00 - Contract Inserts
J. Document 00 52 00 - Agreement Form
K. Document 00 72 00 - General Conditions
L. Document 00 72 10 - Special Owner's Requirements

1.02 INTENT

A. The intent of this Bid request is to obtain an offer to perform the Work to construct the Wastewater Treatment System Expansion and Upgrade for Allen Harim Foods, LLC. At the site indicated on the Contract Documents for a Stipulated Price Contract, in accordance with the Contract Documents.

INVITATION

2.01 BID SUBMISSION

A. Bids signed and under seal, executed, and dated will be received at the office of the Owner at 18752 Harbeson Rd, Harbeson, DE, 19951 before 2:00 p.m. local standard time on the 2nd day of October, 2015.
B. Offers submitted after the above time shall be returned to the bidder unopened.
C. Offers will be opened publicly immediately after the time for receipt of bids.
D. Amendments to the submitted offer will be permitted if received in writing prior to bid closing and if endorsed by the same party or parties who signed and sealed the offer.

2.02 WORK IDENTIFIED IN THE CONTRACT DOCUMENTS

A. Work of this proposed Contract comprises new construction, including general construction, structural, mechanical, and electrical Work.
B. Location: Allen Harim Foods, LLC Wastewater Treatment Plant located at 18752 Harbeson Rd, Harbeson, DE, 19951.

2.03 CONTRACT REQUIREMENTS

A. The construction portion of this project shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware (Refer to Section 00 31 00 - Available Project Information).
B. State of Delaware and Federal Davis Bacon wage rates shall apply for this project. The higher of the two for each labor classification shall be used.
C. The following shall apply for this project (Refer to Section 00 51 00 - Contract Inserts):
    1. Subpart A - Delaware Prevailing Wage Regulations
        a. Davison Bacon Act provisions

2. Subpart B - Equal Opportunity Clause (41 CFR 60-1.4)
3. Subpart C - Certification of Non-segregated Facilities (41 CFR 60-1.8)
4. Subpart E - Civil Rights Act of 1964
5. Subpart F - Section 13 of PL 92-500; Under the Federal Water Pollution Control Act; Rehabilitation Act of 1973; PL 93-112; and age Discrimination Act of 1975.
6. Subpart G - Required Provisions of 40 CFR Part 31 Subpart G
7. Subpart H - Suspension and Debarment and Other Responsibility Matters

2.04 CONTRACT TIME

A. Project Schedule:

1.	Bid Due Date:	October 2, 2015
2.	Commence Construction:	October 16, 2015
3.	Substantial Completion & Startup:	March 16, 2016
4.	Final Completion:	April 20, 2016

BID DOCUMENTS AND CONTRACT DOCUMENTS

3.01 DEFINITIONS

A. Bid Documents: Contract Documents supplemented with Invitation To Bid, Instructions to Bidders, Information Available to Bidders, Bid Form Supplements To Bid Forms and Appendices identified.

B. Contract Documents: Defined in EJCDC C-700 Article 1 including issued Addenda.

C. Bid, Offer, or Bidding: Act of submitting an offer.

D. Bid Amount: Monetary sum identified by the Bidder in the Bid Form.

3.02 CONTRACT DOCUMENTS IDENTIFICATION

A. The Bidding Documents are identified as follows:
   1. Bidding Requirements:
      a. Invitation to Bid.
      b. Instructions to Bidders.
      c. Bid Form.
      d. Bid Bond.
      e. Prequalification - Contractor Qualification Statement
   2. Contract Forms:
      a. Agreement.
      b. Performance and Payment Bonds.
   3. Contract Inserts
      a. Compliance Statement
      b. Notice to Prospective Subcontractors of Requirements for Certification of Non-Segregated Facilities
   4. Contract Conditions:
      a. General Conditions.
      b. Supplementary Conditions.
   5. Technical Specifications.
   6. Contract Drawings.
   7. Addenda issued prior to receipt of Bids.

3.03 AVAILABILITY

A. Bid Documents may be obtained at the office of Engineer.
   1. Contact Adam Zimmerman, azimmerman@reidengineering.com, to request access to the sharefile site for the download of the Bid Documents.
   2. When contacting the engineer provide the following information:
      a. Name
      b. Company
      c. Phone Number

d. Email Address (Sharefile access will be sent to this email)

B. Bid Documents are made available only for the purpose of obtaining offers for this project. Their use does not grant a license for other purposes.

3.04 EXAMINATION

A. Bid Documents may be viewed at the office of Engineer.

B. Upon receipt of Bid Documents verify that documents are complete. Notify Engineer should the documents be incomplete.

C. Immediately notify Engineer upon finding discrepancies or omissions in the Bid Documents.

3.05 INQUIRIES/ADDENDA

A. Direct questions to Adam Zimmerman, telephone 540-371-8500, email azimmerman@reidengineering.com.

B. Addenda may be issued during the bidding period. All Addenda become part of the Contract Documents. Include resultant costs in the Bid Amount.

C. Verbal answers are not binding on any party.

D. Clarifications requested by bidders must be in writing not less than 7 days before date set for receipt of bids. The reply will be in the form of an Addendum, a copy of which will be forwarded to known recipients.

3.06 PRODUCT/ASSEMBLY/SYSTEM SUBSTITUTIONS

A. Where the Bid Documents stipulate a particular product, substitutions will be considered up to 10 days before receipt of bids.

B. When a request to substitute a product is made, Engineer may approve the substitution and will issue an Addendum to known bidders.

C. The submission shall provide sufficient information to determine acceptability of such products.

D. Provide complete information on required revisions to other work to accommodate each proposed substitution.

E. Provide products as specified unless substitutions are submitted in this manner and accepted.

F. See Section 01 60 00 - Product Requirements for additional requirements.

SITE ASSESSMENT

4.01 SITE EXAMINATION

A. Examine the project site before submitting a bid.

B. The bidder is required to contact the Owner at the following address and phone number in order to arrange a date and time to visit the project site:
   1. Address: 18752 Harbeson Road, Harbeson DE, 19951
   2. Contact Person: Kai Schrodt
   3. Contact Phone No.: 410-430-9968
   4. Alternative Contact Person: Jim Quinton, 302-381-8766

C. A visit to the project site has been arranged for bidders as follows: at the Prebid Conference.

4.02 PREBID CONFERENCE

A. A bidders conference has been scheduled for 11:00 a.m. on the 10th day of September, 2015 at the location of the facility - 18752 Harbeson Rd, Harbeson, DE, 19951..

B. All general contract bidders are invited.

C. Representatives of Engineer will be in attendance.

D. Information relevant to the Bid Documents will be recorded in an Addendum, issued to Bid Document recipients.

QUALIFICATIONS

5.01 EVIDENCE OF QUALIFICATIONS

A. To demonstrate qualification for performing the Work of this Contract, bidders may be requested to submit written evidence of financial position, license to perform work in the State and previous work experience.

B. To be considered a Responsive Bidder, Bidders shall submit a list of previous projects completed within the last five (5) calendar years of similar scope and size for a poultry processing facility.
   1. To be considered a Qualified Bidder, Bidders must have completed a minimum of three (3) similar scope and size, or larger, projects within the last five (5) years.
   2. Bidders shall provide reference contact information for verification of previously completed projects.
   3. To demonstrate qualifications for performing the Work of this Contract, Bidders shall submit the Contractor Qualification Statement.

5.02 PREQUALIFICATION

A. Bidders shall complete and submit Qualification Form and previous project information to the Engineer on or before 4:00 p.m. on the 23rd day of September, 2015.

BID SUBMISSION

6.01 SUBMISSION PROCEDURE

A. Bidders shall be solely responsible for the delivery of their bids in the manner and time prescribed.

B. Submit one copy of the executed offer on the Bid Forms provided, signed and sealed in a closed opaque envelope, clearly identified with bidder's name, project name and Owner's name on the outside.

C. Bids shall be submitted to and received by the Owner prior to the specified Bid date and time.
   1. Mailing Address for Bids: 18752 Harbeson Road, Harbeson DE, 19951
   2. Bid Opening Location: 18752 Harbeson Road, Harbeson DE, 19951

6.02 BID INELIGIBILITY

A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, may at the discretion of the Owner, be declared unacceptable.

B. Bid Forms, Appendices, and enclosures that are improperly prepared may, at the discretion of Owner, be declared unacceptable.

BID ENCLOSURES/REQUIREMENTS

7.01 SECURITY DEPOSIT

A. Bids shall be accompanied by a security deposit as follows:
   1. Bid Bond in the amount equal to 10% of the Bidders Total Bid Value.

B. The security deposit will be returned after delivery to the Owner of the required Performance and Payment Bond(s) by the accepted bidder.

C. Include the cost of bid security in the Bid Amount.

D. If no contract is awarded, all security deposits will be returned.

7.02 PERFORMANCE ASSURANCE

A. Accepted Bidder shall provide a Performance and a Labor and Material Payment Bond in the amount of 100% of the Bid Total.

B. Include the cost of performance assurance bonds in the Bid Amount.

7.03 BID FORM REQUIREMENTS

A. Complete all requested information in the Bid Form and Appendices.

7.04 FEES FOR CHANGES IN THE WORK

A. Include in the Bid Form, the fees proposed for subcontract work for changes (both additions and deductions) in the Work. Contractor shall apply fees as noted, to the subcontractor's gross (net plus fee) costs on additional work.

7.05 BID FORM SIGNATURE

A. The Bid Form shall be signed by the bidder, as follows:
   1. Sole Proprietorship: Signature of sole proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature.
   2. Partnership: Signature of all partners in the presence of a witness who will also sign. Insert the word "Partner" under each signature.
   3. Corporation: Signature of a duly authorized signing officer(s) in their normal signatures. Insert the officer's capacity in which the signing officer acts, under each signature. Affix the corporate seal. If the bid is signed by officials other than the president and secretary of the company, or the president/secretary/treasurer of the company, a copy of the by-law resolution of their board of directors authorizing them to do so, must also be submitted with the Bid Form in the bid envelope.
   4. Joint Venture: Each party of the joint venture shall execute the Bid Form under their respective seals in a manner appropriate to such party as described above, similar to the requirements of a Partnership.

7.06 ADDITIONAL BID INFORMATION

A. Submit the following Supplements concurrent with bid submission:
   1. Document 00 43 36 - Proposed Subcontractors Form: Include the names of all Subcontractors and the portions of the Work they will perform.
   2. Document 00 43 22 - Unit Prices Form: Include a listing of unit prices specifically requested by the Contract Documents.
   3. Document 00 43 23 - Alternates Form
   4. Document 00 43 73 - Proposed Schedule of Values: identifies the Bid Amount segmented into portions as requested.
   5. Document 00 43 33 - Supplement H - List of Major Equipment.
   6. Document 00 51 00 - Compliance Statement
   7. Bid Bond

7.07 SELECTION AND AWARD OF ALTERNATES

A. Bids will be evaluated on the total of the base bid price and all of the Alternates. After determination of the successful bidder, consideration will be given to which Alternates will be included in the Work.

OFFER ACCEPTANCE/REJECTION

8.01 DURATION OF OFFER

A. Bids shall remain open to acceptance and shall be irrevocable for a period of thirty (30) days after the bid closing date.

8.02 ACCEPTANCE OF OFFER

A. Owner reserves the right to accept or reject any or all offers.

B. After acceptance by Owner, Engineer on behalf of Owner, will issue to the successful bidder, a written letter of Contract Award.

END OF SECTION

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SECTION 00 31 00
AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 EXISTING CONDITIONS

A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of the Contract Documents, as follows:

B. Geotechnical Report: Entitled Report of Subsurface Exploration and Geotechnical Engineering Recommendations, dated April 30, 2015.
   1. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Engineer.
   2. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in the Contract Documents.

1.02 AMERICAN IRON AND STEEL PROVISION

A. US EPA Memorandum

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 00 41 00

BID FORM

THE PROJECT AND THE PARTIES

1.01 TO:

Owner

_____

Allen Harim Foods, LLC
18752 Harbeson Road
Harbeson, DE 19951

1.02 FOR:

Wastewater Treatment System Upgrade and Expansion - Phase One

1.03 DATE: _____ (BIDDER TO ENTER DATE)

1.04 SUBMITTED BY: (BIDDER TO ENTER NAME AND ADDRESS)

Bidder's Full Name _____
Address _____
City, State, Zip_____

1.05 OFFER

Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Contract Documents prepared by Reid Engineering Company, Inc. for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Price of:

_____
_____ dollars
($_____), in lawful money of the United States of America.

A. We have included the required performance assurance bonds in the Bid Amount as required by the Instructions to Bidders.

B. All applicable federal taxes are included and State of Delaware taxes are included in the Bid Price.

1.06 ACCEPTANCE

A. This offer shall be open to acceptance and is irrevocable for thirty days from the bid closing date.

B. If this bid is accepted by Owner within the time period stated above, we will:
   1. Execute the Agreement within seven days of receipt of Notice of Award.
   2. Furnish the required bonds within seven days of receipt of Notice of Award.
   3. Commence work within seven days after written Notice to Proceed of this bid.

C. If this bid is accepted within the time stated, and we fail to commence the Work or we fail to provide the required Bond(s), the security deposit shall be forfeited as damages to Owner by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

1.07 CONTRACT TIME

A. If this Bid is accepted, we will:

B. Substantially Complete the Work by the 16th day of March, 2016.

C. Complete the Work by the 20th day of April, 2016.

1.08 CHANGES TO THE WORK

A. When Engineer establishes that the method of valuation for Changes in the Work will be net cost plus a percentage fee in accordance with General Conditions, our percentage fee will be:
   1. _____ percent overhead and profit on the net cost of our own Work;
   2. _____ percent on the cost of work done by any Subcontractor.

B. On work deleted from the Contract, our credit to Owner shall be Engineer-approved net cost plus _____ of the overhead and profit percentage noted above.

1.09 ADDENDA

A. The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Price.
   1. Addendum # _____ Dated _____.
   2. Addendum # _____ Dated _____.
   3. Addendum # _____ Dated _____.
   4. Addendum # _____ Dated _____.
   5. Addendum # _____ Dated _____.

1.10 BID FORM SUPPLEMENTS

A. The following Supplements are attached to this Bid Form and are considered an integral part of this Bid Form:
   1. Document 00 43 22 - Unit Prices Form: Include a listing of unit prices specifically requested by the Contract Documents.
   2. Document 00 43 23 - Alternates Form
   3. Document 00 43 33 - Supplement H - List of Major Equipment.
   4. Document 00 43 36 - Proposed Subcontractors Form: Include the names of all Subcontractors and the portions of the Work they will perform.
   5. Document 00 43 73 - Proposed Schedule of Values Form identifies the Bid Sum segmented into portions as requested.
   6. Document 00 51 00 - Contract Inserts - Compliance Statement
   7. Bid Bond

1.11 BID FORM SIGNATURE(S)

The Corporate Seal of

_____

(Bidder - print the full name of your firm)

was hereunto affixed in the presence of:

_____

(Authorized signing officer, Title)

(Seal)

_____

(Authorized signing officer, Title)

IF THE BID IS A JOINT VENTURE OR PARTNERSHIP, ADD ADDITIONAL FORMS OF EXECUTION FOR EACH MEMBER OF THE JOINT VENTURE IN THE APPROPRIATE FORM OR FORMS AS ABOVE.

END OF BID FORM

SECTION 00 41 10

BID BOND

THE ATTACHED DOCUMENT SHALL BE SUBMITTED WITH THE BID.

1.01 BID BOND:

A. EJCDC C-435- Bid Bond

END OF SECTION

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Engineers Joint Documents Committee
Design and Construction Related Documents
Instructions and License Agreement

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If you transfer possession of any copy, modification or merged portion of EJCDC Design and Construction Related Documents to another party, your license is automatically terminated.

Term:
The license is effective until terminated. You may terminate it at any time by destroying **EJCDC Design and Construction Related Documents** altogether with all copies, modifications and merged portions in any form. It will also terminate upon conditions set forth elsewhere in this Agreement or if you fail to comply with any term or condition of this Agreement. You agree upon such termination to destroy **EJCDC Design and Construction Related Documents** along with all copies, modifications and merged portions in any form.

Limited Warranty:
EJCDC warrants the CDs and diskettes on which **EJCDC**

Design and Construction Related Documents is furnished to be free from defects in materials and workmanship under normal use for a period of ninety (90) days from the date of delivery to you as evidenced by a copy of your receipt.

There is no other warranty of any kind, either expressed or implied, including, but not limited to the implied warranties of merchantability and fitness for a particular purpose. Some states do not allow the exclusion of implied warranties, so the above exclusion may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

EJCDC does not warrant that the functions contained in **EJCDC Design and Construction Related Documents** will meet your requirements or that the operation of **EJCDC Design and Construction Related Documents** will be uninterrupted or error free.

Limitations of Remedies:
EJCDC's entire liability and your exclusive remedy shall be:

1. the replacement of any document not meeting EJCDC's "Limited Warranty" which is returned to EJCDC's selling agent with a copy of your receipt, or

2. if EJCDC's selling agent is unable to deliver a replacement CD or diskette which is free of defects in materials and workmanship, you may terminate this Agreement by returning EJCDC Document and your money will be refunded.

In no event will EJCDC be liable to you for any damages, including any lost profits, lost savings or other incidental or consequential damages arising out of the use or inability to use **EJCDC Design and Construction Related Documents** even if EJCDC has been advised of the possibility of such damages, or for any claim by any other party.

Some states do not allow the limitation or exclusion of liability for incidental or consequential damages, so the above limitation or exclusion may not apply to you.

General:
You may not sublicense, assign, or transfer this license except as expressly provided in this Agreement. Any attempt otherwise to sublicense, assign, or transfer any of the rights, duties, or obligations hereunder is void.

This Agreement shall be governed by the laws of the State of Virginia. Should you have any questions concerning this Agreement, you may contact EJCDC by writing to:

Arthur Schwartz, Esq.
General Counsel
National Society of Professional Engineers
1420 King Street
Alexandria, VA 22314

Phone: (703) 684-2845
Fax: (703) 836-4875
e-mail: aschwartz@nspe.org

You acknowledge that you have read this agreement, understand it and agree to be bound by its terms and conditions. You further agree that it is the complete and exclusive statement of the agreement between us which supersedes any proposal or prior agreement, oral or written, and any other communications between us relating to the subject matter of this agreement.

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:
Project (Brief Description Including Location):

BOND
Bond Number:
Date (Not later than Bid due date):
Penal Sum: _____ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER	**SURETY**
_____ (Seal)	_____ (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature and Title	Signature and Title (Attach Power of Attorney)
Attest: _____	Attest: _____
Signature and Title	Signature and Title

Note: Above addresses are to be used for giving required notice.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder any difference between the total amount of Bidder's Bid and the total amount of the Bid of the next lowest, responsible Bidder who submitted a responsive Bid as determined by Owner for the work required by the Contract Documents, provided that:

1.1. If there is no such next Bidder, and Owner does not abandon the Project, then Bidder and Surety shall pay to Owner the penal sum set forth on the face of this Bond, and

1.2. In no event shall Bidder's and Surety's obligation hereunder exceed the penal sum set forth on the face of this Bond.

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 by 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 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 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.

SECTION 00 41 20

CONTRACTOR QUALIFICATIONS STATEMENT

THE ATTACHED DOCUMENT SHALL BE SUBMITTED WITH THE BIDDERS PREQUALIFICATION APPLICATION PER THE REQUIREMENTS OF SECTION 00 21 13 - INSTRUCTIONS TO BIDDERS.

1.01 CONTRACTOR QUALIFICATIONS STATEMENT:

A. Contractor Qualifications Statement

END OF SECTION

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Contractor Qualifications Statement

TO: Allen Harim Foods, Inc.
18752 Harbeson Rd.
Harbeson, DE 19951

FOR: Wastewater Treatment System Upgrade and Expansion - Phase 1

SUBMITTED BY:

NAME: _____
_____

Address: _____
_____
_____
_____

1. How Many Years has your organization been in business as a Contractor?

2. What other names has your organization operated under, if any?

3. List jurisdictions and trade categories in which your organization is legally qualified to do business. Include license or registration numbers.

4. List the categories of work that your organization self performs with its own employees.

5. Has your organization failed to complete any work for which it was contracted? (If yes provide details)

6. Are there any judgments, claims, arbitration, or suits pending or outstanding against your organization? (if yes provide details)

7. Has your organization taken legal action against the Owner of any work for which it had been contracted to perform? (If yes provide details)

8. List major construction projects your organization currently has in progress: (attached separate sheet if necessary)

Project Title	Owner Contact Information	Description	Anticipated Project Completion Dated

9. List projects of similar size and scope, or larger, that your organization has performed in the last five years for a poultry processing facility: (attached separate sheet if necessary)

Project Title	Owner Contact Information	Description	Project Completion Date

10. References:

Trade References:

Trade	Organization Name	Address and Phone Number

Bank Reference:

Institution Name	Contact Person	Address and Phone Number

11. Signature

Name of Organization:_____

By (Type or Print): _____

Signature: _____ Date:_____

_____ being duly sworn deposes and says the information provided herin is true and sufficiently complete so as to not be misleading.

Subscribed and sworn before me this _____ day of _____ 20____

Notary Public:

My Commission Expires:

SECTION 00 43 22
UNIT PRICES FORM

PARTICULARS

THE FOLLOWING IS THE LIST OF UNIT PRICES REFERENCED IN THE BID SUBMITTED BY:

(BIDDER) _____

TO (OWNER): ALLEN HARIM FOODS, LLC.

DATED _____ AND WHICH IS AN INTEGRAL PART OF THE BID FORM.

THE FOLLOWING ARE UNIT PRICES FOR SPECIFIC PORTIONS OF THE WORK AS LISTED, AND ARE APPLICABLE TO AUTHORIZED VARIATIONS FROM THE CONTRACT DOCUMENTS.

UNIT PRICE LIST

2.01 SECTION 31 23 16 - EXCAVATION

A. See Section 01 22 00 - Unit Prices for requirements applicable to this section.

B. Unit Pricing shall include, but not be limited to, equipment, labor, and incidentals for the excavation of unsuitable soils from the site.

C. Unit Price: Excavating Unsuitable Soil Materials$_____/cubic yard

2.02 SECTION 31 23 23 - FILL

A. See Section 01 22 00 - Unit Prices for requirements applicable to this section.

B. Unit Pricing shall include, but not be limited to, equipment, labor, materials, excavation, grading, placement, compaction, and incidentals required for utilizing imported Fill Material for placement of Structural Fill outside the Work as indicated on the Drawings.

C. Unit Price: Structural Fill$_____/cubic yard

2.03 SECTION 31 23 23 - FILL

A. See Section 01 22 00 - Unit Prices for requirements applicable to this section.

B. Unit Pricing shall include, but not be limited to, equipment, labor, materials, excavation, grading, placement, compaction, and incidentals required for utilizing imported Fill Material for placement of Aggregate Fill outside the Work as indicated on the Drawings.

C. Unit Price: Aggregate Fill$_____/cubic yard

2.04 SECTION 03 20 00 - CONCRETE REINFORCEMENT

A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.

B. Unit Pricing shall include reinforcement, placement, and accessories.
   1. Bar Reinforcement$_/ton

2.05 SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

A. See Section 01 22 00 - Unit Prices, for additional unit price requirements.

B. Concrete - Slab-on-Fill or Slab-on-Grade: Includes formwork, reinforcement as specified in Section 03200, concrete, placement accessories, consolidating and leveling, troweling, and curing.
   1. Concrete$_____/Square foot.
   2. Concrete$_____/Cubic yard.

C. Concrete - Vertical in Forms: Includes formwork, reinforcement as specified in Section 03200, concrete, placement accessories, consolidating, and curing.
   1. Concrete$_____/Square foot.
   2. Concrete$_____/Cubic yard.

D. Concrete - Miscellaneous Locations: Includes formwork, reinforcement as specified in Section 03200, concrete, placement accessories, consolidating, and curing. Provide unit price by:
   1. Concrete$_____/Square foot.
   2. Concrete$_____/Cubic yard.

E. Concrete - Grouting: Includes preparation of substrate, grout, placement, consolidating, troweling, and curing. ____.
   1. Grout$_____/Cubic yard

F. Construction Joint Devices: Includes component, accessories, and installation.
   1. Joint Devices$_____/Linear foot

END OF UNIT PRICES FORM

SECTION 00 43 23
ALTERNATES FORM

PARTICULARS

THE FOLLOWING IS THE LIST OF ALTERNATES REFERENCED IN THE BID SUBMITTED BY:

(BIDDER) _____

TO (OWNER): ALLEN HARIM FOODS, LLC

DATED _____ AND WHICH IS AN INTEGRAL PART OF THE BID FORM.

ALTERNATES LIST

THE FOLLOWING SHALL BE ADDED TO OR DEDUCTED FROM THE BID AMOUNT.

Supplement H - List of Major Equipment designates major equipment items to be provided. The Bidder shall indicate which of the specified manufacturer's/supplier's equipment it is offering to provide by writing in one of the named manufacturers/ suppliers listed. A named manufacturer/supplier for each identified major equipment item shall be written in, even if only one is specified. If the Bidder desires to propose a substitute for any named manufacturer/supplier of a specified item, the Bidder shall write in the name of the offered substitute manufacturer/supplier in the table below. The Bidder shall also provide for each proposed substitute the price deduction resulting to the Owner upon the allowed use of the substitute. Named manufacturers/suppliers are defined as those listed in the List of Major Equipment. Substitute manufacturers/suppliers are defined as those proposed and written in by the Bidder in the space so designated. Should the substitute manufacturer/supplier be determined "Not Equal" in the Engineer's discretion, the Bidder must provide the named manufacturer/supplier written in this Supplement H - List of Major Equipment. Should the Bidder fail to indicate the name Manufacturer/ Supplier per equipment item, the Bid shall be deemed to have been based upon and the Bidder, if awarded the contract, shall provide the first of the listed named manufacturer/suppliers for that item.

If a proposed substitute manufacturer/supplier is allowed by the Owner, the associated "Deduct" will be subtracted from the amount of the successful Bidder's Base Bid to determine the Contract Price. Determination of the Low Bidder will be based on the Base Bid without consideration of any deductions resulting from Bidder-Proposed substitute equipment. Allowance of substitute manufacturers/ suppliers does not constitute a waiver of the Specifications or of any other requirements of the Contract Documents.

Unless otherwise stated, all proposed deducts for substitute manufacturers/suppliers are deducts for the equipment associated with the base bid only.

SPECIFICATION SECTION	PROPOSED ALTERNATIVE MANUFACTURER	ADD/DEDUCT FROM BASE BID AMOUNT

2.01 ALTERNATE # 1: ADD / (DEDUCT) $ _____

A. Deduction from the Base Bid Total for performing the Work for this project without complying with the Delaware prevailing wages and the Federal Davis Bacon Act.

2.02 ALTERNATE # 2: ADD / (DEDUCT) $ _____

A. Deduction from the Base Bid Total for performing the Work for this project without complying with the American Iron and Steel provision of the Clean Water Act.

END OF ALTERNATES FORM

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SECTION 00 43 33

SUPPLEMENT H - LIST OF MAJOR EQUIPMENT

PARTICULARS

THE FOLLOWING IS THE LIST OF EQUIPMENT REFERENCED IN THE BID SUBMITTED BY:

(BIDDER) _____

TO (OWNER): ALLEN HARIM FOODS, LLC

DATED _____ AND WHICH IS AN INTEGRAL PART OF THE BID FORM.

Supplement H - List of Major Equipment designates major equipment items to be provided. The Bidder shall indicate which of the specified manufacturer's/supplier's equipment it is offering to provide by writing in one of the named manufacturers/ suppliers listed. A named manufacturer/supplier for each identified major equipment item shall be written in, even if only one is specified. If the Bidder desires to propose a substitute for any named manufacturer/supplier of a specified item, the Bidder shall write in the name of the offered substitute manufacturer/supplier in 00 43 23 - Alternates Form. The Bidder shall also provide for each proposed substitute the price deduction resulting to the Owner upon the allowed use of the substitute. Named manufacturers/suppliers are defined as those listed in the List of Major Equipment. Substitute manufacturers/suppliers are defined as those proposed and written in by the Bidder in the space so designated. Should the substitute manufacturer/supplier be determined "Not Equal" in the Engineer's discretion, the Bidder must provide the named manufacturer/supplier written in this Supplement H - List of Major Equipment. Should the Bidder fail to indicate the name Manufacturer/ Supplier per equipment item, the Bid shall be deemed to have been based upon and the Bidder, if awarded the contract, shall provide the first of the listed named manufacturer/suppliers for that item.

If a proposed substitute manufacturer/supplier is allowed by the Owner, the associated "Deduct" will be subtracted from the amount of the successful Bidder's Base Bid to determine the Contract Price. Determination of the Low Bidder will be based on the Base Bid without consideration of any deductions resulting from Bidder-Proposed substitute equipment. Allowance of substitute manufacturers/ suppliers does not constitute a waiver of the Specifications or of any other requirements of the Contract Documents.

Unless otherwise stated, all proposed deducts for substitute manufacturers/suppliers are deducts for the equipment associated with the base bid only.

LIST OF MAJOR EQUIPMENT FOR BASE BID

40 20 00 - LIQUIDS PROCESS PIPING

40 90 00 - INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

40 91 10 - Process and Instrumentation Equipment

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
   Hach
   Cerlic
   Endress-Hauser

40 91 20 - Magnetic Flow Meters

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
   Rosemont
   ABB
   Sparling Instrument Co., Inc.

40 91 30 - Ultrasonic Level Sensors

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
   Hach
   Magnetrol
   Siemens

43 10 00 - GAS HANDLING EQUIPMENT

43 11 33 - Rotary Lobe Positive Displacement Blowers

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
   Robuschi USA, Inc.
   Kaeser Compressors, Inc.
   Aerzen

43 20 00 - LIQUID HANDLING EQUIPMENT

43 21 22 - Self-Priming Centrifugal Pumps

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
   Gorman Rupp

43 21 35 - Rotary Lobe Pumps

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
   Vogelsang USA - Twinsburg, OH

43 40 00 - GAS AND LIQUID STORAGE

46 20 00 - WATER AND WASTEWATER PRELIMINARY TREATMENT EQUIPMENT

46 30 00 - WATER AND WASTEWATER CHEMICAL FEED EQUIPMENT

46 40 00 - WATER AND WASTEWATER CLARIFICATION AND MIXING EQUIPMENT

46 43 21 - Clarifier Mechanism

1. Proposed Base Bid Manufacturer: Evoqua (Owner Furnished)_____
2. Approved Manufacturers:
   Evoqua/Envirex

46 43 25 - Automated Clarifier Brush Cleaning Device

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
   Ford Hall Company

46 43 63 - Dissolved Air Floatation System

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
3. FRC Systems International

46 50 00 - WATER AND WASTEWATER SECONDARY TREATMENT EQUIPMENT

46 51 18 - Slot Injector Aeration and Mixing System

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
   KLA Systems, Inc.

46 51 21 - Fixed Aeration Header Diffuser System

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
   Aquarius Technologies, Inc.
   Sanitaire Division of ITT Industries

46 60 00 - WATER AND WASTEWATER ADVANCED TREATMENT EQUIPMENT

46 66 53 - Open Channel Ultra-Violet Disinfection System

1. Proposed Base Bid Manufacturer:_____
2. Approved Manufacturers:
   Trojan Technologies, Inc. - London, Ontario Canada

46 70 00 - WATER AND WASTEWATER RESIDUALS HANDLING AND TREATMENT

END OF SECTION

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SECTION 00 43 36

PROPOSED SUBCONTRACTORS FORM

PARTICULARS

1.01 HEREWITH IS THE LIST OF SUBCONTRACTORS REFERENCED IN THE BID SUBMITTED BY:

1.02 (BIDDER) _____

1.03 TO (OWNER): ALLEN HARIM FOODS, LLC

1.04 DATED _____ AND WHICH IS AN INTEGRAL PART OF THE BID FORM.

1.05 THE FOLLOWING WORK WILL BE PERFORMED (OR PROVIDED) BY SUBCONTRACTORS AND COORDINATED BY US:

LIST OF SUBCONTRACTORS

2.01 WORK SUBJECT	**SUBCONTRACTOR NAME**
_____	_____
_____	_____
_____	_____
_____	_____

END OF PROPOSED SUBCONTRACTORS FORM

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SECTION 00 43 73
PROPOSED SCHEDULE OF VALUES FORM

PARTICULARS

THE FOLLOWING IS A COST BREAKDOWN REFERENCED IN THE BID SUBMITTED BY:

(BIDDER) _____

TO (OWNER): ALLEN HARIM FOODS, LLC

DATED _____ AND WHICH IS AN INTEGRAL PART OF THE BID FORM.

ITEM DESCRIPTIONS

EARTHWORK	**$_____**
EROSION & SEDIMENT CONTROL	**$_____**
NEW DAF FEB SYSTEM	**$_____**
NEW RAW WASTEWATER PUMP STATION	**$_____**
MODIFY EX. DAF PRETREATMENT EQUIPMENT	**$_____**
MODIFY EX. DAF EFFLUENT PUMP STATION	**$_____**
NEW FINAL CLARIFIER NO. 2 SYSTEM	**$_____**
MODIFY EXISTING RAS PUMP STATION	**$_____**
NEW JET SYSTEM FOR EX. CMAS #2A	**$_____**
NEW/MODIFIED PROCESS PIPING - BELOW GRADE	**$_____**
NEW/MODIFIED PROCESS PIPING - ABOVE GRADE	**$_____**
NEW REACTOR NO. 1 EFFLUENT PUMP STATION	**$_____**
NEW UV DISINFECTION SYSTEM	**$_____**
DEMOLITION OF LIVE SHED	**$_____**
STRUCTURAL STEEL STAIRS AND WALKS	**$_____**
PIPE HEAT TRACE & INSULATION	**$_____**
MISC. STEEL	**$_____**
MISC. CONCRETE	**$_____**
PAINT	**$_____**
ELECTRICAL	**$_____**
HVAC	**$_____**
CONTINGENCY ALLOWANCE	**$100,000**
GENERAL CONDITIONS	**$_____**
MOBILIZATION	**$_____**
BID BOND	**$_____**
PERFORMANCE & PAYMENT BOND	**$_____**
INSURANCE	**$_____**
TOTAL BID AMOUNT	**$_____**

END OF SUPPLEMENT E

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SECTION 00 50 00
CONTRACTING FORMS AND SUPPLEMENTS

PART 1 GENERAL

1.01 AGREEMENT AND CONDITIONS OF THE CONTRACT

A. See Section 00 52 00 - Agreement Form for the Agreement form to be executed.

B. See Section 00 72 00 - General Conditions for the General Conditions.

C. See Section 00 73 00 - Supplementary Conditions for the Supplementary Conditions.

1.02 FORMS

A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in the Contract Documents.

B. Notice of Award: EJCDC C-510

C. Notice to Proceed: EJCDC C-550

D. Bond Forms:
   1. Bid Bond Form: EJCDC C-435.
   2. Performance Bond Form: EJCDC C-610.
   3. Payment Bond Form: EJCDC C-615.

E. Post-Award Certificates and Other Forms:
   1. Schedule of Values Form: EJCDC C-620.
   2. Application for Payment Form: EJCDC C-620.

F. Clarification and Modification Forms:
   1. Field Order Form: EJCDC C-942.
   2. Work Change Directive Form: EJCDC C-940.
   3. Change Order Form: EJCDC C-941.

G. Closeout Forms:
   1. Certificate of Substantial Completion Form: EJCDC C-625.

1.03 REFERENCE STANDARDS

A. EJCDC C-435 - Bid Bond, Damages Form; 2002.

B. EJCDC C-520 - Suggested Form of Agreement Between Owner & Contractor, Stipulated Price; 2002.

C. EJCDC C-610 - Construction Performance Bond; 2002.

D. EJCDC C-615 - Construction Payment Bond; 2002.

E. EJCDC C-620 - Contractor's Application for Payment; 2002.

F. EJCDC C-625 - Certificate of Substantial Completion; 2002.

G. EJCDC C-700 - Standard General Conditions of the Construction Contract; 2002.

H. EJCDC C-940 - Work Change Directive; 2002.

I. EJCDC C-941 - Change Order; 2002.

J. EJCDC C-942 - Field Order; 2002.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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Notice of Award

Dated _____

Project:	Owner:	Owner's Contract No.:
Contract:		Engineer's Project No.:
Bidder:		
Bidder's Address: (send Certified Mail, Return Receipt Requested)		

You are notified that your Bid dated _____ for the above Contract has been considered. You are the Successful Bidder and are awarded a Contract for _____

_____

_____

(Indicate total Work, alternates or sections or Work awarded.)

The Contract Price of your Contract is _____

_____ Dollars ($_____).

(Insert appropriate data if Unit Prices are used. Change language for Cost-Plus contracts.)

_____ copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award.

_____ sets of the Drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within [15] days of the date you receive this Notice of Award.

1. Deliver to the Owner [_____] fully executed counterparts of the Contract Documents.
2. Deliver with the executed Contract Documents the Contract security [Bonds] as specified in the Instructions to Bidders (Article 20), [and] General Conditions (Paragraph 5.01) [and Supplementary Conditions (Paragraph SC-5.01).]
3. Other conditions precedent:

   _____

   _____

   _____

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 Contract Documents.

_____
Owner

By:_____
Authorized Signature

_____
Title

Copy to Engineer

Notice to Proceed

Dated _____

Project:	Owner:	Owner's Contract No.:
Contract:		Engineer's Project No.:
Contractor:		
Contractor's Address: [send Certified Mail, Return Receipt Requested]		

You are notified that the Contract Times under the above contract will commence to run on_____. On or before that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 4 of the Agreement, the date of Substantial Completion is_____, and the date of readiness for final payment is _____ [(or) the number of days to achieve Substantial Completion is _____, and the number of days to achieve readiness for final payment is _____].

Before you may start any Work at the Site, Paragraph 2.01.B of the General Conditions provides that you and Owner must each deliver to the other (with copies to Engineer and other identified additional insureds) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents.

Also, before you may start any Work at the Site, you must [add other requirements]:

_____

_____

_____

_____ _____
Owner

_____ Given by: _____
Authorized Signature

_____ _____
Title

_____ _____
Date

Copy to Engineer

PERFORMANCE BOND

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

CONTRACTOR (Name and Address):

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

OWNER (Name and Address):

CONTRACT
Date:
Amount:
Description (Name and Location):

BOND
Bond Number:
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title:

EJCDC No. C-610 (2002 Edition)
Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, and the American Institute of Architects.

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner for the performance of the Contract, which is incorporated herein by reference.

2. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 3.1.

3. If there is no Owner Default, Surety's obligation under this Bond shall arise after:

3.1. Owner has notified Contractor and Surety, at the addresses described in Paragraph 10 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and

3.2. Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 3.1; and

3.3. Owner has agreed to pay the Balance of the Contract Price to:

1. Surety in accordance with the terms of the Contract;

2. Another contractor selected pursuant to Paragraph 4.3 to perform the Contract.

4. When Owner has satisfied the conditions of Paragraph 3, Surety shall promptly and at Surety's expense take one of the following actions:

4.1. Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or

4.2. Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and Contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or

4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

1. After investigation, determine the amount for which it may be liable to Owner and, as soon as practicable after the amount is determined, tender payment therefor to Owner; or

2. Deny liability in whole or in part and notify Owner citing reasons therefor.

5. If Surety does not proceed as provided in Paragraph 4 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 4.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.

6. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To a limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

6.1. The responsibilities of Contractor for correction of defective Work and completion of the Contract;

6.2. Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions or failure to act of Surety under Paragraph 4; and

6.3. Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of Contractor.

7. Surety shall not be liable to Owner or others for obligations of Contractor that are unrelated to the 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 Owner or its heirs, executors, administrators, or successors.

8. Surety hereby waives notice of any change, including changes of time, to Contract or to related subcontracts, purchase orders, and other obligations.

9. 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 Contractor Default or within two years after Contractor ceased working or within two years after 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 period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12. Definitions.

12.1 Balance of the Contract Price: The total amount payable by Owner to Contractor under the Contract after all proper adjustments have been made, including allowance to Contractor of any amounts received or to be received by Owner in settlement of insurance or other Claims for damages to which Contractor is entitled, reduced by all valid and proper payments made to or on behalf of Contractor under the Contract.

12.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

12.3. Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

12.4. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone
Surety Agency or Broker
Owner's Respresentative (engineer or other party)

PAYMENT BOND

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

CONTRACTOR (Name and Address):

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

OWNER (Name and Address):

CONTRACT
Date:
Amount:
Description (Name and Location):

BOND
Bond Number:
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

(Space is provided below for signatures of additional parties, if required.)

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title:

EJCDC No. C-615 (2002 Edition)
Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, the American Institute of Architects, the American Subcontractors Association, and the Associated Specialty Contractors.

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to Owner, this obligation shall be null and void if Contractor:

2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2. Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.

4. Surety shall have no obligation to Claimants under this Bond until:

4.1. Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the addresses described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2. Claimants who do not have a direct contract with Contractor:

1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and

2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and

3. Not having been paid within the above 30 days, have sent a written notice to Surety and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.

5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.

6. When a Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at Surety's expense take the following actions:

6.1. Send an answer to that Claimant, with a copy to Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

6.2. Pay or arrange for payment of any undisputed amounts.

7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.

8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.

9. Surety shall not be liable to Owner, Claimants, or others for obligations of Contractor that are unrelated to the Contract. Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related Subcontracts, purchase orders and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, 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.

12. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

15.1. Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and 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.

15.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone
Surety Agency or Broker:
Owner's Representative (engineer or other party):

Certificate of Substantial Completion

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

This [tentative] [definitive] Certificate of Substantial Completion applies to:

☐ All Work under the Contract Documents: ☐ The following specified portions:

_____

_____

_____

_____

_____
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 Project or portion thereof designated above is hereby declared and is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below.

A [tentative] [revised tentative] [definitive] list of items to be completed or corrected, is attached hereto. 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 Documents.

The responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as provided in the Contract Documents except as amended as follows:

☐ Amended Responsibilities ☐ Not Amended

Owner's Amended Responsibilities:

_____

_____

_____

Contractor's Amended Responsibilities:

_____

_____

_____

The following documents are attached to and made part of this Certificate:

_____

_____

_____

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 Documents.

_____ _____
Executed by Engineer Date

_____ _____
Accepted by Contractor Date

_____ _____
Accepted by Owner Date

Work Change Directive

No. _____

Date of Issuance: _____ Effective Date: _____

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

You are directed to proceed promptly with the following change(s):

Item No.	Description

Attachments (list documents supporting change):

_____

_____

Purpose for Work Change Directive:

☐ Authorization for Work described herein to proceed on the basis of Cost of the Work due to:

☐ Nonagreement on pricing of proposed change.

☐ Necessity to expedite Work described herein prior to agreeing to changes on Contract Price and Contract Time.

Estimated change in Contract Price and Contract Times:

Contract Price $ _____ (increase/decrease) Contract Time _____ (increase/decrease)
days

If the change involves an increase, the estimated amounts are not to be exceeded without further authorization.

Recommended for Approval by Engineer:	Date
Authorized for Owner by:	Date
Accepted for Contractor by:	Date
Approved by Funding Agency (if applicable):	Date:

Change Order

No. _____

Date of Issuance: _____ Effective Date: _____

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

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

Description:

Attachments: (List documents supporting change):

CHANGE IN CONTRACT PRICE:	**CHANGE IN CONTRACT TIMES:**
Original Contract Price:	Original Contract Times: ☐ Working days ☐ Calendar days
	Substantial completion (days or date): _____
$_____	Ready for final payment (days or date): _____
[Increase] [Decrease] from previously approved Change Orders No._____ to No._____:	[Increase] [Decrease] from previously approved Change Orders No._____ to No._____:
	Substantial completion (days): _____
$_____	Ready for final payment (days): _____
Contract Price prior to this Change Order:	Contract Times prior to this Change Order:
	Substantial completion (days or date): _____
$_____	Ready for final payment (days or date): _____
[Increase] [Decrease] of this Change Order:	[Increase] [Decrease] of this Change Order:
	Substantial completion (days or date): _____
$_____	Ready for final payment (days or date): _____
Contract Price incorporating this Change Order:	Contract Times with all approved Change Orders:
	Substantial completion (days or date): _____
$_____	Ready for final payment (days or date): _____

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

Approved by Funding Agency (if applicable): _____ Date: _____

Change Order

Instructions

A. GENERAL INFORMATION

This document was developed to provide a uniform format for handling contract changes that affect Contract Price or Contract Times. Changes that have been initiated by a Work Change Directive must be incorporated into a subsequent Change Order if they affect Price or Times.

Changes that affect Contract Price or Contract Times should be promptly covered by a Change Order. The practice of accumulating Change Orders to reduce the administrative burden may lead to unnecessary disputes.

If Milestones have been listed in the Agreement, any effect of a Change Order thereon should be addressed.

For supplemental instructions and minor changes not involving a change in the Contract Price or Contract Times, a Field Order should be used.

B. COMPLETING THE CHANGE ORDER FORM

Engineer normally initiates the form, including a description of the changes involved and attachments based upon documents and proposals submitted by Contractor, or requests from Owner, or both.

Once Engineer has completed and signed the form, all copies should be sent to Owner or Contractor for approval, depending on whether the Change Order is a true order to the Contractor or the formalization of a negotiated agreement for a previously performed change. After approval by one contracting party, all copies should be sent to the other party for approval. Engineer should make distribution of executed copies after approval by both parties.

If a change only applies to price or to times, cross out the part of the tabulation that does not apply.

Field Order

No. _____

Date of Issuance: _____ Effective Date: _____

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

Attention:
You are hereby directed to promptly execute this Field Order issued in accordance with General Conditions Paragraph 9.05A., for minor changes in the Work without changes in Contract Price or Contract Times. If you consider that a change in Contract Price or Contract Times is required, please notify the Engineer immediately and before proceeding with this Work.

Reference: _____ (Specification Section(s)) _____ (Drawing(s) / Detail(s))

Description:

Attachments:

	Engineer:

Receipt Acknowledged by (Contractor):	Date:

Copy to Owner

SECTION 00 51 00

CONTRACT INSERTS

THE FOLLOWING DOCUMENTS ARE TO BE INSERTED "VERBATIM" IN ALL CONSTRUCTION CONTRACTS.

1.01 CONTRACT INSERT FORMS:

A. Compliance Statement

B. Notice to Prospective Subcontractors of Requirements for Certification of Non-Segregated Facilities

C. Subpart A - Delaware Prevailing Wage Regulations

D. Subpart B - Equal Opportunity Clause (41 CFR 60-1.4)

E. Subpart C - Certification of Non-segregated Facilities (41 CFR 60-1.8)

F. Subpart E - Civil Rights Act of 1964

G. Subpart F - Section 13 of PL 92-500; Under the Federal Water Pollution Control Act; Rehabilitation Act of 1973; PL 93-112; and age Discrimination Act of 1975.

H. Subpart G - Required Provisions of 40 CFR Part 31 Subpart G

I. Subpart H - Suspension and Debarment and Other Responsibility Matters

END OF SECTION

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COMPLIANCE STATEMENT

This statement relates to a proposed contract with _____

_____

(Name of borrower or grantee)

who expects to finance the contract with assistance from either the Delaware Water Pollution Control Revolving Fund or Delaware 21st Century Fund (whether by a loan, grant, loan insurance, guarantee, or other form of financial assistance). I am the undersigned bidder or prospective contractor, I represent that:

1. ☐ I have, ☐ have not, participated in a previous contract or subcontract subject to Executive Order 11246 (regarding equal employment opportunity) or a preceding similar Executive Order.

2. If I have participated in such a contract or subcontract, ☐ I have, ☐ have not, filed all compliance reports that have been required to file in connection with the contract or subcontract.

If the proposed contract is for $50,000 or more and I have 50 or more employees, I also represent that:

3. ☐ I have, ☐ have not previously had contracts subject to the written affirmative action programs requirements of the Secretary of Labor.

4. If I have participated in such a contract or subcontract, ☐ I have, ☐ have not developed and placed on file at each establishment affirmative action programs as required by the rules and regulations of the Secretary of Labor.

I understand that if I have failed to file any compliance reports that have been required of me, I am not eligible and will not be eligible to have my bid considered or to enter into the proposed contract unless and until I make an arrangement regarding such reports that is satisfactory to either the DNREC, or to the office where the reports are required to be filed.

I also certify that I do not maintain or provide for my employees any segregated facilities at any of my establishments, and that I do not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I certify further that I will not maintain or provide for my employees any segregated facilities at any of my establishments, and that I will not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I agree that a breach of this certification is a violation of the Equal Opportunity clause in my contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and wash rooms, restaurants and other eating areas time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. I further agree that (except where I have obtained identical certifications for proposed subcontractors for specific time periods) I will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause; that I will retain such certifications in my files; and that I will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS FOR CERTIFICATIONS OF NON-SEGREGATED FACILITIES

A certification of Nonsegregated Facilities, as required by the May 9, 1967, order (32F.R. 7439, may 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a subcontract exceeding $ 10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

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

_____

(Signature) (Date)

_____

(Name and Title of Signer – Please Type)

SUBPART A
Delaware Prevailing Wage Regulations

The Project or Program to which the work covered by this contract pertains to is being assisted by the State of Delaware and the following provisions are included in this Contract pursuant to the provisions applicable to such Clean Water State Revolving Loan Fund (CWSRF) Program. Loan recipients or engineering representatives are to verify with the State of Delaware Department of Labor to the appropriate wage determination before they go out for competitive bidding.

Delaware Prevailing Wage Regulations, Worker Classifications, Current Prevailing Wage Rates and forms may be found at:

http://www.delawareworks.com/industrialaffairs/services/LaborLawEnforcementInfo.shtml#pw1

or by contacting:

State of Delaware
Department of Labor
Division of Industrial Affairs
225 Corporate Blvd. Suite 104
Newark, DE 19702
Telephone No. (302) 761-8200

Weekly sworn payroll forms are also to be submitted to the same address.

SUBPART B:
Equal Opportunity Clause (41 CFR 60-1.4)

A. Executive Order 11246 (Applicable to Contracts/subcontracts above $10,000).

1. During the performance of this contract the contractor and all subcontractors agree as follows:

   a. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, 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, 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 of 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.

   b. 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 considerations for employment without regard to race, color, religion, sex, or national origin.

   c. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

   d. 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.

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

   f. In the event of the contractors' noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be cancelled, 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.

g. The contractor will include the portion of the sentence immediately preceding Paragraph (1) and the provisions of Paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: *Provided, however,* that in the event a contractor becomes involved in, or is threatened with litigation with a subcontractor or vendor as a result of such direction by the administering agency the contractor may request the United States to enter into such litigation to protect the interests of the United States.

SUBPART C:
Certification of Non-segregated Facilities (41 CFR 60-1.8)

Bidders and offerers are cautioned as follows: By signing this bid or offer, the bidder or offerers will be deemed to have signed and agreed to the provisions of the "Certification of Nonsegregated Facilities" in this solicitation. The certification provides that the bidder or offerer does not maintain or provide for his employees facilities which are segregated on a basis of race, creed, color, or national origin, whether such facilities are segregated by directive or on a de facto basis. The certification also provides that he will not maintain such segregated facilities.

SUBPART E

Civil Rights Act of 1964

The contractor and any subcontractors shall not, on the grounds of race, color, or national origin, or sex, exclude from participation in, deny the benefits of, or subject to discrimination any person under any program or activity receiving Federal financial assistance.

SUBPART F
Section 13 of PL 92-500; Under the Federal Water Pollution Control Act; Rehabilitation Act of 1973; PL 93-112; and Age Discrimination Act of 1975

The contractor and any subcontractors shall not on the ground of race, color, national origin, or sex, exclude from participation in, deny the benefits of, or subject to discrimination any person or activity funded in whole or in part with Federal funds. Any prohibition against discrimination on the basis of age under the Age Discrimination Act of 1975, or with respect to any otherwise qualified handicapped individual as provided in Section 504 of the Rehabilitation Act of 1973 shall also apply to any such program of activity.

SUBPART G
Required Provisions of 40 CFR Part 31 Subpart C

A. **Contracts awarded in excess of $10,000**

1. Equal Employment Opportunity Clause
    a. The contractor agrees to comply with Executive Order 11246, entitled Equal Employment Opportunity, "as amended by Executive Order 11375, and as supplemented in Department of Labor regulations (41 CFR Part 60).

B. **Contracts awarded in Excess of $100,000**

1. Violating Facilities Clause
    a. The contractor agrees to comply with all applicable standards, orders or requirements issued under section 306 of the Clean Air Act (42 U.S.C 1857 (h), section 508 of the Clean Water Act (33 U.S.C. 1368), Executive Order 11738, and EPA regulations (40 CFR Part 15) which prohibits the award of this contract to facilities included on the EPA List of Violating Facilities. The contractor shall report violations to EPA.

SUBPART H
Suspension and Debarment and Other Responsibility Matters

The Project or Program to which the work covered by this contract pertains to is being assisted by the State of Delaware and the following provision is included in this Contract pursuant to the provisions applicable to such SRF Program. Loan Recipients or engineering representatives are to refer to the "List of parties excluded from Federal Procurement and Nonprocurement Programs" to insure that the contractor or subcontracts are not on this list. A copy of the list may be obtained from the World Wide Web at www.epls.gov or by calling (202) 512-1800 or by writing to this address:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC
20402

ACCESS TO PROJECT SITE

The Contractor shall allow representatives of U.S. EPA and the State of Delaware DNREC access to the project site.

PROJECT SIGN

The contractor shall provide and erect a sign at a prominent location at each construction site. The sign and location shall be approved by the Engineer. The sign shall be prepared in accordance with the attached detailed instructions. It shall be the responsibility of the Contractor to maintain the sign in good condition throughout the life of the project.

The sign wording shown on Figure 1 is an example only and must be adapted to suit each project. The Contractor shall be responsible for obtaining the appropriate wording from the Engineer.

WORKING FOR YOU TO PROVIDE CLEAN WATER
FOR TODAY & TOMORROW

NAME OF PROJECT

PROJECT NO. xxxx-xx
Name of Engineering Firm

FUNDING PROVIDED BY: **DIVISION OF WATER RESOURCES**

Funding Source	**$xx,xxx,xxx**
Funding Source	**$xx,xxx,xxx**
Funding Source	**$xx,xxx,xxx**
Total Project Costs	**$xx,xxx,xxx**

CONSTRUCTION SITE SIGN REQUIREMENTS

Sign Dimensions: 1200 x 2400 x 19 mm (4' x 8' x ¾") Exterior Plywood (A-B Grade).
1st four lines are 4 inches in height; remaining lines are 2 inches in height.
DNREC Logo is to be the standard colors – decal to be provided by the Financial Assistance Branch.
Black letters on white background with 3 inch border around the perimeter in dark blue. Place bottom of sign 36 inches to 48 inches above grade to permit public viewing.
Provide adequate support for sign.

EXAMPLE
Figure 1

SECTION 00 52 00
AGREEMENT FORM

PART 1 GENERAL

1.01 FORM OF AGREEMENT

1.02 THE AGREEMENT TO BE EXECUTED IS ATTACHED FOLLOWING THIS PAGE.

1.03 RELATED REQUIREMENTS

A. Section 00 72 00 - General Conditions.

B. Section 00 73 00 - Supplementary Conditions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF AGREEMENT

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This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification.

~~SUGGESTED FORM OF~~ AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By

ACEC
American Council of Engineering Companies

National Society of Professional Engineers
Professional Engineers in Private Practice

ASCE American Society of Civil Engineers

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
a practice division of the
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AMERICAN COUNCIL OF ENGINEERING COMPANIES

AMERICAN SOCIETY OF CIVIL ENGINEERS

This document has been approved and endorsed by

The Associated General Contractors of America

Knowledge for Creating and Sustaining the Built Environment

Construction Specifications Institute

EJCDC C-520 Suggested Form of Agreement Between Owner and Contractor for Construction Contract (Stipulated Price)
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This Suggested Form of Agreement has been prepared for use with the Standard General Conditions of the Construction Contract (C-700, 2002 Edition). Their provisions are interrelated, and a change in one may necessitate a change in the other. The language contained in the Suggested Instructions to Bidders (C-200, 2002 Edition) is also carefully interrelated with the language of this Agreement. Their usage is discussed in the Commentary on EJCDC Construction Documents. See also Guide to the Preparation of Supplementary (C-800, 2002 Edition).

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1420 King Street, Alexandria, VA 22314-2715

American Council of Engineering Companies
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American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400

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Introduction

This Suggested Form of Agreement between Owner and Contractor for Construction Contract (Stipulated Price) ("Agreement") has been prepared for use with the Guide to the Preparation of Instructions to Bidders ("Instructions")(C-200, 2002 Edition) and with the Standard General Conditions of the Construction Contract ("General Conditions")(C-700, 2002 Edition). Their provisions are interrelated, and a change in one may necessitate a change in the others. For guidance in the preparation of Supplementary Conditions and coordination with Instructions to Bidders, see Guide to the Preparation of Supplementary Conditions ("Supplementary Conditions")(C-800, 2002 Edition). See also Suggested Bid Form ("Bid Form") (C-410, 2002 Edition). The EJCDC has not prepared a suggested form of Advertisement or Invitation to Bid because such documents will vary widely to conform to statutory requirements.

This form and the other Bidding Documents prepared and issued by the EJCDC assume acceptance of the Project Manual concept of the Construction Specifications Institute which provides for an organizational format for location of all bound documentary information for a construction project, namely: Bidding Requirements (which term refers to the Advertisement or Invitation to Bid, the Instructions, and any Bid Form that may be suggested or prescribed, all of which provide information and guidance for all Bidders) and the Contract Documents (defined in Article 1 of the General Conditions), which include the Agreement, bonds and certificates, the General Conditions, the Supplementary Conditions, the Drawings, and the Specifications. The Bidding Requirements are not considered part of the Contract Documents because much of their substance pertains to the relationships prior to the award of the Contract and has little effect or impact thereafter and because many contracts are awarded without going through the bidding process. In some cases, however, the actual Bid may be attached as an exhibit to the Agreement to avoid extensive retyping. (The terms "Bidding Documents" and "Bidding Requirements" are defined in Article 1 of the General Conditions.) The Project Manual concept is explained in the Manual of Practice issued by the Construction Specifications Institute.

Suggested language is presented herein with "Notes to User" to assist in preparing the Agreement. Much of the language should be usable on most projects, but modifications and additional provisions will often be necessary. The suggested language has been coordinated with the other standard forms produced by the EJCDC. When modifying the suggested language or writing additional provisions, the user must check the other documents thoroughly for conflicts and coordination of language usage and make appropriate revisions in all affected documents.

Refer to the discussions in EJCDC's Recommended Competitive Bidding Procedures for Construction Projects ("Bidding Procedures") (No. 1910-9-D, 1987 Edition) (to be reissued in 2002) on the particular paragraphs of which frequent reference is made below.

For brevity, paragraphs of the Instructions to Bidders are referenced with the prefix "I," those of the Bid Form are referenced with the prefix "BF," and those of this Agreement are referenced with the prefix "A."

NOTES:

1. EJCDC publications may be ordered from:

NSPE headquarters
1420 King Street
Alexandria VA 22314-2715
703-684-2800
www.nspe.org

ASCE headquarters
1801 Alexander Bell Drive
Reston, VA 20191-4400
800-548-2723
www.asce.org

ACEC headquarters
1015 15th Street NW
Washington DC 20005
202-347-7474
www.acec.org

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EJCDC
SUGGESTED FORM OF AGREEMENT
BETWEEN OWNER AND CONTRACTOR FOR
CONSTRUCTION CONTRACT(STIPULATED PRICE)

THIS AGREEMENT is by and between _____

(Owner) and _____

(Contractor).

Owner and Contractor, in consideration of the mutual covenants set forth herein, agree as follows:

ARTICLE 1 - WORK

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

Construction of a Wastewater Treatment Plant Upgrade at which includes the following general components:

ARTICLE 2 - THE PROJECT

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

Wastewater Treatment Plant Upgrade

ARTICLE 3 - ENGINEER

3.01 The Project has been designed by

Reid Engineering Company

(Engineer), who is 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.

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ARTICLE 4 - CONTRACT TIMES

4.01 Time of the Essence

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

4.02 Dates for Substantial Completion and Final Payment

A. The Work will be substantially completed on or before _____, and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions on or before _____.

~~[or]~~

~~4.02 Days to Achieve Substantial Completion and Final Payment~~

~~A. The Work will be substantially completed within _____ days after the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions within _____ 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 of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. 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), Contractor shall pay Owner $1,500.00 for each day that expires after the time specified in Paragraph 4.02 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner $500.00 for each day that expires after the time specified in Paragraph 4.02 for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 5 - CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to Paragraphs 5.01.A, 5.01.B, and 5.01.C below:

A. For all Work other than Unit Price Work, a Lump Sum of:

_____ ($)
(words) (numerals)

All specific cash allowances are included in the above price and have been computed in accordance with paragraph 11.02 of the General Conditions.

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ARTICLE 6 - PAYMENT PROCEDURES

6.01 Submittal and Processing of Payments

A. Contractor shall submit Applications for Payment in accordance with Article 14 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 30 day of each month during performance of the Work as provided in Paragraphs 6.02.A.1 and 6.02.A.2 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements:

1. Prior to Substantial Completion, 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 Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions:

a. 95 percent of Work completed (with the balance being retainage~~). If the Work has been 50 percent completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, Owner, on recommendation of Engineer, may determine that as long as the character and progress of the Work remain satisfactory to them, there will be no additional retainage; and~~

b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

2. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions and less 100 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

6.03 Final Payment

A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07.

ARTICLE 7 - INTEREST

7.01 All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the rate of 5.00 percent per annum.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

8.01 In order to induce Owner to enter into this Agreement Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

B. Contractor has visited the Site 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 federal, state, and local 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 contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the ~~Supplementary Conditions~~ Contract Documents as provided in

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Paragraph 4.02 of the General Conditions and (2) reports and drawings of a Hazardous Environmental Condition, if any, at the Site which has been identified in the ~~Supplementary Conditions~~ Contract Documents as provided in Paragraph 4.06 of the General Conditions.

E. Contractor has obtained and carefully studied (or assumes responsibility for doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto.

F. Contractor does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

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

H. Contractor has correlated the information known to Contractor, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.

I. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

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

ARTICLE 9 - CONTRACT DOCUMENTS

9.01 Contents

A. The Contract Documents consist of the following:

1. This Agreement (pages 1 to 9, inclusive).

2. Performance bond (pages _____ to _____, inclusive).

3. Payment bond (pages _____ to _____, inclusive).

~~4. Other bonds (pages _____ to _____, inclusive).~~

~~a. _____ (pages _____ to _____, inclusive).~~

~~b. _____ (pages _____ to _____, inclusive).~~

~~c. _____ (pages _____ to _____, inclusive).~~

5. General Conditions (pages 1 to 42, inclusive).

~~6. Supplementary Conditions (pages _____ to _____, inclusive).~~

7. Specifications as listed in the table of contents of the Project Manual.

8. Drawings consisting of _ sheets with each sheet bearing the following general title: Wastewater Treatment Plant Upgrade ~~[or] the Drawings listed on attached sheet index~~.

9. Addenda (numbers ____ to ___, inclusive).

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10. Exhibits to this Agreement (enumerated as follows):

a. Contractor's Bid (pages _____ to _____, inclusive).

b. Documentation submitted by Contractor prior to Notice of Award (pages _____ to _____, inclusive).

c. _____.

11. The following which may be delivered or issued on or after the Effective Date of the Agreement and are ~~not~~ attached hereto:

a. Notice to Proceed (pages 1 to 1, inclusive).

b. Work Change Directives.

c. Change Order(s).

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 Paragraph 3.04 of 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. 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, moneys that may become due and moneys that are 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 partners, successors, assigns, and legal representatives to the other party hereto, its partners, 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.

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10.05 Other Provisions

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

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

OWNER:	CONTRACTOR:
_____	_____
By: _____	By: _____
Title: _____	Title: _____
[CORPORATE SEAL]	[CORPORATE SEAL]
Attest: _____	Attest: _____
Title: _____	Title: _____
Address for giving notices:	Address for giving notices:
_____	_____
_____	_____
_____	_____
(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 Owner-Contractor Agreement.)	License No.: _____ (Where applicable)
	Agent for service or process: _____
	_____
	(If Contractor is a corporation or a partnership, attach evidence of authority to sign.)

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SECTION 00 72 00
GENERAL CONDITIONS

FORM OF GENERAL CONDITIONS

1.01 THE GENERAL CONDITIONS APPLICABLE TO THIS CONTRACT IS ATTACHED FOLLOWING THIS PAGE.

END OF SECTION

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By

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American Council of Engineering Companies

National Society of Professional Engineers
Professional Engineers in Private Practice

ASCE American Society of Civil Engineers

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Knowledge for Creating and Sustaining the Built Environment

Construction Specifications Institute

EJCDC C-700 Standard General Conditions of the Construction Contract.
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These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor Nos. C-520 or C-525 (2002 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the EJCDC Construction Documents, General and Instructions (No. C-001) (2002 Edition). For guidance in the preparation of ~~Supplementary Conditions~~Contract Documents, see Guide to the Preparation of ~~Supplementary Conditions~~Contract Documents (No. C-800) (2002 Edition).

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*--Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*--The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*--The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*--The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*--The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*--The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*--The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*--A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*--A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

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

12. *Contract Documents*-- Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor's submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*--The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*--The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any, (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*--The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*--See Paragraph 11.01.A for definition.

17. *Drawings*--That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer*--The individual or entity named as such in the Agreement.

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20. *Field Order*--A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

22. *Hazardous Environmental Condition*--The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

23. *Hazardous Waste*--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*--Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*--Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*--The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*--A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

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

30. *PCBs*--Polychlorinated biphenyls.

31. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*--A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

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

34. *Project Manual*--The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Related Entity* -- An officer, director, partner, employee, agent, consultant, or subcontractor.

37. *Resident Project Representative*--The authorized representative of Engineer who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

39. *Schedule of Submittals*--A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

40. *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.

41. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

42. *Site*--Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

43. *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

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administrative requirements and procedural matters applicable thereto.

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

45. *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.

46. *Successful Bidder*--The Bidder submitting a responsive Bid to whom Owner makes an award.

47. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

48. *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 any Subcontractor.

49. *Underground Facilities*--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

50. *Unit Price Work*--Work to be paid for on the basis of unit prices.

51. *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.

52. *Work Change Directive*--A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following 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 requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day*

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents, or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents, or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

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E. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 - PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the ~~Supplementary Conditions~~Contract Documents, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to two printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

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

2.04 *Starting the Work*

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

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule; indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate may be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be

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made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, or Engineer, or any of, their Related Entities, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies

1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor knew or reasonably should have known thereof.

B. Resolving Discrepancies

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1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample; (Subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier or other individual or entity performing or furnishing all of the Work under a direct or indirect contract with Contractor, 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 Engineer's consultants, including electronic media editions; or

2. reuse any of 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 adaption by Engineer.

B. The prohibition of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Copies of data furnished by Owner or Engineer to Contractor or Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party..

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as

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necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Contract Documents identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Contract Documents. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. Possible Price and Times Adjustments

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous

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areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, Owner and Engineer, and any of their Related Entities shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the ~~Supplementary Conditions~~Contract Documents:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all such information and data,

b. locating all Underground Facilities shown or indicated in the Contract Documents,

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction, and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* Reference is made to the ~~Supplementary Conditions~~Contract Documents for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the Engineer in the preparation of the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. ~~Such "technical data" is identified~~

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~~in the Supplementary Conditions~~Contract Documents~~.~~ Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered to Contractor written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06. G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

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5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

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

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the ~~Supplementary Conditions~~Contract Documents.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured identified in the ~~Supplementary Conditions~~Contract Documents, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured identified in the ~~Supplementary Conditions~~Contract Documents, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

   a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

   b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insured (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the ~~Supple-~~

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mentary ConditionsContract Documents, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary ConditionsContract Documents or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary ConditionsContract Documents to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment.

a. Contractor shall furnish Owner and each other additional insured identified in the Supplementary ConditionsContract Documents, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary ConditionsContract Documents, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary ConditionsContract Documents or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary ConditionsContract Documents, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, (other than caused by flood) and such other perils or causes of loss as may be specifically required by the Supplementary ConditionsContract Documents;

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

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary ConditionsContract Documents or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary ConditionsContract Documents, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is

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deemed to have an insurable interest and shall be listed as an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the ~~Supplementary Conditions~~Contract Documents. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the ~~Supplementary Conditions~~Contract Documents to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, and Engineer, and all other individuals or entities identified in the ~~Supplementary Conditions~~Contract Documents to be listed as insured or additional insured (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order .

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached,

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Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

6.02 *Labor; Working Hours*

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

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

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

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6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole,

3) it has a proven record of performance and availability of responsive service; and

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times, and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented in the General Requirements and as Engineer may decide is appropriate under the circumstances.

d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time;

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b) whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

c) whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

a) all variations of the proposed substitute item from that specified , and

b) available engineering, sales, maintenance, repair, and replacement services;

4) and shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change,

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B Whether or not Engineer approves a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the ~~Supplementary Conditions~~Contract Documents require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary ConditionsContract Documents, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued . No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

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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 anything in the Contract Documents create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, and Engineer,, and all other individuals or entities identified in the ~~Supplementary Conditions~~Contract Documents to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of Owner or Engineer its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and 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.

6.08 *Permits*

A. Unless otherwise provided in the ~~Supplementary Conditions~~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 opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

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C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

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

6.11 *Use of Site and Other Areas*

A. Limitation on Use of Site and Other Areas

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

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

6.12 *Record Documents*

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

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall

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cooperate with them in the protection, removal, relocation, and replacement of their property.

C. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or , 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).

D. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

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

6.15 *Hazard Communication Programs*

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

6.16 *Emergencies*

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

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the acceptable Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. Shop Drawings

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:* Contractor shall also submit Samples to Engineer for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals.

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals , any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. Submittal Procedures

1. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:

a. all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to Contractor's responsibilities for means, methods, techniques,

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sequences, and procedures of construction, and safety precautions and programs incident thereto; and

d. shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations, that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample Submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its Related Entities shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

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6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, 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 respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 - OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or via other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times

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that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in ~~Supplementary Conditions~~Contract Documents:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the ~~Supplementary Conditions~~Contract Documents, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's actions or inactions.

C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's action or inactions.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

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

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

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

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

8.06 *Insurance*

A. Owner's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

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8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility in respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the ~~Supplementary Conditions~~Contract Documents.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents and will not be changed without written consent of Owner and Engineer.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the ~~Supplementary Conditions~~Contract Documents, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the ~~Supplementary Conditions~~Contract Documents.

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment , a Claim may be made therefor as provided in Paragraph 10.05.

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9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

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

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

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

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

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to, the Resident Project Representative, if any, and assistants, if any.

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ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.B.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

A. If notice 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) is required by the provisions of any bond to be given to a surety, the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim, shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

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1. deny the Claim in whole or in part,

2. approve the Claim, or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.

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 at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to Engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equip-

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ment, 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, imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expresses, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *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, expediters, 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 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which 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 Paragraphs 11.01.A and 11.01.B.

C. *Contractor's Fee:* When all the Work 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 or when a Claim for an 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 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, 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.

11.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*

1. Contractor agrees that:

a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

b. Contractor's costs for unloading and handling on the Site, labor, installation , overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

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C. Contingency Allowance

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect any other item of Work; and

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier

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Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times , or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer and the Related Entities of each of them shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

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

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all

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inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in said Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, it must, if requested by Engineer, be uncovered for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

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13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications .

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be

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issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. Applications for Payments

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations on the Site 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, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

b. that 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.

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4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Work, or

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

c. there are other items entitling Owner to a set-off against the amount recommended; or

d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor corrects to Owner's satisfaction the reasons for such action.

3. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1.

14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, , Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

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C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will within 14 days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will within said 14 days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to complete or correct items on the tentative list.

14.05 *Partial Utilization*

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

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

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

14.07 *Final Payment*

A. Application for Payment

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.7;

b. consent of the surety, if any, to final payment;

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c. a list of all Claims against Owner that Contractor believes are unsettled; and

d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. *Engineer's Review of Application and Acceptance*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and , will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents

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(including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion),

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B, and 15.02.C.

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

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B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the ~~Supplementary Conditions~~Contract Documents, or

2. agrees with the other party to submit the Claim to another dispute resolution process, or

3. gives written notice to the other party of their intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 - MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

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

17.03 *Cumulative Remedies*

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

17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

17.06 *Headings*

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

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SECTION 00 72 10

SPECIAL OWNER'S REQUIREMENTS

THE FOLLOWING DOCUMENTS ARE TO BE INCLUDED AS PART OF THE CONSTRUCTION CONTRACT

1.01 OWNER'S FORMS AND DOCUMENTS:

A. Certificate of Insurance Requirements for Service Providers

B. Contractor Safety Handbook

C. Contractor Safety Program

END OF SECTION

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CERTIFICATE OF INSURANCE REQUIREMENTS FOR SERVICE PROVIDERS

All companies providing services for **ALL NAMED INSUREDS LISTED BELOW** are to have the following insurance requirements on their Certificate of Insurance regardless whether entering onto the property or not.

General Liability	
General Aggregate	**$2,000,000**
Products/Completed Operations Aggregate	**$2,000,000**
Each Occurrence	**$1,000,000**
Automobile Liability	
Combined Single Limit BI&PD	**$1,000,000**
Workers Compensation	
Employers' Liability	
Each Accident	**$100,000**
Policy Limit	**$500,000**
Each Employee	**$100,000**
Umbrella	
Aggregate	**$1,000,000**
Each Occurrence	**$1,000,000**

*****All trucking and freight vendors are required to have Motor Truck Cargo with a minimum limit of $100,000 *****

Named Insureds should be listed as **ADDITIONAL INSUREDS on the GENERAL LIABILITY, AUTOMOBILE and UMBRELLA POLICIES. A 30-Day notice of cancellation is also required. Insurance should be primary and noncontributory. ALL NAMED INSUREDS** reserve the right to modify these requirements as deemed necessary for the risk presented to them.

The certificate holder address should read as follows:
Named Insureds:
Allen Harim Foods, LLC; Allen Harim Farms, LLC;
126 North Shipley Street
Seaford, DE 19973

ALLEN HARIM FOODS, LLC

ALLEN HARIM FARMS, LLC

CONTRACTOR SAFETY HANDBOOK

EXHIBIT 8-6

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INTRODUCTION

Safety, in all aspects of our work, is a top priority in our company, which includes Allen Harim Foods, LLC and Allen Harim Farms. Throughout this document, we will use the term to describe our company and our personnel; "our" covers all our companies and all their facilities; "On Site Contact Person" is our employee who will be notified upon arrival at the site and who in the event of an emergency will be your contact. Our company is committed to a safe and healthy workplace.

As a contractor or vendor working on our property, you are required to assure that your employees and/or subcontractors are trained in and follow all applicable facility work practices and safety rules and are informed of known potential hazards. Contract employers must document that their employees and/or subcontractors were trained and understood the training. Contract employers must inform their employees of any unique hazard presented by the contract employer's work, or of any hazard found by the contractor's work. The Contractor also has the responsibility for complete compliance with this "Contractor Safety Handbook" and all other safety rules and practices.

Contractors/Vendors must review "our" contractor packet; train all their employees who will be doing work at our facilities and forward required documentation per the attached cover letter. Documentation of all training will be retained on site where the contractor performs work.

Allen's Management Team must obtain and evaluate the contractor safety performance documents required by this program when selecting a contractor and must periodically evaluate the safety performance while performing work. Allen's Management Team must inform contractors of potential hazards related to the contractor's work, as well as applicable facility safety rules and applicable provisions of the emergency response plan.

2.0 VISITOR POLICY

All visitors must check in at the Security/Main Office. All visitors will be asked to read the Visitor Policy, sign the Visitor Log and will be issued a Visitor's Pass. By signing the Visitor Log, the Visitor acknowledges that they have been informed and understand "Our" Visitor Policy. The "On-Site Contact Person" will be called and advised of the visitor. Usually, the "On-Site Contact Person" will come to Security/Main Office to escort the visitor.

If a contractor/vendor is bringing in a crew, the foreman will register with the Security/Main Office. The Contract Foreman will:

- Advise Security/Main Office of the contractor/vendor's "On-Site Contact Person".

- Advise the number of people in his crew. Security/Main Office will issue the appropriate number of visitor passes directly to each crewmember.

- Must provide the Security/Main Office with his cell phone number. This number will be used in the event of an emergency or evacuation, the Contract Foreman will be called to make sure he and his people are accounted for. If the Contract Foreman does not have a cell phone, it will be the responsibility of the Contract Foreman to contact his "On Site Contact Person" or Security/Main Office in the event of an emergency or evacuation.

The Contract Foreman at all times is responsible for the men in his crew. In the event of emergency evacuation, the Contract Foreman will be responsible for the head count of his people.

At the end of the visit, the Contract Foreman will return to Security/Main Office, sign out and return all visitor passes. If contractors do not sign out, the Security/Main Office will advise the Safety Coordinator, who will contact the vendor and advise the company of the failure to comply with "Our" Security Policy. We reserve the right to charge **$3.00** a piece for visitors passes not returned.

PLEASE NOTE: ANY CONTRACTOR /VENDOR WHO LEAVES THE FACILITY FOR MORE THAN 15 MINUTES MUST SIGN OUT WITH SECURITY / MAIN OFFICE AND RE-REGISTER WITH SECURITY/MAIN OFFICE UPON RETURN.

Possession and/or use of guns, alcohol, or nonprescription drugs on company property are prohibited. Persons found with these materials will be escorted from the premises immediately.

In the event of heighten security, Security/Main Office will advise additional security procedures.

3.0 GENERAL SAFETY RULES

The following are the General Safety Rules for each facility:

- Read all warning signs and adhere to their message.
- Horseplay, practical jokes, and other such acts while performing work duties can lead to an injury and will not be tolerated.
- Smoking is only allowed in designated areas, so verify that it is okay before lighting up.
- Good housekeeping practices must be maintained on company property. Do your part to keep your work area clean, neat, and orderly.
- Hardhat, steel toe shoes and eye protection are required in production area at all times. Additional safety equipment may be required in certain areas.
- Never work, walk, or stand under a suspended load.
- Always wear the appropriate safety equipment for your job.
- All tools must be maintained in first class condition. Report defects to your supervisor.
- Personnel may operate forklifts and/or pallet jacks only when they have been qualified. Under no circumstances will anyone other than the driver ride on forklifts or walk along trucks. Employees are not permitted to be raised on forklifts unless a special safety platform has been provided.
- Hot work permits are required before any welding can be performed. Hot Work Permits will be issued by our Hot Work Supervisors only. An attendant must be present with a fire extinguisher.
- All electrical repair work must be done by **qualified** persons who have been trained in avoiding electrical hazards. Treat all electrical wires as live ones and do not touch them. Do not open an electrical box to change fuses, push reset button, etc. Contact your supervisor.

4.0 EVACUATION PROCEDURES

In the event of an emergency, which necessitates the evacuation of the facility, an alarm system will be activated (blowing horns throughout the facility) and the following steps shall be followed.

- All associates and/or visitors/contractors are to follow the emergency escape routes and clearly marked exits to evacuate the area they are working in during the emergency.
- Remain calm, exit the building quickly without running, and report to the designated staging area outside the building (see enclosed Site Map)
- Supervisors and/or "On Site Contact Person" will aid associates and visitors/contractors in evacuating the facility.
- A roll call shall be conducted to account for all individuals.

At the processing facilities (Cordova, and Harbeson) notification of a chemical release is done via a radio call system. At times, evacuation may not be the preferred response to such an emergency; therefore, if an emergency situation arises, visitors and/or contractors will be escorted by their "On Site Contact Person" to an appropriate assembly area. If the "On Site Contact Person" is not readily available, Security/Main Office will call the cell phone number(s) of the contractor foreman and give instructions on what method of response is appropriate, where to assemble and how to get there.

5.0 HOW TO REPORT AND RESPOND TO AN EMERGENCY

If you are the first to discover an emergency such as fire, medical emergency, chemical spill, or other emergency, immediately notify the Security/Main Office Department or "On Site Contact Person".

In the event of a fire, you will hear an alarm signal. All personnel are to evacuate the facility immediately by the nearest exit or to the exit directed "On Site Contact Person". Before you start a job, locate the nearest exit from the work area.

Once outside, move to the assembly area closest to your work area.

All injuries, beyond First Aid, that occur on our property should be reported to the Medical or "On Site Contact Person".

- For any injury resulting in exposure to blood or other bodily fluids, these fluids must be cleaned by personnel who are trained in OSHA's Bloodborne Pathogens regulation (29CFR1910.1030).

6.0 STOPPING UNSAFE WORK PRACTICES

We reserve the right to stop any project being performed by a contractor, which might endanger our employees or the facility.

The Safety Coordinator, Corporate Engineer, or members of our management staff have the authority to demand that contract employees work in a safe manner and comply with federal and state regulations as well as our policies.

7.0 ENVIRONMENTAL REGULATIONS

Before chemicals are used, make sure floor drains; manholes, or other openings are surrounded by absorbent material to prevent any spills from entering the environment.

Report all chemical or oil spills to the Security/Main Office Department or "On Site Contact Person".

All discharges into the sanitary and storm sewer must be approved by the site Environmental Manager.

Do not abandon waste chemicals or other materials on our property. All waste materials must be removed from the job site and disposed of according to all applicable federal, state, and local regulations.

8.0 CHEMICALS

Material Safety Data Sheets (MSDS) must be available for all chemicals used by the contractors/vendors on the job site. MSDS for our chemicals are available in the Medical Department.

- All chemical containers must be labeled as to their contents.
- Flammables and combustibles must be stored in the manufacturer's original containers or in an approved safety can.
- Storage of chemicals on our property is prohibited.

9.0 WORKING AROUND ASBESTOS

To protect your health and the health of those around you, you must not disturb any pipe or boiler insulation, structural fireproofing, transit siding, roofing materials, or vinyl flooring until it has been verified to be asbestos-free. Breathing asbestos dust increases your hazard of cancer or lung disease.

If you observe damaged or crumbling insulation in your immediate work area contacts the site Safety Coordinator or Maintenance Manager before proceeding. Their approval must be obtained before starting any dust producing activities such as sweeping, grinding, sawing, sanding, abrading, scraping, drilling or demolishing any of the above materials.

Do not suspend or hang objects from pipes that may contain asbestos material.

10.0 WORKING AROUND ANHYDROUS AMMONIA

At ambient pressure and temperature, anhydrous ammonia (ammonia) is a colorless gas made up of 1 part nitrogen and three parts hydrogen. Ammonia is classified as both a toxic and flammable substance. Ammonia released to the atmosphere forms a gas with a pungent odor. This odor makes ammonia a self-alarming substance that is readily recognized and is irritating to people that may be exposed to it. Because of this, most people seek relief from its effect before it becomes a "true health hazard". However, there have been situations in which people that were trapped within an ammonia vapor cloud that resulted in death from its toxic effects.

The flammability limits at atmospheric pressures for ammonia are 16 to 25 percent by volume of air. Although the relatively high lower limit of flammability reduces combustion and explosion hazards, there have been instances of catastrophic fires associated with ammonia refrigeration systems. An important consideration is that the lower limit of flammability of 16 percent by volume of ammonia in air can be significantly lowered by the presence of compressor oils entrained within ammonia vapor. Included is an MSDS sheet on anhydrous ammonia.

The criteria to determine if work is on or adjacent to the ammonia refrigeration system is as follows: All but a few areas of the plant have ammonia refrigeration piping. Exceptions to this may - but not

necessarily - be found in office areas, shop areas, dry storage warehouses, and wastewater pre-treatment areas. All other areas of a plant typically contain ammonia piping or equipment.

Work to be done by outside contractors that satisfy any one of the following criteria shall trigger compliance with paragraph (h) of OSHA's Process Safety Management regulation and execution of this guideline:

- the work is on any mechanical equipment, piping, piping insulation, or valving that currently contains ammonia, or will contain ammonia in the future (i.e., new construction)
- The work is on any electrical system (power wiring, control wiring, control logic) that currently or in the future directly powers or controls any component of an ammonia refrigeration system.
- The work is not directly on any ammonia-related mechanical or electrical components, but the location of the work is in the vicinity of ammonia piping and/or equipment, and an incident involving the contractor has the potential to jeopardize the integrity of an existing ammonia refrigeration system. For example, a contractor (mechanical, plumbing, electrical, flooring, etc.) - with major power tools and equipment (forklifts, welders, torches, etc.) - working in a room with ammonia piping and/or controls.

11.0 SAFE WORK PRACTICES

The control of hazards during periods of work is implemented through the issuance of Permits. Contractors and our personnel must have a Safe Work Permit (SWP) issued to them by "Our" authorized personnel before beginning work on or near the ammonia refrigeration system. The permit describes the work to be done and the location of the work.

The SWP identifies the general hazards associated with the job as well as the precautions that have been or should be taken to avoid injury to personnel and/or property. It also identifies the safety equipment required to be used and the safety equipment that must be available in an emergency situation.

The SWP must be signed by a contractor foreman before beginning work. Signing the SWP is an acknowledgement of the permit and the requirements set forth by the permit.

If another permit is being used, such as a hot work permit, lockout/tagout permit, or line breaking permit a SWP is not required.

12.0 LINE BREAKING PERMIT

The purpose of a line breaking procedure is to minimize the risk of injuries to employees engaged in the breaking or disconnecting of a line or hose. Examples of operations that are considered line breaking include, but are not limited to, the following:

- Replacing pump seals
- Removing valves for repair
- Opening or disconnecting pipelines
- Removal or replacement of sight gauges
- Removal or replacement of level devices

All pipelines associated with the ammonia refrigeration system, whether the lines currently contain ammonia or have in the past contained ammonia, should have a line-breaking permit issued prior to opening. Required protective equipment that may be necessary includes hardhat, chemical splash goggles, face shield, and gauntlet type rubber gloves. For emergency purposes, a full-face gas mask with industrial size ammonia canister and a water source should be on hand.

The line-breaking permit should be issued by the Maintenance Management, Designated Refrigeration Technicians, Corporate Engineer, or Safety Coordinator for all line breaking operations conducted on the ammonia refrigeration system.

13.0 HOT WORK PERMIT

A hot work permit should be issued and completed by **Our Hot Work Supervisor** for all hot work operations and retained until the hot work permit is completed.

14.0 LOCKOUT/TAGOUT PROCEDURES

Contractors/vendors must comply with all requirements of OSHA's lockout/tagout standard (29CFR1910.147).

- Lock and tag all sources of energy when applicable.
- The use of tagout procedures only is prohibited unless approved by "Our" Maintenance Manager, Refrigeration Supervisor, Safety Coordinator, or Corporate Engineer.
- " Our On Site Personnel" will assist in Lockout/Tagout procedures as necessary.
- Lockout/Tagout procedures involving work in or around refrigeration equipment shall be approved by the Refrigeration Supervisor. Group or dual Lockout/Tagout should be used including both contractors and "Our" personnel.

15.0 COMPRESSED GASES

The following rules, at a minimum, must be observed when bringing and/or using compressed gases at our facilities:

- Compressed gas bottles must be secured in an upright position at all times.
- Bottles shall have an original cap or be fitted with a regulator.
- All gas bottles must be labeled as to their contents.
- If compressed gases are to be left on site, .all applicable regulations must be followed.
- All cylinders must be secured.
- Oxygen cylinders must be stored at a minimum 20 feet from all other gas cylinders.

- If storage is over 48 hours, our Safety Department must be notified and approve the storage location.

16.0 LADDERS AND SCAFFOLDS

All ladders and scaffolds must be of sufficient height to safely reach the work area. When not in use, ladders shall be stored so that aisle ways are not blocked. Scaffolds must be constructed as specified by OSHA scaffolding regulations.

17.0 FALL PROTECTION

Contractors and vendors working at heights above 6 feet must be protected by a fall protection system, which shall be selected, and in place prior to the start of work. The use of portable ladders does not require fall protection.

18.0 CONFINED SPACE

Contractors/vendors are required to comply with OSHA's permit required Confined Space regulation, 29CFR1910.146, as well as our confined space procedure.

- Our "On Site Contact Person" must be notified prior to any contractor/vendor initiating confined space work.
- Permits must be posted and barricades used where applicable.
- An attendant must be present outside the confined space entrance, as required by the regulation.
- The contractor/vendor must provide equipment and all attendants necessary for a safe entry and rescue if necessary.
- We will provide the contractor/vendor with any known dangers in the confined space and, in turn, the contractors/vendors shall report any dangers created during the entry.

19.0 SUBCONTRACTING

"Our" Company must be notified if the contractor/vendor subcontracts a portion of their work scope to another company. The same rules will apply to any company that is a subcontractor. The prime contractor/vendor will be responsible for notification of their subcontractors on our rules and procedures. Documentation of the subcontractor's compliance with "Our" safety rules and regulation including forwarding of "Certificate of Issuance" and "Contractor Employee Acknowledgement Record" for each subcontractor's employee who will be doing work at any of "Our" facilities.

20.0 MATERIALS OF CONSTRUCTION/CODE CERTIFICATION

Contractors working facilities must comply with all local, state, and federal regulations and all applicable code standards.

EXHIBIT 8-6

21.0 CERTIFICATE OF ISSUANCE

I have received a copy, and have read **Contractor Safety Handbook** carefully and do understand fully its contents.

I am a responsible official of my company and I understand that I am required to abide by all policies and procedures and to go over such procedures with all employees of my company working at any worksite of Allen Harim Foods or Allen Harim Farms.

I also sign knowing that I will have to review this handbook and its contents with any subcontractor I may employ in the course of the contract term, project, or any periodic service work I may perform for any one of the aforementioned companies.

_____ _____

Company Name Date

_____ _____

Name of Officer Title

_____

Officer's Signature

EXHIBIT 8-6

22.0 CONTRACTOR AGREEMENT

In consideration of all related work to be performed, _____ agrees to the following:
Contractor/Vendor

- In performance of the Work, the Contractor agrees to indemnify, protect, safe harmless and defend the Owner, its agents and employees, from and against all loss, cost damage and expense, including costs and attorney's fees and all claims and demands thereof, whether with or without merit, for damages because of bodily injury, sickness, disease or death at any time resulting there from sustained by any person or persons, including employees of the Contractor, or on account of damage to property including the loss of use thereof, resulting from, arising out of or caused in whole or part by an negligent act or omission of the Contractor, any subcontractor, any directly or indirectly employed by any of them or anyone who may be liable.

- It is the intent of this provision to absolve and protect the Owner, its agent and employees, from any and all liability and loss resulting from or arising out of operations of Work performed by the Contractor, its agents, employees, any subcontractor, anyone directly or indirectly employed by any of them may be liable and the Owner, its agents and employees, and caused by the Contractor, its agents, employees or others.

- The Contractor shall provide workers' compensation insurance covering its employees, or adequate employees liability insurance in amounts required to fulfill the terms of this Contract and as provided by law. The Contractor shall also provide public general liability insurance with limits not less than ***two million dollars*** in the aggregate covering personal injury, bodily injury, death or property damage suffered by anyone other than employees of the Contractor during the course of and on the site of the operations covered by this Contract, and shall furnish Owner with a certificate of the insurance policies which certified that the Contract had the required coverage's in force at all relevant times. **Such certificate shall name, as applicable, Allen Harim Foods, LLC and/or Allen Harim Farms, LLC LLC as an additional insured party and shall state that such insurance may not be cancelled without thirty (30) days notice to the Owner.**

- Contractor will agree to complete Certificate of Issuance, Contract Safety Qualification Form, Contractor Employee Acknowledgement Record for all employee performing work at "Our" facilities, EMR, OSHA 300A, Contractor Qualification Form, Contractor Employee Acknowledgement Record for all employees, training information and licenses.

Agreed to this day_____, in the month of _____, in the year_____.

By: _____ By: _____
Owner Representative Contractor Representative

EXHIBIT 8-6

23.0 CONTRACTOR SAFETY QUALIFICATION FORM

General Information		
Company Name:	Telephone:	Fax:
Street Address:	Mailing Address:	
Are you self-insured for Worker's compensation Insurance?	Yes	*No*
Form completed by: (Name)	Date:	
Title:	Telephone:	Fax:
Safety & Health Management		
Highest ranking safety/health professional in the company:		
Title:	Telephone:	Fax:
Safety & Health Programs		

1. Do you have the following written programs and do they satisfy your responsibility under the law?

a) Safety & Health Program	Yes	_____	No	_____	N/A	_____
b) Lockout/Tag out Program	Yes	_____	No	_____	N/A	_____
c) Confined Space Program	Yes	_____	No	_____	N/A	_____
d) Fall Protection Program	Yes	_____	No	_____	N/A	_____
e) Personal Protective Equipment	Yes	_____	No	_____	N/A	_____
f) Hearing Conservation Program	Yes	_____	No	_____	N/A	_____
g) Respiratory Protection Program	Yes	_____	No	_____	N/A	_____
h) Hazard Communication Program	Yes	_____	No	_____	N/A	_____
i) Powered Industrial Truck Program	Yes	_____	No	_____	N/A	_____

2. Do you have personnel trained to perform first aide and CPR? Yes _____ No _____ N/A _____

3. Do you use subcontractors? (If no, skip to question 4) Yes _____ No _____ N/A _____

EXHIBIT 8-6

CONTRACTOR SAFETY EVALUATION FORM (Continued)

a) Do you evaluate the ability of subcontractors to comply with applicable safety & health requirements as part of the selection process? Yes _____ No _____ N/A _____

b) Do your subcontractors have written programs where required and do they satisfy their requirements under the law? Yes _____ No _____

c) Do you include subcontractors in your safety & health orientation? Yes _____ No _____

Craft Training

4. Have employees been trained in the appropriate job skills? Yes _____ No _____

5. Do you have a process to assess the skills of your workers to assure they are qualified? Yes _____ No _____

Incident Information Analysis

6. Do you complete and maintain OSHA Form 301? Yes _____ No _____

7. Do you complete and maintain OSHA Form 300? Yes _____ No _____

Contractor Representative Name: _____

Contractor Representative Signature: _____

Contractor Representative Title: _____

Reviewer Signature: _____

EXHIBIT 8-6

24.0 CONTRACTOR EMPLOYEE ACKNOWLEDGMENT RECORD

NAME OF CONTRACTOR: _____

NAME OF EMPLOYEE: _____

Employees to initial each box when instruction is completed and understood.
(Indicate NA in [ ], if instruction is not applicable).

1.	Allen Harim Foods, LLC. Visitor Policy	[ ]
2.	Allen Harim Foods, LLC. General Safety Rules	[ ]
3.	Allen Harim Foods, LLC. Evacuation Procedures	[ ]
4.	Allen Harim Foods, LLC. Emergency Reporting and Response	[ ]
5.	Allen Harim Foods, LLC. Environmental Regulations	[ ]
6.	Allen Harim Foods, LLC. Chemicals	[ ]
7.	Allen Harim Foods, LLC. Working Around Asbestos	[ ]
8.	Allen Harim Foods, LLC. Working Around Anhydrous Ammonia	[ ]
9.	Allen Harim Foods, LLC. Compressed Gases	[ ]
10.	Allen Harim Foods, LLC. Ladders and Scaffolds	[ ]
11.	Allen Harim Foods, LLC. Fall Protection	[ ]
12.	Allen Harim Foods, LLC. Safe Work Practices	[ ]
13.	Allen Harim Foods, LLC. Hot Work Permit	[ ]
14.	Allen Harim Foods, LLC. Confined Space	[ ]
15.	Allen Harim Foods, LLC. Lockout/Tagout Procedures	[ ]
16.	Allen Harim Foods, LLC. Line Breaking Permit	[ ]
17.	Forklift/Scissor Lift Program	[ ]

On,_____, I reviewed the above checked items relating to the safety rules and safe
Insert date
work procedures for work at Allen Harim Foods, LLC. and Allen Harim Farm, LLC. facilities.

_____ _____

Employee Name: PRINTED

_____ _____

Employee Signature *Date*

I certify that the above-named employee has received and understood the training described above.

_____

Instructor Signature

August 21, 2015

RE: CONTRACTOR SAFETY PROGRAM

Dear Contractor:

Allen Harim Foods, LLC. two processing plants are regulated under 29 CFR 119.120 (Process Safety Management) for its anhydrous ammonia system (The System). Under this regulation, Allen Harim Foods, LLC. must have written documentation that contractors who perform work on or around The System have had required training. It also requires that Allen Harim Foods, LLC. evaluate contractor safety performance. The existing contractor program has been revised.

Allen Harim Foods, LLC., and Allen Harim Farms, LLC (Allen's) have adopted this revised contractor program and it applies to all contractors doing work at any of Allen's facilities. A copy of the Contractor Safety Handbook is enclosed.

Please feel free to contract any of the Safety Coordinators listed below or myself, if you have any questions concerning the enclosed information and your requirements.

Allen's requires that within 30 days, **written** documentation of compliance with the contractor program is received by each facility in which a contractor does work.

The contractor will forward the following information:

- The contractor's Experience Modification Rating (EMR). Please note that this must be submitted annually.
- A Certificate of Insurance. Please note that Allen's specific location must be named as additional insured.
- OSHA 300 A: Annual Summary of Illness and Injury
- Certificate of Issuance, included as Chapter 21 of the Contractor Safety Handbook.
- Contractor Agreement, included as Chapter 22 of the Contractor Safety Handbook.
- Contractor Safety Qualification Form, included as Chapter 23 of the Contractor Safety Handbook.

- Contractor Employee Acknowledgement Record, included as Chapter 24 of the Contractor Safety Handbook for every employee that might do work at one of Allen's facilities. It is the responsibility of the contractor to train their employees. For new employees hired throughout the year, forms can be forwarded directly to the Safety Coordinators at each facility. Please make sure that your company name is at the top of each form.
- A list of all training that you provide for your employees.
- Copies of any relevant licenses.

Contractors are required to send the requested information to the appropriate Safety Coordinator for each facility where the contractor performs work. **Please note that if your company does work at all Allen's facilities, please make copies of all documents and send a copy to each facility, the complete mailing addresses are listed below.**

Allen Harim Foods, LLC
Attn: Wilfredo Novo
PO Box 63
Harbeson, DE 19951
(302) 684-1640 Ext.146

Allen Harim Foods, LLC
Attn: Danny Lister
12041 Cordova Road
Cordova, MD 21625
(410) 820-2100 Ext 149

Required information for Contractor for Allen Harim Farms, LLC should be sent to:

Allen Harim Foods, LLC
Attn: Paula Gray
126 N. Shipley Street
Seaford, DE 19973
(302) 629-9180 ext.162

(302) 629-5081 (fax)

The Safety Coordinators will be doing random audits to ensure that Allen's has proper documentation for each of your employees. Thank you in advance for your prompt attention to this matter.

Sincerely,

Paula Gray

Paula Gray
Safety and Loss Control Manager
Allen Harim Foods, LLC
Paula.gray@allenharimllc.com

Enclosure: Contractor Safety Packet

SECTION 01 10 00
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Wastewater Treatment System Upgrade & Expansion - Phase One.

B. Owner's Name: Allen Harim Foods, LLC.

C. Engineer's Name: Reid Engineering Company, Inc..

D. The Project consists of the construction of the following:
   1. Replacement and Upgrade of the Raw Wastewater Pump Station,
   2. A new DAF FEB Tank and associated aeration and pumping equipment,
   3. Modifications to the existing DAF Pretreatment system,
   4. Modifications to the existing DAF Effluent Pump Station,
   5. A new Anoxic Reactor Effluent Pump Station,
   6. Demolition of the existing Live Shed,
   7. A new Final Clarifier No. 2,
   8. A new UV Disinfection System,
   9. Modification to the existing RAS Pump Station, and
   10. associated piping and electrical work

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 52 00 - Agreement Form.

1.03 WORK BY OWNER

A. Owner will supply the following for installation by Contractor:
   1. Section 46 43 21 - Clarifier Mechanism.

1.04 OWNER OCCUPANCY

A. Bidders are hereby informed that the Work of this project is to be conducted at the Allen Harim Foods, LLC.'s existing wastewater treatment facility in Harbeson, DE. The wastewater treatment facility shall remain in operation throughout the course of the project. The contractor shall coordinate all work with the Owner so as to not interrupt the Owner's ability to treat the process wastewater. The successful Bidder must insure, with cooperation from the Owner, that adequate coordination of tie-ins to live lines and processes occurs in a manner that avoids spills and/or improper treatment of raw or partially treated wastewater.

B. Owner intends to continue to occupy adjacent portions of the existing wastewater treatment facility during the entire construction period.

C. Owner intends to occupy the Project upon Substantial Completion.

D. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

E. Schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

A. Arrange use of site and premises to allow:
   1. Owner occupancy.

B. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

C. Utility Outages and Shutdown:
   1. Limit disruption of utility services to hours the building is unoccupied.
   2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days' notice to Owner and authorities having jurisdiction.
   3. Prevent accidental disruption of utility services to other facilities.

1.06 WORK SEQUENCE

A. Construct Work in stages during the construction period:

B. Coordinate construction schedule and operations with Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Price and Contract Time.

C. Change procedures.

D. Correlation of Contractor submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

A. Section 00 50 00 - Contracting Forms and Supplements: Forms to be used.

B. Document 00 52 00 - Agreement Form: Contract Price, retainages, payment period, monetary values of unit prices.

C. Document 00 72 00 - General Conditions and Document 00 73 00 - Supplementary Conditions: Additional requirements for progress payments, final payment, changes in the Work.

D. Section 01 21 00 - Allowances: Payment procedures relating to allowances.

E. Section 01 22 00 - Unit Prices: Monetary values of unit prices, payment and modification procedures relating to unit prices.

1.03 SCHEDULE OF VALUES

A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Engineer for approval.

B. Forms filled out by hand will not be accepted.

C. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.

D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify site mobilization and bonds and insurance.

E. Include within each line item, a direct proportional amount of Contractor's overhead and profit.

F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Engineer for approval.

C. Forms filled out by hand will not be accepted.

D. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Percentage of Completion.
   9. Balance to Finish.
   10. Retainage.

E. Execute certification by signature of authorized officer.

F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.

H. Submit three copies of each Application for Payment.

I. Include the following with the application:
   1. Transmittal letter as specified for Submittals in Section 01 30 00.
   2. Certification that the Contractor has complied with the required State of Delaware and/or Federal Davis Bacon wage rates, whichever is greater for each labor classification, for the work included in the request for payment. Provide sufficient information for the Owner to verify compliance.
   3. Certification(s) for compliance with the American Steel and Iron provision for all applicable material included in the request for payment.
   4. A lean release for all work included in the pay request.

J. When Engineer requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.05 MODIFICATION PROCEDURES

A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to the Contract Documents.

B. For minor changes not involving an adjustment to the Contract Price or Contract Time, Engineer will issue instructions directly to Contractor.

C. For other required changes, Engineer will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Price or Contract Time.
   2. Promptly execute the change.

D. Contractor may propose a change by submitting a request for change to Engineer, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Price and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01 60 00.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
   1. For change requested by Engineer for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
   2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Engineer.
   3. For pre-determined unit prices and quantities, the amount will based on the fixed unit prices.
   4. For change ordered by Engineer without a quotation from Contractor, the amount will be determined by Engineer based on the Contractor's substantiation of costs as specified for Time and Material work.

F. Substantiation of Costs: Provide full information required for evaluation.
   1. On request, provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.

2. Support each claim for additional costs with additional information:
   a. Origin and date of claim.
   b. Dates and times work was performed, and by whom.
   c. Time records and wage rates paid.
   d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

G. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.

I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

J. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
   1. All closeout procedures specified in Section 01 70 00.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 21 00
ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Contingency allowance.

1.02 RELATED REQUIREMENTS

A. Section 01 20 00 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 CONTINGENCY ALLOWANCE

A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.

B. Funds will be drawn from the Contingency Allowance only by Change Order.

C. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.04 ALLOWANCES SCHEDULE

A. Contingency Allowance: Include the stipulated sum/price of $ 100,000 for use upon Owner's instructions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 22 00
UNIT PRICES

PART 1 GENERAL

1.01 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.02 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.03 MEASUREMENT OF QUANTITIES

A. Take all measurements and compute quantities. Measurements and quantities will be verified by Owner.

B. Assist by providing necessary equipment, workers, and survey personnel as required.

1.04 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Engineer, multiplied by the unit price.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preconstruction meeting.
B. Site mobilization meeting.
C. Progress meetings.
D. Construction progress schedule.
E. Progress photographs.
F. Coordination drawings.
G. Submittals for review, information, and project closeout.
H. Number of copies of submittals.
I. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Document 00 72 00 - General Conditions: Dates for applications for payment.
B. Section 01 78 00 - Closeout Submittals: Project record documents.

1.03 PROJECT COORDINATION

A. Project Coordinator: Owner's representative.
B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for vehicular access, traffic, and parking facilities.
C. During construction, coordinate use of site and facilities through the Project Coordinator.
D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
G. Make the following types of submittals to Engineer through the Project Coordinator:
    1. Requests for interpretation.
    2. Requests for substitution.
    3. Shop drawings, product data, and samples.
    4. Test and inspection reports.
    5. Design data.
    6. Manufacturer's instructions and field reports.
    7. Applications for payment and change order requests.
    8. Progress schedules.
    9. Coordination drawings.
    10. Correction Punch List and Final Correction Punch List for Substantial Completion.
    11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

A. Owner will schedule a meeting after Notice of Award.
B. Attendance Required:
    1. Owner.

2. Engineer. (if required by Owner)
3. Contractor.
4. Project Coordinator.

C. Agenda:
1. Execution of Owner- Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
5. Designation of personnel representing the parties to Contract and Engineer.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Scheduling.
8. Scheduling activities of a Geotechnical Engineer.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, Owner, participants, and those affected by decisions made.

3.02 SITE MOBILIZATION MEETING

A. Contractor shall schedule a meeting prior to Contractor mobilization.

B. Attendance Required:
1. Contractor.
2. Owner.
3. Engineer. (if required by Owner)
4. Contractor's Superintendent.
5. Major Subcontractors.
6. Project Coordinator.

C. Agenda:
1. Use of premises by Owner and Contractor.
2. Owner's requirements and occupancy prior to completion.
3. Construction facilities and controls provided by Owner.
4. Temporary utilities provided by Owner.
5. Survey and building layout.
6. Security and housekeeping procedures.
7. Schedules.
8. Application for payment procedures.
9. Procedures for testing.
10. Procedures for maintaining record documents.
11. Requirements for start-up of equipment.
12. Inspection and acceptance of equipment put into service during construction period.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.

3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

A. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

B. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major contractors have reviewed and accepted proposed schedule.

C. Within 10 days after joint review, submit complete schedule.

D. Submit updated schedule with each Application for Payment.

3.05 PROGRESS PHOTOGRAPHS

A. Provide photographs of site and construction throughout progress of Work

B. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Completion of site clearing.
   2. Excavations in progress.
   3. Foundations in progress and upon completion.
   4. Structural framing in progress and upon completion.
   5. Enclosure of building, upon completion.
   6. Final completion, minimum of ten (10) photos.

C. Views:
   1. Provide non-aerial photographs from four cardinal views at each specified time, until Date of Substantial Completion.
   2. Consult with Engineer for instructions on views required.
   3. Provide factual presentation.
   4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

D. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email.
   2. File Naming: Include project identification, date and time of view, and view identification.
   3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
   4. Photo CD(s): Provide 1 copy including all photos cumulative to date and PDF file(s), with files organized in separate folders by submittal date.

3.06 RECORD DRAWINGS

A. Provide information required by Engineer for preparation of record drawings.

B. Review drawings prior to submission to Engineer.

3.07 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.

B. Submit to Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

C. Samples will be reviewed only for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.08 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.

B. Submit for Engineer's knowledge as contract administrator or for Owner. No action will be taken.

3.09 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warrantles.
   4. Bonds.
   5. Other types as indicated.

D. Submit certifications necessary for the Owner to verify that the material used for the construction of this project complies with the American Steel and Iron provision of the State Revolving Loan Fund.

E. Submit documentation verifying compliance with the applicable State of Delaware and Federal Davis Bacon wage rates for the entire project.

F. Submit for Owner's benefit during and after project completion.

3.10 NUMBER OF COPIES OF SUBMITTALS

A. Documents for Review:
   1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches: Submit the number of copies that Contractor requires, plus two copies that will be retained by Engineer.
   2. Larger Sheets, Not Larger Than 24 x 36 inches: Submit one reproducible transparency.

B. Documents for Information: Submit two copies.

C. Documents for Project Closeout: Make one reproduction of submittal originally reviewed. Submit one extra of submittals for information.

D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Engineer.
   1. After review, produce duplicates.

2. Retained samples will not be returned to Contractor unless specifically so stated.

3.11 SUBMITTAL PROCEDURES

A. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
   2. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.

B. Transmit each submittal with a copy of approved submittal form.

C. Within twenty (20) days after date of the Agreement submit a schedule of submittals, identifying Specification section

D. Transmit each submittal with approved form.

E. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

F. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

G. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

H. Deliver submittals to Engineer at business address.

I. Schedule submittals to expedite the Project, and coordinate submission of related items.

J. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

K. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

L. Provide space for Contractor and Engineer review stamps.

M. When revised for resubmission, identify all changes made since previous submission.

N. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

O. Submittals not requested will not be recognized or processed.

END OF SECTION

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SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. References and standards.
B. Quality assurance submittals.
C. Control of installation.
D. Tolerances.
E. Testing and inspection services.
F. Manufacturers' field services.

1.02 RELATED REQUIREMENTS

A. Document 00 31 00 - Available Project Information: Soil investigation data.
B. Document 00 72 00 - General Conditions: Inspections and approvals required by public authorities.
C. Section 01 30 00 - Administrative Requirements: Submittal procedures.
D. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2014).
B. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2014.
C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2013.
D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2014a.
F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2013.

1.04 SUBMITTALS

A. Testing Agency Qualifications:
   1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
B. Design Data: Submit for Engineer's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
C. Test Reports: After each test/inspection, promptly submit two copies of report to Engineer and to Contractor.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.

f. Location in the Project.
g. Type of test/inspection.
h. Date of test/inspection.
i. Results of test/inspection.
j. Conformance with Contract Documents.
k. When requested by Engineer, provide interpretation of results.

2. Test report submittals are for Engineer's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Engineer, in quantities specified for Product Data.
1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
2. Certificates may be recent or previous test results on material or product, but must be acceptable to Engineer.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports: Submit reports for Engineer's benefit as contract administrator or for Owner.
1. Submit report in duplicate within 30 days of observation to Engineer for information.
2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

G. Erection Drawings: Submit drawings for Engineer's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
2. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

1.05 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Engineer shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.06 TESTING AND INSPECTION AGENCIES

A. Contractor shall employ and pay for services of an independent testing agency to perform specified testing.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

C. Contractor Employed Agency:
   1. Testing agency: Comply with requirements of ASTM E 329, ASTM E 543, ASTM C 1021, ASTM C 1077, and ASTM C 1093.
   2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
   3. Laboratory: Authorized to operate in the State in which the Project is located.
   4. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
   5. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have Work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.03 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests and inspections required by Engineer.
   7. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Engineer and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Engineer.

F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.04 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.05 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not conforming to specified requirements.

B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures for Contractor employees. Provide at time of project mobilization.

B. Maintain daily in clean and sanitary condition.

1.02 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.03 SECURITY

A. Coordinate with Owner's security program.

1.04 VEHICULAR ACCESS AND PARKING

A. Coordinate access and haul routes with governing authorities and Owner.

B. Provide and maintain access to fire hydrants, free of obstructions.

C. Provide means of removing mud from vehicle wheels before entering streets.

D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.05 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to complete and make functional temporary erosion and sedimentation control measures as indicated on the drawings and specified herein.

1.02 SECTION INCLUDES

A. Prevention of erosion due to construction activities.

B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

C. Restoration of areas eroded due to insufficient preventive measures.

D. Performance bond.

E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.03 RELATED REQUIREMENTS

A. Section 31 10 00 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.

B. Section 31 22 00 - Grading: Temporary and permanent grade changes for erosion control.

C. Section 32 11 23 - Aggregate Base Courses: Temporary and permanent roadways.

1.04 REFERENCE STANDARDS

A. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus; 2007.

B. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2014).

C. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2011.

D. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2008.

E. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2012.

F. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2002 (Reapproved 2009).

G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.

H. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; Federal Highway Administration; 1995.

1.05 PERFORMANCE REQUIREMENTS

A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP), whether the project is required by law to comply or not.

B. Follow the Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.

C. Follow the Storm Water Pollution Prevention Plan (SWPPP)and submit plan and periodic inspection reports.
   1. The Contractor shall be response for the preparation of a SWPPP pertaining to the construction activity covered by this project.
   2. The Contractor will be required to maintain the SWPPP for the duration of the project.

D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
   1. Owner will obtain permits and pay for securities required by authority having jurisdiction.
   2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.

E. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.

F. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
   1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
   2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.

H. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
   1. Control movement of sediment and soil from temporary stockpiles of soil.
   2. Prevent development of ruts due to equipment and vehicular traffic.
   3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

I. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
   1. Prevent windblown soil from leaving the project site.
   2. Prevent tracking of mud onto public roads outside site.
   3. Prevent mud and sediment from flowing onto sidewalks and pavements.
   4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

J. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
   2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

K. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

L. Open Water: Prevent standing water that could become stagnant.

M. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Erosion and Sedimentation Control Plan:
   1. Include:
      a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
      b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
      c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
      d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
      e. Other information required by law.
      f. Format required by law is acceptable, provided any additional information specified is also included.
   2. Obtain the approval of the Plan by authorities having jurisdiction.
   3. Obtain the approval of the Plan by Owner.

C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.01 MATERIALS

A. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

B. Bales: Air dry, rectangular straw bales.
   1. Cross Section: 14 by 18 inches, minimum.
   2. Bindings: Wire or string, around long dimension.

C. Bale Stakes: One of the following, minimum 3 feet long:
   1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.
   2. Wood, 2 by 2 inches in cross section.

D. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
   1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
   2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D4491.
   3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355 after 500 hours exposure.
   4. Tensile Strength: 100 lb-f, minimum, in cross-machine direction; 124 lb-f, minimum, in machine direction; when tested in accordance with ASTM D4632.
   5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632.
   6. Tear Strength: 55 lb-f, minimum, when tested in accordance with ASTM D4533.
   7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.

E. Silt Fence Posts: One of the following, minimum 5 feet long:

F. Gravel: See Section 32 11 23 for aggregate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.
   1. Width: As required; 20 feet, minimum.
   2. Length: 50 feet, minimum.
   3. Provide at each construction entrance from public right-of-way.
   4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences.
   1. Provide linear sediment barriers:
      a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
   2. Space sediment barriers with the following maximum slope length upslope from barrier:
      a. Slope of Less Than 2 Percent: 100 feet..
      b. Slope Between 2 and 5 Percent: 75 feet.
      c. Slope Between 5 and 10 Percent: 50 feet.
      d. Slope Between 10 and 20 Percent: 25 feet.
      e. Slope Over 20 Percent: 15 feet.

D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
   1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
   2. Straw bale row blocking entire inlet face area; anchor into pavement.

E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.

F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.

G. Soil Stockpiles: Protect using one of the following measures:
   1. Cover with polyethylene film, secured by placing soil on outer edges.
   2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.

H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.

I. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

A. Traffic-Bearing Aggregate Surface:
   1. Excavate minimum of 6 inches.
   2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
   3. Place and compact at least 6 inches of 1.5 to 3.5 inch diameter stone.

B. Silt Fences:
   1. Store and handle fabric in accordance with ASTM D4873.
   2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.

3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
5. Install with top of fabric at nominal height and embedment as specified.
6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
7. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.

C. Straw Bale Rows:
1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
2. Install bales so that bindings are not in contact with the ground.
3. Embed bales at least 4 inches in the ground.
4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
5. Fill gaps between ends of bales with loose straw wedged tightly.
6. Place soil excavated for trench against bales on the upslope side of the row, compacted.

D. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.
2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
5. Incorporate fertilizer into soil before seeding.
6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.

B. Repair deficiencies immediately.

C. Silt Fences:
1. Promptly replace fabric that deteriorates unless need for fence has passed.
2. Remove silt deposits that exceed one-third of the height of the fence.
3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Straw Bale Rows:
1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
2. Remove silt deposits that exceed one-half of the height of the bales.
3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

E. Clean out temporary sediment control structures weekly and relocate soil on site.

F. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Engineer.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations and procedures.

E. Procedures for Owner-supplied products.

F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 40 00 - Quality Requirements: Product quality monitoring.

B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.

B. DO NOT USE products having any of the following characteristics:
   1. Made using or containing CFC's or HCFC's.

C. Where all other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions, as defined in Section 01 61 16.
   2. If wet-applied, have lower VOC content, as defined in Section 01 61 16.
   3. Have a published GreenScreen Chemical Hazard Analysis.

D. Provide interchangeable components of the same manufacture for components being replaced.

E. Motors: NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

F. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.

G. Cord and Plug: Provide minimum 6 foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.

B. Engineer will consider requests for substitutions only within 10 days prior to Bid Date.

C. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

D. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

E. A request for substitution constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.
   5. Will reimburse Owner and Engineer for review or redesign services associated with re-approval by authorities.

F. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

G. Substitution Submittal Procedure:
   1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
   2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
   3. The Engineer will notify Contractor in writing of decision to accept or reject request.

3.02 OWNER-SUPPLIED PRODUCTS

A. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to the Contractor and the Engineer.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish products.
   4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

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SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.

C. Pre-installation meetings.

D. Cutting and patching.

E. Surveying for laying out the work.

F. Cleaning and protection.

G. Starting of systems and equipment.

H. Demonstration and instruction of Owner personnel.

I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

B. Section 01 30 00 - Administrative Requirements: Submittals procedures, Electronic document submittal service.

C. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.

D. Section 01 50 00 - Temporary Facilities and Controls: Temporary exterior enclosures.

E. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.

F. Individual Product Specification Sections:

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 QUALIFICATIONS

A. For survey work, employ a land surveyor registered in the State in which the Project is located and acceptable to Engineer. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.

1.05 PROJECT CONDITIONS

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.06 COORDINATION

A. See Section 01 10 00 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Engineer four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Engineer of any discrepancies discovered.

C. Contractor shall locate and protect survey control and reference points.

D. Control datum for survey is that indicated on Drawings.

E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

F. Promptly report to Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Engineer.

H. Utilize recognized engineering survey practices.

I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

J. Periodically verify layouts by same means.

K. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as shown.
   2. Report discrepancies to Engineer before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
   2. Remove items indicated on drawings.
   3. Relocate items indicated on drawings.
   4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. See Section 01 10 00 for other limitations on outages and required notifications.
      c. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.

5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.

E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
   1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Engineer.
   2. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Engineer review and request instructions.

F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

G. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

H. Clean existing systems and equipment.

I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

J. Do not begin new construction in alterations areas before demolition is complete.

K. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-conforming work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.

J. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.10 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Engineer and owner seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.

D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

E. The amount of time required for instruction on each item of equipment and system is that specified in individual sections.

3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.
   1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.

B. Use cleaning materials that are nonhazardous.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Clean filters of operating equipment.

G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.

H. Clean site; sweep paved areas, rake clean landscaped surfaces.

I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Engineer and Owner.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Engineer when work is considered ready for Engineer's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Engineer's Substantial Completion inspection.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Engineer's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Engineer.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Accompany Project Coordinator on Contractor's preliminary final inspection.

H. Notify Engineer when work is considered finally complete and ready for Engineer's Substantial Completion final inspection.

I. Complete items of work determined by Engineer listed in executed Certificate of Substantial Completion.

END OF SECTION

SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 00 72 00 - General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.

B. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

C. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.

D. Individual Product Sections: Specific requirements for operation and maintenance data.

E. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Engineer with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Engineer comments. Revise content of all document sets as required prior to final submission.
   4. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

D. Submit certifications necessary for the Owner to verify that the material used for the construction of this project complies with the American Steel and Iron provision of the State Revolving Loan Fund.

E. Submit documentation verifying compliance with the applicable State of Delaware and Federal Davis Bacon wage rates for the entire project.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.

3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish first floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
1. Product data, with catalog number, size, composition, and color and texture designations.
2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
1. Description of unit or system, and component parts.

2. Identify function, normal operating characteristics, and limiting conditions.
3. Include performance curves, with engineering data and tests.
4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

L. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

M. Include test and balancing reports.

N. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

D. Prepare data in the form of an instructional manual.

E. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

F. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

G. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Engineer, Consultants, Contractor and subcontractors, with names of responsible parties.

H. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

I. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

J. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.

K. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

L. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

M. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.
      f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
   3. Part 3: Project documents and certificates, including the following:
      a. Shop drawings and product data.
      b. Certificates.
      c. Photocopies of warranties and bonds.

N. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Engineer and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include photocopies of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION

SECTION 02 20 01
SITE CONDITIONS

PART 1 GENERAL

1.01 SUBSURFACE INFORMATION

A. A report of subsurface exploration at particular locations in the area of the work has been conducted. The report identifies properties of below grade conditions at the locations and at the time that the borings were conducted.

B. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations may be made.

C. Geotechnical report data are not considered all conclusive and it is the Contractor's responsibility to further investigate site conditions as he determines necessary and at his own expense.

1.02 SITE INVESTIGATION AND REPRESENTATION

A. It is the Contractor's responsibility that he completely satisfy himself as to the nature and location of the work; the general and local conditions, particularly those related to the availability of transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, river/stream stages, or similar physical conditions at the site; the current and potential conditions of the ground; the type and quantity of equipment and facilities needed prior to and during the execution of the Work and all other matters and conditions which can in any way affect the work or the associated costs required by this Contract.

B. It is also the responsibility of the Contractor that he completely satisfy himself with regard to the character, quality, and quantity of surface and subsurface materials to be encountered from inspecting the site and from evaluating information provided by the Owner in the geotechnical report, as well as from information presented within these Contract Documents. Any failure by the Contractor to acquaint himself with all the available information will not relieve him from his duty to properly estimate the difficulty or cost of successfully performing the work. Neither the Owner nor the Engineer assume responsibility for any conclusion or interpretation made by the Contractor on the basis of the information made available by the Owner or the Engineer.

1.03 RESPONSIBILITY FOR UTILITY PROPERTIES AND SERVICE

A. Utilities and structures which are known to be adjacent to or in the area of the work are shown on the Drawings. The locations shown are taken from existing records, the best information available from existing plans, and survey information; however, the Contractor shall anticipate deviations and omissions in the actual locations and types and quantities of utilities and structures shown. Those shown are for the convenience of the Contractor only, and no responsibility is assumed by either the Owner or the Engineer for their accuracy or completeness.

B. The Contractor shall at all times provide unobstructed access to fire hydrants, underground conduit, manholes, and water or gas valve boxes.

C. The Contractor shall notify all utility offices that are affected by the work at least fifteen (15) days prior to starting construction operations. The Contractor shall not expose any utility without first obtaining permission from the affected agency. Once permission has been granted, locate and, if necessary, expose and provide temporary support for all existing underground utilities in advance of operations.

D. When existing utility lines or structures are located such that they physically conflict with permanent structures to be constructed under this Contract, the utility line or structure shall be permanently relocated. Such relocations shall be considered as required by this Contract.

E. The Contractor shall give immediate notice to the Engineer, the Owner and the owner of the utility (where applicable) when a physical conflict is determined to exist. Any delays resulting from the required relocations of the utilities are the responsibility of the Contractor.

F. Where existing utility lines or structures are so located as to interfere with the Contractor's prosecution of the work, but do not physically conflict with completed manholes or other permanent structures to be constructed under this Contract, any modification, alteration, or relocation of interfering utility, either permanent or temporary, shall be accomplished at the expense of the Contractor.

G. When notified by the Contractor that an interference or conflict has been determined to exist, the Engineer will determine whether such interference shall be considered as required by construction or as incidental to construction.

1.04 INTERFERING STRUCTURES

A. The Contractor shall take all necessary precautions to prevent damage to existing structures whether on the surface, aboveground, or underground. An attempt has been made to show major structures on the Plans. While the information has been compiled from the best available sources, the completeness and accuracy of the Plans cannot be guaranteed, and it is given as a guide to avoid known possible difficulties.

B. The Contractor shall protect existing structures from damage, whether or not they lie within the right-of-way or the limits of the easements obtained by the Owner. Where existing structures must be removed to properly conduct the work, or are damaged during the work, they shall be restored at the Contractor's own expense to at least their original condition and to the satisfaction of the Engineer.

C. The Contractor may, with the approval of the Engineer and without additional compensation, remove and replace in a condition as good as or better than original, any small interfering structures such as fences and signposts that interfere with the Contractor's operations.

1.05 FIELD RELOCATION

A. During the progress of the work, minor relocations of the work may be necessary. Such relocations shall be made only by direction of the Engineer. If existing structures are encountered that will prevent construction as shown, notify the Engineer before continuing with the work in order that the Engineer may make such field revisions as necessary to avoid conflict with the existing structures. Failure to notify the Engineer when an existing structure is encountered and the work proceeds in spite of this interference, the Contractor shall be responsible for any damage that may occur.

1.06 DIFFERING SITE CONDITIONS

A. If the existing site conditions materially differ than what is represented on the Drawings, the contractor shall notify the Owner and Engineer immediately. If the differences will result in the contractor submitting a change order for additional Work, the contractor shall be responsible for obtaining additional topographic and/or utility surveys of the existing conditions to fully substantiate his claim for additional Work. Surveys shall be signed by a licensed land surveyor in the state where the project is located.

1.07 PAYMENT

A. The work specified in this Section shall be considered incidental and payment will be included as part of the appropriate lump sum specified in the Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals for concrete reinforcement to complete the Work as indicated on the Drawings and as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Section 01300 - Administrative Requirements.

B. Section 01400 - Quality Requirements.

C. Section 03300 - Cast-in-Place Concrete.

1.03 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.

B. ACI 318 - Building Code Requirements For Structural Concrete and Commentary; American Concrete Institute International; 2011.

C. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International; 2004.

D. ASTM A 185/A 185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.

E. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary; 2006.

F. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2015.

G. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute; 2009.

H. CRSI (P1) - Placing Reinforcing Bars; Concrete Reinforcing Steel Institute; Ninth Edition.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Shop drawings for reinforcement for fabrication, bending, and placement of concrete reinforcement. Comply with ACI SP-66 (2004), "ACI Detailing Manual," showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures. Include locations of construction joints and additional reinforcing for construction joints.

C. Review of these drawings is mandatory by the Structural Engineer of Record prior to fabrication.

D. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301.

B. Provide Engineer with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420).
   1. Plain billet-steel bars.
   2. Unfinished.

B. Welded Wire Fabric: ASTM A185
   1. Plain welded steel wire fabric.
   2. Unfinished.

C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
      a. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
      b. For exposed-to-view concrete surfaces where legs of supports are in contact with forms provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.02 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

B. Welding of reinforcement is not permitted.

C. Locate reinforcing splices not indicated on drawings at point of minimum stress.
   1. Submit locations of splices to Engineer.

PART 3 EXECUTION

3.01 PLACEMENT

A. General: Comply with the Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars." for details and methods of reinforcement placement and supports and as specified herein.

B. Avoid cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

C. Accurately place, support and secure reinforcement against displacement. Do not deviate from required position.

D. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that remove or destroy bond with concrete.

E. Accommodate placement of formed openings.

F. Place reinforcement to obtain at least minimum coverages for concrete protection and within tolerances permitted by ACI 318 unless noted otherwise on the drawings. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

G. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces at least two full mesh lengths and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

H. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.02 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control inspection and testing as indicated on the Drawings.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals for cast-in-place concrete required to complete the Work as indicated on the Drawings and as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Section 03 20 00 - Concrete Reinforcement.

1.03 REFERENCES

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2009).

B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.

C. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.

D. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.

E. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001. (Reapproved 2008).

F. ACI 350 - Code Requirements For Environmental Engineering Concrete Structures; American Concrete Institute International; 2006.

G. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.

H. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2015.

I. ASTM C 33 - Standard Specification for Concrete Aggregates; 2011.

J. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2014.

K. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2014.

L. ASTM C 150 - Standard Specification for Portland Cement; 2012.

M. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete; 2013.

N. ASTM C 173/C 173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.

O. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2010.

P. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.

Q. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 2013.

R. ASTM C 685/C 685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.

S. ASTM C 881/C 881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2014.

T. COE CRD-C 572 - Corps of Engineers Specifications for Polyvinylchloride Waterstop; Corps of Engineers; 1974.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, dry-shake finish materials, and others as requested by the Architect.

C. Shop drawings for reinforcement, prepared under the supervision of a registered Professional Engineer for fabrication, bending, and placement of concrete reinforcement. Comply with ACI SP-66 (04), "ACI Detailing Manual," showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures. Include locations of construction joints and additional reinforcing for construction joints.

D. Shop drawings and calculations for formwork, shoring and reshoring, prepared by a registered Professional Engineer, for fabrication erection of forms for specific finished concrete surfaces. Show for construction including jointing, special for joint or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually. Formwork, shoring and reshoring shop drawings, and calculations must bear the seal and signature of an engineer registered in the jurisdiction where the project is being constructed.
   1. Engineer's review is for general architectural applications and features only. Design of formwork for structural stability and efficiency is Contractor's responsibility.

E. Laboratory test reports for concrete materials and mix design test.

F. Minutes of pre-construction conference.

G. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.
   1. Maintain one copy of each document on site.

B. Follow recommendations of ACI 305R when concreting during hot weather.

C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Form Coatings: Provide commercial formulation form-coating compounds with a maximum VOC (Volatile Organic Compounds) of 350 mg/l that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to exposed surface.
   1. Provide ties that, when removed, will leave holes not larger than 1 inch diameter in concrete surface.

2.02 REINFORCEMENT

A. Comply with requirements of Section 03200.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type I - Normal Portland type.
   1. Use one brand of cement throughout project unless otherwise acceptable to Engineer.

B. Fine and Coarse Aggregates: ASTM C 33. Provide aggregates from a single source for exposed concrete.
   1. Do not use fine or coarse aggregates containing spalling-causing deleterious substances.
   2. Local aggregates not complying with ASTM C33 but that special tests or actual service have shown to produce concrete of adequate strength and durability may be used when approved by the Engineer.

C. Fly Ash: ASTM C 618, Class C or F.

D. Calcined Pozzolan: ASTM C 618, Class N.

E. Water: Clean and not detrimental to concrete.

2.04 CHEMICAL ADMIXTURES

A. General: Do not use chemicals that will result in soluble chloride ions in excess of 0.05 percent by weight of cement.

B. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. "Air-Mix" or "AEA 92", Euclid Chemical Co.
      b. "Darex AEA" or "Daravair," W.R. Grace & Co.
      c. "MB-VR" or "Micro-Air," Master Builders, Inc.
      d. "Sika AER," Sika Corp.
      e. Or Approved Equal.

C. 1. Substitutions: See Section 01 60 00 - Product Requirements.

D. Water-Reducing Admixture: ASTM C 494, Type A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. "Eucon WR-75" or "Eucon WR-91" or "Eucon MR", Euclid Chemical Co.
      b. "WRDA with Hycol", W.R. Grace & Co.
      c. "Pozzolith 200N" or "Polyheed 997", Master Builders, Inc.
      d. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

E. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G. The admixture shall not contain more than 0.05 percent Chloride ions.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. "Eucon 37", "Eucon 1037", or "Plastol 5000", Euclid Chemical Co.
      b. "WRDA 19" or "Daracem 100", W.R. Grace & Co.
      c. "Rheobuild 1000" or "Rheobuild 716", Master Builders, Inc.
      d. "Sikament 300," Sika Corp.
      e. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

F. Water Reducing, Non-Corrosive, and Non-Chloride Accelerating Admixture: ASTM C 494, Type C or Type E, and not contain more than 0.05% chloride ions.
   1. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least one year duration) using an acceptable accelerated corrosion test method such as electrical potential measures.
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. "Accelguard 80", "Accelguard 90", or "Eucon NCA", Euclid Chemical Co.
      b. "Daraset," W.R. Grace & Co.
      c. "Pozzutec 20," Master Builders, Inc.
      d. Or Approved Equal.

1) Substitutions: See Section 01 60 00 - Product Requirements.

G. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. "Eucon Retarder 75, "Euclid Chemical Co.
      b. "Daratard-17," W.R. Grace & Co.
      c. "Pozzolith 300-R," Master Builders, Inc.
      d. "Plastiment," Sika Corporation.
      e. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

H. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted

I. Certification: Written conformance to the requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to the mix design review by the Engineer.

2.05 ACCESSORY MATERIALS

A. Non-Shrink Grout: ASTM C 1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents. In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout, when placed at a fluid consistency, shall achieve 95% bearing under a 48" x 48" base plate.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. "Euco NS", Euclid Chemical Co.
      b. "Masterflow 713," Master Builders, Inc.
      c. "Crystex," L&M Construction Chemicals, Inc.
      d. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.
   2. Where high fluidity and/or increased placing time are required, use high flow grout. In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout, when placed at a fluid consistency, shall achieve 95% bearing under and 18" x 36" base plate.
      a. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to the following:
         1) "High-Flow Grout," Euclid Chemical Co.
         2) "Masterflow 928," Master Builders, Inc.
         3) Minimum Compressive Strength at 48 Hours: 2,400 psi.
         4) Minimum Compressive Strength at 28 Days: 7,000 psi.
         5) Or Approved Equal.
            (a) Substitutions: See Section 01 60 00 - Product Requirements.

B. Waterstops: Provide centerbulb-type waterstops at construction joints and other joints as indicated. Size to suit joints.

C. Polyvinyl Chloride Waterstops: Corps of Engineers CRD-C 572.
   1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
      a. The Burke Co.
      b. Greenstreak Plastic Products Co.
      c. W. R. Meadows, Inc.
      d. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

D. Vapor Retarder: Provide vapor retarder cover over prepared base material where indicated below slabs on grade. Use only materials that are resistant to deterioration when tested in accordance with ASTM E 154, as follows:
   1. Polyethylene sheet not less than 8 mils thick.

E. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

F. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
   1. Waterproof paper.
   2. Polyethylene film.
   3. Polyethylene-coated burlap.

G. Curing and Sealing Compound (VOC Compliant, 700 g/l): Liquid type membrane-forming curing compound, clear styrene acrylate type, complying with ASTM C1315, Type I, Class B, 25% solids content minimum. Moisture loss shall be no more than 0.30 Kg/m2 when applied at 300 sq. ft./gal. Manufacturer's certification is required.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. "Super Rez Seal," Euclid Chemical Co.
      b. "Masterseal 30," Master Builders.
      c. "Kure N Seal 30," Sonneborn.
      d. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

H. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. "Eucobar," Euclid Chemical Co.
      b. "E-Con," L&M Construction Chemicals, Inc.
      c. "Confilm," Master Builders, Inc.
      d. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

2.06 BONDING AND JOINTING PRODUCTS

A. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard or felt, complying with ASTM D 1751, 1/4 inch thick and 4 inches deep; tongue and groove profile.

B. Joint Filler: Compressible asphalt mastic with felt facers, complying with ASTM D 994, 1/4 inch thick and 4 inches deep.

C. Bonding Compound: Polyvinyl acetate or acrylic base.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Polyvinyl Acetate (Interior Only):
         1) "Euco Weld," Euclid Chemical Co.
         2) "Everweld," L&M Construction Chemicals, Inc.
      b. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.
   2. Acrylic or Styrene Butadiene:
      a. "SBR Latex," Euclid Chemical Co.
      b. "Daraweld C," W.R. Grace & Co.
      c. "Everbond," L&M Construction Chemicals, Inc.
      d. "Acryl-Set," Master Builders, Inc.
      e. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

D. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material "Type," "Grade," and "Class" to suit project requirements.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. "Euco Epoxy System #452MV or Eucopoxy LPC," Euclid Chemical Co.
      b. "Concresive 1001," Master Builders, Inc.
      c. "Sikadur 32 Hi-Mod," Sika Corp.
      d. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

2.07 CONCRETE MIX DESIGN

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301, Section 4.2.3. If trial batch method used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

B. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.

C. The exact percentage of supplementary cementitious material used shall be based on a successful test placement on-site.
   1. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
   2. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.

D. Design mixes to provide normal weight concrete with as indicated on drawings and schedules:

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

F. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows
   1. Subjected to freezing and thawing; W/C 0.45.
   2. Subjected to deicers/watertight; W/C 0.40.
   3. Reinforced concrete subjected to brackish water, salt spray, or deicers; W/C 0.40.
   4. Trowel finish interior floors subjected to small hard wheel traffic; W/cm 0.50.

G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
   1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
   2. Reinforced foundation systems: Not less than 1 inch and not more than 3 inches.
   3. Concrete containing HRWR admixture (Superplasticizer): 7 to 9 inch range after addition of HRWR to verified 2-inch to 3-inch slump concrete (3" to 4" for concrete receiving a dry shake hardener).
   4. Other concrete: Not more than 4 inches.

2.08 ADMIXTURES

A. Use water-reducing admixture or high-range water-reducing admixture (Superplasticizer) in concrete as required for placement and workability.

B. Use nonchloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).

C. Use high-range water-reducing admixture (HRWR) in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water/cement ratios below 0.50.

D. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within following limits:
   1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:
      a. 5.0 percent for 1-1/2-inch max aggregate.
      b. 5.5 percent for 1-inch max aggregate.
      c. 5.5 percent for 3/4-inch max aggregate.
      d. 6.0 percent for 1/2-inch max aggregate.
   2. Other concrete (not exposed to freezing, thawing, or hydraulic pressure) or to exposed interior steel troweled finished subjected to vehicular traffic: maximum 3 percent air.

E. Use admixture for water reduction and set controls in strict compliance with manufacturer's directions.

2.09 MIXING

A. Job-Site Mixing: Mix materials for concrete in appropriate drum-type batch machine mixer. For mixers of one cu. yd. or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each cu. yd. or fraction thereof.

B. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

C. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as specified.
   1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery to 60 minutes.

2.10 PRE-CONCRETE CONFERENCE

A. This conference shall be held at least 7-14 days prior to the beginning of the installation of foundations. The Contractor shall hold a meeting to review the detailed requirements for the concrete, including the concrete mix designs, placing techniques, finishing techniques, curing techniques and, the equipment required for these procedures.

B. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including, but not limiting to, the following:
   1. Contractor's superintendent.
   2. Laboratory responsible for the concrete design mix.
   3. Laboratory responsible for field quality control.
   4. Concrete subcontractor.
   5. Ready-mix concrete producer(s).
   6. Admixture manufacturer.
   7. Concrete pumping contractor.
   8. Engineer
   9. Owner project manager

C. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes:
   1. Owners representative.
   2. Resident engineer.
   3. Structural engineer.

D. The minutes shall include a statement by the concrete contractor indicating that the proposed mix design and placing techniques can produce the concrete quality required by these specifications.

E. The Structural Engineer will be present at the conference. The Contractor shall notify the Structural Engineer at least 10 days prior to the scheduled date of the conference.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

B. Coordinate the installation of joint materials and vapor retarder with placement of forms and reinforcing steel.

3.02 PREPARATION

A. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

3.03 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, recesses, and the like, for easy removal.

D. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or other rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Provisions for other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

H. Tolerances for formed surfaces shall conform to the following:
   1. Variation from plumb:
      a. In the lines and surfaces of columns, piers, walls, and in arises:
         1) In any 10 ft. of length 1/4 in.
         2) Maximum for the entire length 1/2 in.
      b. For exposed corner columns, control-joint grooves and other conspicuous lines:
         1) In any 20 ft. length 1/4 in.
         2) Maximum for the entire length 1/2 in.
   2. Variation from the level or from the grades specified in the contract documents:
      a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores:
         1) Maximum for the entire length 3/8 in.
      b. In exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines:
         1) Maximum for the entire length 1/2 in.
         2) Refer to section regarding monolithic slab finishes for F(F) and F(L) numbers.
   3. Variation of the linear building lines from established position in plan and related position of columns, walls and partitions:
      a. In any bay 1/4 in.
      b. In any 20 ft. of length 3/8 in.

c. Maximum for the entire length 1/2 in.

4. Variation in the sizes and locations of:
   a. Sleeves, floor openings and wall openings 1/4 in.
5. Variation in cross sectional dimensions columns and beams and in the thickness of slabs and walls:
   a. Minus 1/4 in.
   b. Plus 1/4 in.
6. Footings
   a. Variations in dimensions in plan:
      1) Minus 1/2 in.
      2) Footings 2 in.
   b. Misplacement or eccentricity:
      1) 2 percent of the footing width in the direction of the misplacement, but not more than 2 in.
   c. Thickness:
      1) Decrease in specified thickness 5 %
      2) Increase in specified thickness No limit
7. Variation in steps:
   a. In a flight of steps:
      1) Rise+ 1/8 in.
      2) Tread+ 1/4 in.
   b. In consecutive steps:
      1) Rise+ 1/16 in.
      2) Tread+ 1/8 in.
8. Construct edges of slabs to tolerance that is compatible with the connections of the architectural finishes.

3.04 VAPOR RETARDER INSTALLATION

A. General: Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of pour.

B. Lap joint 6 inches and seal vapor retarder joints with manufacturers' recommended mastic and pressure-sensitive tape.

3.05 INSTALLING REINFORCEMENT

A. A. General: Comply with requirements of Section 03200 Concrete Reinforcement.

3.06 JOINTS

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer. Submit locations of construction joints with shop drawings showing reinforcement.

B. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated.

C. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

D. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Field-fabricate joints in waterstops in accordance with manufacturer's printed instructions.

E. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
   1. Joint filler and sealant materials are specified in Division 7 Sections of these specifications.

F. Contraction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-ground to form panels of patterns as shown.
   1. If joints are formed by saw cuts, saw cut joints immediately after slab finishing and as may be safely done without dislodging aggregate using a Soff-Cut machine or equal to a depth of 1.25 inches deep or as indicated on the Drawings.
   2. If joints are formed by preformed inserts, insert premolded plastic, hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
   3. Joint sealant material is specified in Division 7 Sections of these specifications.

3.07 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.08 PREPARATION OF FORMS SURFACES

A. Clean re-used forms of concrete matrix residue, repair and patch, as required, to return forms to acceptable surface condition.

B. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before reinforcement is placed.

C. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

D. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.09 PLACING CONCRETE

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.

B. General: Comply with ACI 304, "Recommend Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.

C. All water in the concrete mix shall be added at the mix plant. Water shall not be added at the jobsite.

D. Notify Engineer not less than 24 hours prior to commencement of placement operations.

E. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete to avoid segregation at its final location.

F. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while the preceding layer is still plastic to avoid cold joints.
   1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
   2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have not begun to set. At each

insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

G. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
   1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Bring slab surfaces to correct level with straightedge and strike off. Use highway bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
   3. Maintain reinforcing in proper position during concrete placement.

H. Cold-Weather Placing: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

I. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
   1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   2. Only the specified non-corrosive non-chloride accelerator shall be used.

J. Hot-Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
   1. Cool ingredients before nixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
   2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
   3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
   4. Use water-reducing retarding admixture when required by high-temperatures, low humidity, or other adverse placing conditions, when acceptable to the Engineer.
   5. Special hot weather concreting practices for watertight concrete in addition to other items specified:
      a. When low humidity or windy conditions exist, construct a temporary wind barrier around the concrete pour.
      b. Fog spray the entire placement during and for 3 hours after, final finishing with approved compressed air or mist foggers. Fog the air above the slab until a sheen appears on the slab surface, but do not allow standing water to build up on the slab surface.
      c. Immediately after bull floating, apply a monomolecular film-forming compound for evaporation control

3.10 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly

and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

C. Related Unformed Surfaces: At top of walls, horizontal offsets, and similar uniformed surfaces occurring 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 uniformed surfaces unless otherwise indicated.

D. Grout-Cleaned Finish: Provide grout-cleaned finish to scheduled concrete surfaces that have received smooth form finish treatment.
   1. Combine one part portland cement to 1-1/2 parts fine sand by volume, and a 50: 50 mixture of acrylic or styrene butadiene-based bonding admixture and water to consistency of thick paint. Blend standard portland cement and white portland cement, amounts determined by trial patches, so that final color of dry grout will match adjacent surfaces.
   2. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

3.11 MONOLITHIC SLAB FINISHES

A. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
   1. After floating, begin first trowel finish operation using a power driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of Ff 25 - FL 20. Grind smooth surface defects that would telegraph through applied floor covering system.
   2. Note Areas requiring quick-dry concrete.

B. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply initial a single trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming. Texture shall be as approved by Engineer from sample panel.
   1. Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
      a. Immediately after float finishing, slightly roughen concrete surface by brooming with a fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner project manager before application.
      b. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose nonslip aggregate.

3.12 CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and after finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screening and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Cure continuously for not less than 7 days.

C. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified. Cure watertight concrete by moist curing or moisture cover curing for a minimum of 7 days.

D. Provide moisture-retaining cover curing by following methods.
   1. Keep concrete surface continuously wet by covering with water.
   2. Use continuous water-fog spray.

3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.

E. Provide moisture-cover curing as follows:
1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

F. Provide curing and sealing compound to all exposed interior slabs, not receiving a liquid densifier, and troweled slabs receiving mastic applied adhesives or "shake on" hardeners. Exterior slabs, sidewalks, curbs, and architectural concrete, not receiving a penetrating sealer, shall be cured with the specified clear, non-yellowing curing and sealing compound. Maximum coverage shall be 400 ft2/gallon on floated or broomed surfaces for the curing/sealing compound.
1. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

G. The curing process must begin immediately after final finishing.

H. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue with curing with methods specified above, as applicable.

I. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, by application of appropriate curing method.

3.13 REMOVAL OF FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed until concrete has attained at least 75% of design minimum 28 day compressive strength but not less than the following time limits:
1. Beams, joists and one-way slabs - 7 days.
2. Two-way slabs - 14 days.
3. Post-tensioned concrete - approval of stressing records.

C. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

D. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.14 REUSE OF FORMS

A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces except as acceptable to Engineer.

3.15 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein other miscellaneous concrete filling shown or required to complete work.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

C. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

D. Grout base plates and foundations, as indicated, using specified non-shrink grout. Where high fluidity and/or increased placing time is required use the specified high flow grout. This grout shall be used for all base plates larger than 10 square feet.

3.16 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.
   1. Cut out honeycomb, rock pockets, and voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.
   2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at an inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins, and other projections on surface, and stains and other discoloration's that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.
   1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete

C. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.
   1. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, including crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through nonreinforced sections regardless for width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
   2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
   3. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing them with underlayment compound or repair topping. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Owner project manager.
   4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to

sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

D. Repair isolated random cracks and single holes not over 1 inch in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

E. Perform structural repairs with prior approval of Engineer for method and procedure, using specified epoxy adhesive and mortar.

F. Repair methods not specified above may be used, subject to acceptance of Engineer.

G. Bonding Compound Usage: The specified bonding compound shall be used in interior uses not subject to moisture. In moist conditions, a bonding grout, including the specified bonding admixture or the specified epoxy adhesive, must be used. The patching mortar or new concrete must then be placed while the bonding grout or epoxy adhesive is still tacky.

3.17 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control inspection and testing as indicated on Drawings.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

E. Sampling and testing for quality control during placement of concrete may include the following, as directed by Engineer.
   1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
   2. Slump: ASTM C 143; one test at one point of discharge for each set of compressive strength test cylinders; additional tests when concrete consistency seems to have changed.
   3. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each set of compressive strength test cylinders for each type of air-entrained concrete.
   4. Water Content: The water content of freshly mixed concrete will be tested each time cylinders are made and as directed by the Architect in accordance with ASSHTO T318 Measurement of Water Content of Fresh Concrete Using the Microwave Oven.
   5. Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and each time a set of compression test specimens is made.
   6. Compression Test Specimen: ASTM C 31. Mold and store cylinders for laboratory-cured test specimens except when field-cure test specimens are required.
   7. Compressive Strength Tests: The following number of concrete test cylinders shall be cast for each class of concrete for each day's work (pour), 75 cubic yards, or 5000 square feet or greater:
      a. For Footings and Other Structural Concrete:
         1) 2 @ 7 Days, Lab Cured
         2) 3 @ 28 Days, Lab Cured

b. For Columns and Walls:
   1) 2 @ 7 Days, Lab Cured
   2) 3 @ 7 Days, Field Cured
   3) 3 @ 28 Days, Lab Cured
   4) 3 @ 28 Days, Field Cured

8. When additional test specimens shall be performed as directed by the Engineer or Engineer of Record with two (2) specimens required for a test. To establish break data, two (2) cylinders must be broken and averaged.
9. NOTE: All field cured test cylinders shall be cast and cured in the field in the concrete placement and under environmental conditions similar as possible to the conditions to which the pour is subjected.
10. When frequency of testing will provide fewer than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

F. Test results will be reported in writing to Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

3.18 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by the Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.19 SCHEDULE - CONCRETE TYPES AND FINISHES

A. See structural drawings for minimum 28 day compressive strength.

END OF SECTION

SECTION 04 20 00
UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to complete and make ready for use all unit masonry assemblies required to complete the Work as indicated on the Drawings and as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 REFERENCES

A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures; American Concrete Institute International; 2011.

B. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2011.

C. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

D. ASTM A 951/A 951 M - Standard Specification for Steel Wire for Masonry Joint Reinforcement

E. ASTM C 90 - Standard Specification for Load-Bearing Concrete Masonry Units; 2015.

F. ASTM C 91 - Standard Specification for Masonry Cement; 2012.

G. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar

H. ASTM C 150 - Standard Specification for Portland Cement

I. ASTM C 270 - Standard Specification for Mortar for Unit Masonry

J. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout

K. ASTM C 476 - Standard Specification for Grout for Masonry

L. ASTM C 1019 - Specification for Method of Sampling and Testing Grout

1.03 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.

C. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
   1. 1. Masonry units:
      a. Include material test reports substantiating compliance with requirements.
      b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Cementitious materials. Include brand, type, and name of manufacturer
   3. Grout mixes. Include description of type and proportions of ingredients.
   4. Reinforcing bars.
   5. Joint reinforcement.
   6. Anchors, ties, and metal accessories.

D. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Reinforcement: Reinforcing bars, bar positioners, and horizontal joint reinforcement. Detail bending and placement of unit masonry reinforcing bars and joint reinforcement.

3. Accessories: Flashings, weeps, and vents.

E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

F. Cold-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

G. Hot-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

1.04 QUALITY ASSURANCE

A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry materials to project in undamaged condition.

B. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

E. Store masonry reinforcing and accessories in dry locations to prevent corrosion and accumulation of dirt and oil.

1.06 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of wall from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted, prefinished or integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold Weather Requirements: Comply with recommendations of IMIAWC (CW).
   1. Maintain materials and surrounding air temperature to a minimum of 40 degrees F prior to, during, and 48 hours after completion of masonry work

2. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions.
3. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 degrees F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot Weather Requirements: Comply with IMIAWC (HW).
1. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. General: Comply with requirements indicated below applicable to each form of concrete masonry unit required.
1. Defective Units: If referenced masonry unit standards allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard, such units shall not be used in the work unless approved in writing by the Engineer. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

B. Standard Concrete Masonry Units: ASTM C 90
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
2. Weight Classification: Weight classifications as follows, unless otherwise indicated:
   a. Below grade - Normal weight units
   b. Exterior walls - Normal weight units
   c. Interior wall - Normal weight units
3. Size: Manufactured to dimensions 3/8 inch less than nominal dimensions indicated below.
   a. 8 x 8 x 16.
   b. 12 x 8 x 16.
4. Texture/Color: Provide standard smooth texture and manufacturer's standard color unless otherwise noted.
5. Special Shapes: Provide shapes as follows
   a. Provide special shapes for half units, lintels, corners, jambs, sashes, movement joints, headers, bond beams, and other special conditions.

2.02 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold-weather construction.

B. Hydrated Lime: ASTM C 207, Type S.

C. Masonry Cement: ASTM C 91
1. Available Products:
   a. Lafarge North America Inc.; Magnolia Masonry Cement or Lafarge Masonry Cement
   b. Lehigh Cement Company; Lehigh Masonry Cement.
   c. National Cement Company, Inc.; Coosa Masonry Cement.
   d. Or Approved Equal.
      1) Substitutions: See Section 01 60 00 - Product Requirements.

D. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand.

E. Aggregate for Grout: ASTM C 404.

F. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
   1. Available Products:
      a. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
      b. Master Builders, Inc.; Rheomix Rheopel.
      c. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

G. Water: Clean and potable.

H. Accelerating Admixture: Nonchloride type for use in cold weather.
   1. See Section 01 60 00 - Product Requirements.

2.03 REINFORCEMENT

A. Steel Reinforcing Bars: Uncoated deformed steel bars meeting ASTM A 615, Grade 60.

B. Horizontal Joint Reinforcement, General: ASTM A 951.
   1. Exterior and Interior Walls: Hot-dip galvanized, carbon steel.
   2. Wire Size for Side Rods: 9 gauge minimum.
   3. Wire Size for Cross Rods: 9 gauge minimum.
   4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Horizontal Joint Reinforcement for Single-Wythe Masonry: Ladur type with single pair of side rods.
   1. Reinforcement Spacing:
      a. Above finish floor: 16 inches on center
      b. Below finish floor and parapets: 8 inches on center
   2. Available Products:
      a. Dur-O-Wal: www.dur-o-wal.com.
      b. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

2.04 TIES/ANCHORS/BAR POSITIONERS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.
   1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
   2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
   3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Bar Positioners: Provide wire-type positioners for vertical and horizontal reinforcing bars.
   1. Type: Z-shape positioners fabricated with hot-dip galvanized 9 gauge carbon steel wire.
   2. Available Products:
      a. Dayton Superior Corp., Dur-O-Wal Division; D/A 810, D/A 812, or D/A 817.
      b. Heckmann Building Products, Inc.; No. 376 Rebar Positioner.
      c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
      d. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

C. Control Joint Ties: At expansion and control joints, provide galvanized metal/wire joint stabilization anchors.
   1. Dur-O-Wal No. D/A 2200.
   2. Hohmann & Barnard, Inc. "Slip-Set" stabilizer.
   3. Or Approved Equal.
      a. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

B. Post-Installed Anchors: Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as described by testing per ASTM E 488, conducted by a qualified independent testing agency.
   1. Type: Adhesive Anchors
      a. Simpson Strong-Tie; Acrylic-Tie
      b. Hilti; HIT HY 20
      c. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

2.06 MASONRY ACCESSORIES

A. Joint Filler: Closed cell foam, oversized 50 percent; self-expanding joints.

B. Preformed Control Joint Gaskets: Made from PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Grout Stop: A monofilament screen to isolate grout flow and prevent grout fall-through while maintaining a positive bond in the mortar joint.
   1. Provide a monofilament screen fabricated from ¼ inch 30 inch high-strength non-corrosive polypropylene polymers.
      a. Available Products:
         1) Dur-O-Stop by Dur-O-Wal.
         2) MGS-Mortar/Grout Screen by Hohmann & Barnard, Inc.
         3) Grout Shield by Sandell Manufacturing Company, Inc.
      b. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

2.07 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces.
   1. Use product expressly approved for intended use by cleaner manufacturer and by manufacturer of masonry units being cleaned.
      a. Available Manufactures:
         1) Diedrich Technologies, Inc.
         2) EaCo Chem, Inc.
         3) ProSoCo, Inc.
      b. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

B. Proprietary Detergent Cleaners: Manufacturer's standard strength concrete masonry cleaner designed for removing mortar/grout stains from new masonry.
   1. Use only products expressly approved by manufacturer of CMU units.
      a. Available Manufacturers:
         1) Sure-Klean 600.
         2) Vanitrol.
      b. Or Approved Equal.
         1) Substitutions: See Section 01 60 00 - Product Requirements.

2.08 MORTAR AND GROUT MIXES

A. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or need to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type M.
   2. For exterior masonry above grade, use Type S.
   3. For interior masonry, use Type S.

B. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of coarse type that will comply with Table 1.15.1 in ACE 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Grout shall develop an ultimate compressive strength of 2,000 psi at 28 days.
      a. Aggregate: Conform to ASTM C 144; maximum size coarse aggregate shall be ½ inch.
      b. Slump: 8 to 11 inches as measured according to ASTM C 143/C 143 M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.

3.04 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar and mortar smears as work progresses.

E. Interlock intersections and external corners.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

J. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, and remove loose masonry units and mortar.

K. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.05 REINFORCEMENT AND ANCHORAGE - GENERAL

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center, except at 8 inches on center in parapets and below finish floor.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place continuous joint reinforcement in first joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches.

E. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

F. Provide continuity at wall intersections by using prefabricated T-shaped units.
   1. Space reinforcement not more than 8 inches on center.

G. Provide continuity at corners by using prefabricated L-shaped units.
   1. Space reinforcement not more than 8 inches on center.

H. Cells that contain vertical reinforcing are to be grouted full. Grout to have a 28 day minimum compressive strength of 2500 psi. Lap vertical reinforcing a minimum of 48 bar diameters and insure bar is centered in the cell. Fill cells in 48 inch lifts maximum. Power vibrate grout in each cell full height of each lift.

I. Verify that anchorages embedded in concrete or attached to structural steel members are properly placed.

3.06 LINTELS

A. Install reinforced unit masonry lintels over openings where lintels are not scheduled on the drawings.
   1. Openings to 42 inches: Place two, No. 4 reinforcing bars 1 inch from bottom web.
   2. Openings from 42 inches to 78 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
   3. Do not splice reinforcing bars.
   4. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
   5. Allow masonry lintels to attain specified strength before removing temporary supports.

B. Maintain minimum 8 inch bearing on each side of opening.

3.07 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:
   1. Install preformed control-joint gaskets designed to fit standard sash block and of width requiring for installing sealant and backer rod specified in Division 7 Section "Joint Sealants," but not less than 3/8 inch.

3.08 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
   1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.09 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4 inch.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

F. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.10 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointing to eliminate evidence of replacement.

B. Replace defective mortar. Match adjacent work.

C. Pointing: During the tooling of joints, enlarge voids and holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat uniform appearance. Prepare joints for sealant application, where indicated.

D. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

E. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooded paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent non-masonry surfaces from contact with acidic cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
   6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.12 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners which are subject to damage by construction activities.

B. Provide protection without damaging completed work.

C. At day's end, cover unfinished wall to prevent moisture infiltration. Weight cover down to prevent blow-off and maintain protection for fresh masonry work.

3.13 SCHEDULES

A. Interior Partitions: Single wythe concrete block units.

3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove and legally dispose of all masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, off of Owner's property.

3.15 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control inspection and testing as indicated on the Drawings.

END OF SECTION

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SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, and incidentals required and install structural steel including bearing plates, columns, beams, and miscellaneous shapes and plates required to erect the structural framing as indicated on the Drawings and as specified herein. The Contractor shall provide all anchor bolts, nuts, and washers as required to install the structural in a safe and workmanlike manner in accordance with the Drawings and specifications or as required to complete the installation.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.; 2011.

B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2010.

C. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts; 2004.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

F. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2013.

G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.

H. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

I. ASTM A242/A242M - Standard Specification for High-Strength Low-Alloy Structural Steel; 2004 (Reapproved 2009).

J. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2012.

K. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2010.

L. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength; 2012.

M. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

N. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2007.

O. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2007a (Reapproved 2014).

P. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts [Metric]; 2007.

Q. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011.

R. ASTM E94 - Standard Guide for Radiographic Examination; 2004 (Reapproved 2010).

S. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2013.

T. ASTM E165/E165M - Standard Test Method for Liquid Penetrant Examination for General Industry; 2012.

U. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2014.

V. ASTM F436 - Standard Specification for Hardened Steel Washers; 2011.

W. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.

X. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010 w/Errata.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections not detailed.
   3. Indicate cambers and loads.
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.04 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."

B. Fabricator: Company specializing in performing the work of this section with minimum five (5) years of documented experience.

C. Erector: Company specializing in performing the work of this section with minimum five (5) years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Angles, Plates, and Channels: ASTM A36/A36M.

B. Rolled Steel Structural Shapes: ASTM A992/A992M.

C. Steel Shapes, Plates, and Bars: ASTM A 242/A 242M high-strength, corrosion-resistant structural steel.

D. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.

E. Hot-Formed Structural Tubing: ASTM A501, seamless or welded.

F. Pipe: ASTM A53/A53M, Grade B, Finish black.

G. Stainless Steel: ASTM A276 Standard Specifications for stainless steel bars and shapes.

H. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A galvanized to ASTM A 153/A 153M, Class C.

I. High-Strength Structural Bolts, Nuts, and Washers: ASTM A325 or A325M, Type 1, medium carbon, galvanized, with matching compatible ASTM A563 or A563M nuts and ASTM F436 washers.

J. Headed Anchor Rods: ASTM F 1554, Grade 36, Heavy Hex.

K. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

L. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

C. Fabricate connections for bolt, nut, and washer connectors.

2.03 FINISH

A. Galvanize all structural steel members to comply with ASTM A 123/A 123M. Provide minimum 1.7 oz/sq ft galvanized coating.

2.04 SOURCE QUALITY CONTROL

A. An independent testing agency will perform shop quality control inspection and testing as indicated on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".

B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components indicated on shop drawings.

D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with AISC "Specification for Structural Joints Using ASTM A325".

E. Do not field cut or alter structural members without approval of Engineer.

F. After erection, prime welds, abrasions, and surfaces not galvanized, except surfaces to be in contact with concrete.

G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control inspection and testing as indicated on Drawings.

END OF SECTION

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SECTION 05 21 00
STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.

B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.

C. Supplementary framing for floor and roof openings greater than 18 inches.

D. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Superstructure framing.

B. Section 05 31 00 - Steel Decking: Support framing for openings less than 18 inches in decking.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2007.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2012.

F. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.

G. SJI (SPEC) - Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders; Steel Joist Institute; 2011.

H. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; Steel Joist Institute; 2008.

I. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

J. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, and connections.

C. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

A. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Delaware.

B. Joists shall be designed for the uplift load indicated on the Drawings. Additional bridging / bracing required shall be indicated on the shop drawings.

C. Perform Work, including that for headers and other supplementary framing, in accordance with SJI Standard Specifications Load Tables and SJI Technical Digest No.9.

D. Manufacturer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products to SJI requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Joists:
   1. Any member of the Steel Joist Institute.

2.02 MATERIALS

A. Open Web Joists: SJI Type K Joists:
   1. Provide bottom and top chord extensions as indicated.
   2. Finish: Galvanized.

B. Anchor Bolts, Nuts and Washers: ASTM A 307, hot-dip galvanized per ASTM A 153/A 153M, Class C.

C. Shear Stud Connectors: Made from ASTM A 108 Grade 1015 bars.

D. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A 36/A 36M.

E. Welding Materials: AWS D1.1; type required for materials being welded.

F. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

A. Fabrication shall be done only from shop drawings that have been approved by the Engineer.

2.04 FINISH

A. Galvanize joists as specified.

B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

C. Galvanizing: Provide minimum 1.7 oz/sq ft galvanized coating to ASTM A123/A123M requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 ERECTION

A. Erect joists with correct bearing on supports.

B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.

C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.

D. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.

E. After joist alignment and installation of framing, field weld joist seats to bearing plates.

F. Position and field weld joist chord extensions and wall attachments as detailed.

G. Install supplementary framing for floor and roof openings greater than 18 inches.

H. Do not permit erection of decking until joists are braced bridged, and secured or until completion of erection and installation of permanent bridging and bracing.

I. Do not field cut or alter structural members without approval of joist manufacturer.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control inspection and testing as indicated on the drawings.

END OF SECTION

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SECTION 05 31 00
STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof deck.

B. Supplementary framing for openings up to and including 18 inches.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Support framing for openings larger than 18 inches.

B. Section 05 21 00 - Steel Joist Framing: Support framing for openings larger than 18 inches.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2013.

D. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.

E. AWS D1.3 - Structural Welding Code - Sheet Steel; American Welding Society; 2008.

F. SDI (DM) - Publication No.31, Design Manual for Composite Decks, Form Decks, Roof Decks; Steel Deck Institute; 2007.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.

B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

D. Certificates: Certify that products furnished meet or exceed specified requirements.

E. Submit manufacturer's installation instructions.

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this Section approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Deck:
   1. Any good standing member of Steel Deck Institute.

2.02 STEEL DECK

A. Roof Deck: Non-composite type, fluted steel sheet:
   1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On concrete and masonry surfaces provide minimum 4 inch bearing.

C. On steel supports provide minimum 1-1/2 inch bearing.

D. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods specified.

E. Weld deck in accordance with AWS D1.3.

F. At deck openings from 6 inches to 18 inches in size, provide 2 x 2 x 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.

G. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

3.03 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control inspection and testing as indicated on drawings.

END OF SECTION

SECTION 08 16 13
FIBERGLASS DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic (FRP) doors.

B. Frames for fiberglass reinforced plastic doors.

C. Hinges and other door hardware.

D. Glazing.

E. Accessories.

1.02 REFERENCE STANDARDS

A. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Obtain hardware templates from hardware manufacturer prior to starting fabrication.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard details, installation instructions, and hardware and anchor recommendations.

C. Shop Drawings: Show layout and profiles; include assembly methods.
   1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.
   2. Indicate wall conditions, door and frame elevations, sections, materials, gages, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on Drawings to identify details and openings.

D. Maintenance Data: Include instructions for repair of minor scratches and damage.

E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer; include detailed terms of warranty.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of experience.

B. Installer Qualifications: Company specializing in installing products of the type specified in this section with not less than three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Mark doors with location of installation, door type, color, and weight.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.
   1. Store at temperature and humidity conditions recommended by manufacturer.
   2. Do not use non-vented plastic or canvas shelters.
   3. Immediately remove wet wrappers.

D. Store in position recommended by manufacturer, elevated minimum 4 inches above grade, with minimum 1/4 inches space between doors.

1.07 FIELD CONDITIONS

A. Do not install doors until structure is enclosed.

B. Maintain temperature and humidity at manufacturer's recommended levels during and after installation of doors.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide ten (10) year manufacturer warranty covering materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Molded Fiberglass Doors:
   1. ChemPruf Door Company, Ltd: www.chem-pruf.com.
   2. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOOR AND FRAME ASSEMBLIES

A. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.
   1. Door and frame pre-assembled, complete with hinges; shipped with braces, spreaders, and packaging as required to prevent damage.
   2. Mechanical Durability: Tested to ANSI/SDI A250.4 Level A (1,000,000 cycles), minimum; tested with hardware and fasteners intended for use on project.
   3. Screw-Holding Capacity: Tested to 900 psi, minimum.
   4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A; when tested in accordance with ASTM E84.
   5. Flammability: Self-extinguishing when tested in accordance with ASTM D635.
   6. Chemical Resistance: Resist degradation due to exposure to tap water and distilled water.
      a. Sewage and moisture-laden air in sewage treatment areas.
      b. Chlorine-treated moisture in air.
   7. Sizes: As indicated on drawings.
   8. Clearance Between Door and Frame: 1/8 inch, maximum.
   9. Clearance Between Meeting Stiles of Pairs of Doors: 1/8 inch, maximum.
   10. Clearance Between Bottom of Door and Finished Floor: 3/4 inch, maximum; not less than 1/4 inch clearance to threshold.
   11. Provide frame anchors that allow for variation in rough opening size; do not field cut doors or frames to fit.

2.03 COMPONENTS

A. Doors: Through-color gel coating on fiberglass reinforced polyester resin construction with reinforced core.
   1. Thickness: 1-3/4 inches, overall.
   2. Door Construction: Molded in one piece including gel coating on all sides; manufacturer's standard subframe, core and faces fused during cure in mold; hardware reinforcements
   3. Subframe and Reinforcements: Manufacturer's standard materials.
   4. Waterproof Integrity: All edges, cut-outs, and hardware preparations factory fabricated of fiberglass reinforced plastic; provide cut-outs with joints sealed independently of glazing or louver inserts or trim.

5. Hardware Preparations: Factory reinforce, machine, and prepare for all hardware including field installed items; provide solid blocking for each hardware item; make field cutting, drilling or tapping unnecessary; obtain manufacturer's templates for hardware preparations.
6. Bottom Rail: Provide height necessary to allow up to 1-1/4 inches to be field cut off bottom of door without impairing door strength or durability.

B. Frames: Profiles and dimensions as indicated on drawings; same type and construction used in mechanical durability test for doors.
1. Construction for Non-Fire-Rated Doors: Use one of the following:
a. Molded fiberglass with gel-coating matching doors.
2. Corner Joints: Mitered with concealed corner blocks or angles of same material as frame; fiberglass and aluminum joined with screws; steel and stainless steel spot welded; sealed watertight with silicone sealant.
3. At hardware cut-outs provide continuous backing or mortar guards of same material as frame, sealed watertight.
4. Frame Anchors: Stainless steel, Type 304; provide 3 anchors in each jamb for heights up to 84 inches with one additional anchor for each additional 24 inches in height.

C. Transom and Other Panels: Same construction as doors.

D. Hinge and Hardware Fasteners: Stainless steel, Type 304; wood screws.

2.04 ACCESSORIES

A. Astragals for Inactive Leaves: Pultruded fiberglass angle or tee; same color as gel coat.

B. Glazing and Louver Stops: Pultruded fiberglass unless otherwise indicated or required by fire rating; provided by door manufacturer to fit factory made openings, color and texture to match door; fasteners not penetrating waterproof integrity.
1. Exterior Doors: Provide non-removable stops on outside and continuous compression gasket weatherseal.
2. Glazed Openings: Provide removable stops on one side.
3. Opening Sizes: As indicated on drawings.

C. Glazing: Laminated safety glass, 1/4 inch thick, with minimum 0.030 inch thick interlayer, clear.

D. Louvers for Non-Fire-Rated Doors: Same materials, construction, finish, and color as door; fixed vanes, 45 degree sloped vanes.

E. Hardware: As specified in Section 08 71 00.

F. Thresholds: Molded fiberglass, with skid resistant surface, full width of door opening, same color as frame.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.

B. Do not begin installation until substrates have been properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Remove existing doors and frames, and dispose of all removed materials in accordance with local authorities having jurisdiction.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Clean and prepare substrate in accordance with manufacturer's directions.

D. Protect adjacent work and finish surfaces from damage during installation.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions; do not penetrate frames with anchors.

B. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.

C. Separate aluminum and other metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.

D. Repair or replace damaged installed products.

3.04 ADJUSTING

A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.

B. Adjust hardware for smooth and quiet operation.

C. Adjust doors to fit snugly and close without sticking or binding.

3.05 CLEANING

A. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for fiberglass doors.

B. Electrically operated and controlled hardware.

C. Thresholds.

D. Weatherstripping, seals and door gaskets.

1.02 RELATED REQUIREMENTS

A. Section 08 16 13 - Fiberglass Doors and Frames

1.03 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

C. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.

D. BHMA A156.1 - American National Standard for Butts and Hinges; Builders Hardware Manufacturers Association, Inc.; 2013 (ANSI/BHMA A156.1).

E. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; Builders Hardware Manufacturers Association; 2011 (ANSI/BHMA A156.2).

F. BHMA A156.3 - American National Standard for Exit Devices; Builders Hardware Manufacturers Association; 2014 (ANSI/BHMA A156.3).

G. BHMA A156.4 - American National Standard for Door Controls - Closers; Builders Hardware Manufacturers Association, Inc.; 2013 (ANSI/BHMA A156.4).

H. BHMA A156.6 - American National Standard for Architectural Door Trim; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.6).

I. BHMA A156.7 - American National Standard for Template Hinge Dimensions; Builders Hardware Manufacturers Association; 2014 (ANSI/BHMA A156.7).

J. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; Builders Hardware Manufacturers Association, Inc.; 2010 (ANSI/BHMA A156.8).

K. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; Builders Hardware Manufacturers Association; 2012 (ANSI/BHMA A156.13).

L. BHMA A156.18 - American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc.; 2012 (ANSI/BHMA A156.18).

M. BHMA A156.21 - American National Standard for Thresholds; Builders Hardware Manufacturers Association; 2014 (ANSI/BHMA A156.21).

N. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012 (ANSI/BHMA A156.22).

O. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; Door and Hardware Institute; 2004.

P. ICC A117.1 - Accessible and Usable Buildings and Facilities; International Code Council; 2009 (ANSI).

Q. NFPA 101 - Life Safety Code; National Fire Protection Association; 2012.

R. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware will be installed upon.

B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

C. Convey Owner's keying requirements to manufacturers.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.

C. Shop Drawings:
   1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts,.

D. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.

E. Keying Schedule: Submit for approval of Owner.

F. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

G. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

H. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.

I. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year warranty for door closers.

PART 2 PRODUCTS

2.01 DOOR HARDWARE - GENERAL

A. Provide hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.

B. Provide items of a single type of the same model by the same manufacturer.

C. Provide products that comply with the following:
   1. Applicable provisions of federal, state, and local codes.
   2. Accessibility: ADA Standards and ICC A117.1.
   3. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
   4. Applicable provisions of NFPA 101, Life Safety Code.
   5. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

D. Electrically Operated and/or Controlled Hardware: Provide all power supplies, power transfer hinges, relays, and interfaces required for proper operation; provide wiring between hardware and control components and to building power connection.

E. Finishes: Provide door hardware of the same finish unless otherwise indicated.
   1. Primary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
   2. Secondary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
      a. Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.
   3. Finish Definitions: BHMA A156.18.
   4. Exceptions:
      a. Where base metal is specified to be different, provide finish that is an appearance equivalent according to BHMA A156.18.

2.02 LOCKS AND LATCHES

A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
   1. If no hardware set is indicated for a swinging door provide an office lockset.
   2. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
   3. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.

B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
   1. Provide cams and/or tailpieces as required for locking devices required.

C. Keying: Grand master keyed.

D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.03 HINGES

A. Hinges: Provide hinges on every swinging door.
   1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
   2. Provide ball-bearing hinges at all doors having closers.
   3. Provide hinges in the quantities indicated.
   4. Provide non-removable pins on exterior outswinging doors.

B. Butt Hinges: Comply with BHMA A156.1 and A156.7; standard weight, unless otherwise indicated.
   1. Provide hinge width required to clear surrounding trim.

C. Quantity of Hinges Per Door:
   1. Doors From 60 inches High up to 90 inches High: Three hinges.
   2. Doors 90 inches High up to 120 inches High: Four hinges.

2.04 PUSH/PULLS

A. Push/Pulls: Comply with BHMA A156.6.
   1. Provide push and pull on doors not specified to have lockset, latchset, exit device, or auxiliary lock.
   2. On solid doors, provide matching push plate and pull plate on opposite faces.

2.05 LOCKS AND LATCHES

A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
   1. Hardware Sets indicate locking functions required for each door.
   2. If no hardware set is indicated for a swinging door provide an office lockset.
   3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.

4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
5. In door sections, where a lock cylinder referenced to Section 08 71 00 is specified, furnish and install a mortise lock cylinder keyed to the building keying system.

B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
1. Provide cams and/or tailpieces as required for locking devices required.

C. Keying: Grand master keyed.
1. Key to existing keying system.

D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.06 CYLINDRICAL LOCKSETS

A. Locking Functions: As defined in BHMA A156.2, and as follows.
1. Passage: No locking, always free entry and exit.
2. Privacy: F76, emergency tool unlocks.
3. Office: F81, key not required to lock, remains locked upon exit.

2.07 MORTISE LOCKSETS

A. Locking Functions: As defined in BHMA A156.13, and as follows:
1. Passage: F01.
2. Privacy: F19, or F02 with retraction of deadbolt by use of inside lever/knob.
3. Office: F04, key not required to lock, remains locked upon exit.
4. Entry, Deadbolt: F20, may be locked without key, free egress.

2.08 FLUSHBOLTS AND COORDINATORS

A. Flushbolts: Lever extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
1. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
2. Floor Bolts: Provide dustproof strike except at metal thresholds.

B. Manual Flushbolts: Provide lever extensions for top bolt at over-size doors.

C. Self-Latching Flushbolts: Automatically latch upon closing of door; manually retracted.

D. Coordinators: Provide on doors having closers and self-latching or automatic flushbolts to ensure that leaves close in proper order.

2.09 EXIT DEVICES

A. Provide Exit devices for doors as indicated on the Hardware Schedule and for all Electrical room doors.

B. Locking Functions: Functions as defined in BHMA A156.3, and as follows:
1. Entry/Exit, Always-Unlocked: Outside lever unlocked, no outside key access, no latch holdback.
2. Entry/Exit, Free Swing: Key outside retracts latch, latch holdback (dogging) for free swing during occupied hours, not fire-rated; outside trim must be specified as lever or pull.

2.10 CLOSERS

A. Closers: Complying with BHMA A156.4.
1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
2. Provide a door closer on every exterior door.
3. Provide a door closer on every fire- and smoke-rated door. Spring hinges are not an acceptable self-closing device unless specifically so indicated.
4. On pairs of swinging doors, if an overlapping astragal is present, provide coordinator to ensure the leaves close in proper order.
5. At outswinging exterior doors, mount closer in inside of door.

2.11 STOPS AND HOLDERS

A. Stops: Complying with BHMA A156.8; provide a stop for every swinging door, unless otherwise indicated.
   1. Provide wall stops, unless otherwise indicated.
   2. If wall stops are not practical, due to configuration of room or furnishings, provide overhead stop.
   3. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop unless specifically so stated.

2.12 GASKETING AND THRESHOLDS

A. Gaskets: Complying with BHMA A156.22.
   1. On each door in smoke partition, provide smoke gaskets; top, sides, and meeting stile of pairs. If fire/smoke partitions are not indicated on drawings, provide smoke gaskets on each door identified as a "smoke door" and 20-minute rated fire doors.
   2. On each exterior door, provide weatherstripping gaskets, unless otherwise indicated; top, sides, and meeting stiles of pairs.
      a. Where exterior door is also required to have fire or smoke rating, provide gaskets functioning as both smoke and weather seals.
   3. On each exterior door, provide door bottom sweep, unless otherwise indicated.
   4. On each interior electrical room door, provide gaskets similar to smoke gaskets.

B. Thresholds: Complying with BHMA A156.21.
   1. At each exterior door, provide a threshold unless otherwise indicated.

C. Fasteners At Exterior Locations: Non-corroding.

2.13 PROTECTION PLATES AND ARCHITECTURAL TRIM

A. Protection Plates:
   1. Kickplate: Provide on push side of every door with closer, except aluminum storefront and glass entry doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Mounting heights for hardware from finished floor to center line of hardware item.
   1. For steel doors and frames: Comply with DHI "Recommended Locations for Architectural Hardware for Steel Doors and Frames."

D. Set exterior door thresholds with full-width bead of elastomeric sealant on each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 40 00.

3.04 ADJUSTING

A. Adjust work under provisions of Section 01 70 00.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING

A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

A. Protect finished Work under provisions of Section 01 70 00.

B. Do not permit adjacent work to damage hardware or finish.

HARDWARE SETS

4.01 HARDWARE SETS - GENERAL

A. These Hardware Sets indicate requirements for single doors of that type, with conditional requirements for pairs and other situations.

B. Pairs of Swinging Doors: Provide one of each specified item on each leaf unless specifically stated otherwise. Treat pairs as two active leaves unless otherwise indicated.

4.02 SWING DOORS -- NOT REQUIRING KEY LOCKING

A. HW-1: Push/Pull, Non-Fire-Rated:
   1. Closer.
   2. Push/Pull.

B. HW-2: Latchset, Non-Fire-Rated.
   1. Latchset, Passage.
   2. Pair: One leaf inactive, with manual flush bolts.

C. HW-5: Privacy Lockset, Non-Fire-Rated:
   1. Lockset, Privacy.

D. HW-6: Exit Device, Always-Unlocked, Normally-Closed, Fire-Rated or Non-Fire-Rated:
   1. Closer.
   2. Exit Device, Rim, Entry/Exit, Always-Unlocked.
   3. Pair: Removable Mullion, removable only by key.

4.03 SWING DOORS -- LOCKABLE, MAY BE LEFT UNLOCKED, KEY NOT REQUIRED TO LOCK

A. HW-10: Office, Non-Fire-Rated:
   1. Lockset, Office.
   2. Pair: One leaf inactive, with manual flush bolts.

B. HW-13: Public Entrance, Exit Device, Lockable, Non-Fire-Rated:
   1. Closer.
   2. Exit Device, Rim, Entry/Exit, Free Swing, lever outside trim.
   3. Pair: Surface vertical rod type devices.

END OF SECTION

SECTION 09 91 23
PAINTS AND COATINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to prepare surfaces and apply paints and coatings as specified within this Section, unless otherwise indicated on the Drawings.

1.02 REFERENCES

A. ANSI/NSF 61 - Drinking Water System Components - Health Effects.

B. ASTM D 16 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products.

C. ASTM D 4263 - Indicating Moisture in Concrete by the Plastic Sheet Method.

D. ASTM F 1869 - Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

E. AWWA C 652 - Disinfection of Water-Storage Facilities.

F. AWWA D 102 - Painting Steel Water Storage Tanks.

G. International Concrete Repair Institute (ICRI) Guideline No. 03732 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

H. SSPC-SP 1 - Solvent Cleaning.

I. SSPC-SP 2 - Hand Tool Cleaning.

J. SSPC-SP 3 - Power Tool Cleaning.

K. SSPC-SP 5/NACE 1 - White Metal Blast Cleaning.

L. SSPC-SP 6/NACE 3 - Commercial Blast Cleaning.

M. SSPC-SP 10/NACE 2 - Near-White Metal Blast Cleaning.

N. SSPC-SP 13/NACE 6 - Surface Preparation of Concrete.

1.03 DEFINITIONS

A. Definitions of Painting Terms: ASTM D 16, unless otherwise specified.

B. Dry Film Thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000 inch).

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's product data for each coating, including generic description, complete technical data, surface preparation, and application instructions.

C. Manufacturer's Quality Assurance: Submit manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.

D. Applicator's Quality Assurance: Submit list of a minimum of 5 completed projects of similar size and complexity to this Work. Include for each project:
   1. Project name and location.
   2. Name of owner.
   3. Name of contractor.
   4. Name of engineer.
   5. Name of coating manufacturer.
   6. Approximate area of coatings applied.
   7. Date of completion.

E. Warranty: Submit manufacturer's standard warranty.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Specialize in manufacture of coatings with a minimum of 10 years successful experience.
   2. Able to demonstrate successful performance on comparable projects.
   3. Single Source Responsibility: Coatings and coating application accessories shall be products of a single manufacturer.

B. Applicator's Qualifications:
   1. Experienced in application of specified coatings for a minimum of 5 years on projects of similar size and complexity to this Work.
   2. Applicator's Personnel: Employ persons trained for application of specified coatings.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
   1. Coating or material name.
   2. Manufacturer.
   3. Color name and number.
   4. Batch or lot number.
   5. Date of manufacture.
   6. Mixing and thinning instructions.

B. Storage:
   1. Store materials in a clean dry area and within temperature range in accordance with manufacturer's instructions.
   2. Keep containers sealed until ready for use.
   3. Do not use materials beyond manufacturer's shelf life limits.

C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Weather:
   1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
   2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
   3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
   4. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
   5. Wind: Do not spray coatings if wind velocity is above manufacturer's limit.

B. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with AWWA D 102.

C. Dust and Contaminants:
   1. Schedule coating work to avoid excessive dust and airborne contaminants.
   2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tnemec Company Incorporated

B. Benjamin Moore

C. Sherwin Williams

D. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COATING SYSTEMS FOR STEEL - STRUCTURAL, TANKS, PIPE, AND EQUIPMENT

A. Exterior Exposed:
   1. System Type: Epoxy/urethane.
   2. Surface Preparation: SSPC-SP 6.
   3. Primer: Series 66 Hi-Build Epoxoline: DFT 3.0 to 5.0 mils.
   4. Intermediate Coat: Series 66 Hi-Build Epoxoline: DFT 2.0 to 3.0 mils.
   5. Finish Coat: Series 73 Endura-Shield: DFT 2.0 to 5.0 mils.
   6. Total DFT: 7.0 to 13.0 mils.
   7. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

B. Interior Exposed:
   1. System Type: Epoxy.
   2. Surface Preparation: SSPC-SP 6.
   3. Primer: Series 66 Hi-Build Epoxoline: DFT 3.0 to 5.0 mils
   4. Finish Coat: Series 66 Hi-Build Epoxoline: DFT 4.0 to 6.0 mils.
   5. Total DFT: 7.0 to 11.0 mils.
   6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

C. Immersion:
   1. System Type: Coal tar epoxy.
   2. Surface Preparation: SSPC-SP 10.
   3. Finish Coat: Series 46H-413 Hi-Build Tneme-Tar: DFT 14.0 to 20.0 mils.
   4. Total DFT: 14.0 to 20.0 mils.
   5. Finish Color: Black.

D. Below Grade:
   1. System Type: Coal tar epoxy.
   2. Surface Preparation: SSPC-SP 10.
   3. Finish Coat: Series 46H-413 Hi-Build Tneme-Tar: DFT 14.0 to 20.0 mils.
   4. Total DFT: 14.0 to 20.0 mils.
   5. Finish Color: Black.

E. Marginally Prepared Surfaces (Maintenance, Non-Immersion):
   1. System Type: Epoxy.
   2. Surface Preparation: In accordance with manufacturer's instructions.
   3. Primer: Series 135 Chembuild: DFT 4.0 to 6.0 mils.
   4. Finish Coat: Series 66 Hi-Build Epoxoline: DFT 4.0 to 6.0 mils.
   5. Total DFT: 8.0 to 12.0 mils.
   6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

2.03 COATING SYSTEMS FOR FACTORY PRIMED STEEL - DOORS, FRAMES, AND MISCELLANEOUS EQUIPMENT

A. Exterior Exposed:
   1. System Type: Epoxy/urethane.
   2. Surface Preparation: Clean and dry.
   3. Primer: Factory primed.
   4. Intermediate Coat: Series 27 Typoxy: DFT 2.0 to 3.0 mils.
   5. Finish Coat: Series 73 Endura-Shield: DFT 2.0 to 3.0 mils.
   6. Total DFT: 4.0 to 6.0 mils.
   7. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

B. Interior Exposed:
   1. System Type: Epoxy.

2. Surface Preparation: Clean and dry.
3. Primer: Factory primed.
4. Intermediate Coat: Series 27 Typoxy: DFT 2.0 to 3.0 mils.
5. Finish Coat: Series 66 Hi-Build Epoxoline: DFT 2.0 to 3.0 mils.
6. Total DFT: 4.0 to 6.0 mils.
7. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

2.04 COATING SYSTEMS FOR NONFERROUS METAL - PIPE AND MISCELLANEOUS FABRICATIONS

A. Exterior Exposed:
1. System Type: Epoxy/urethane.
2. Surface Preparation: In accordance with manufacturer's instructions.
3. Primer: Series 66 Hi-Build Epoxoline: DFT 2.0 to 3.0 mils.
4. Finish Coat: Series 73 Endura-Shield: DFT 2.0 to 3.0 mils.
5. Total DFT: 4.0 to 6.0 mils.
6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

B. Interior Exposed:
1. System Type: Epoxy.
2. Surface Preparation: In accordance with manufacturer's instructions.
3. Primer: Series 66 Hi-Build Epoxoline: DFT 2.0 to 3.0 mils.
4. Finish Coat: Series 66 Hi-Build Epoxoline: DFT 2.0 to 3.0 mils.
5. Total DFT: 4.0 to 6.0 mils.
6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

C. Immersion:
1. System Type: Epoxy.
2. Surface Preparation: SSPC-SP 1 followed by abrasive blast.
3. Primer: Series 66 Hi-Build Epoxoline: DFT 3.0 to 5.0 mils.
4. Finish Coat: Series 66 Hi-Build Epoxoline: DFT 4.0 to 6.0 mils.
5. Total DFT: 7.0 to 11.0 mils.
6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

2.05 COATING SYSTEMS FOR DUCTILE OR CAST IRON - PIPE, PUMPS AND VALVES

A. Exterior Exposed:
1. System Type: Epoxy.
2. Surface Preparation: In accordance with manufacturer's instructions.
3. Primer: Series 66 Hi-Build Epoxoline: DFT 3.0 to 5.0 mils.
4. Intermediate Coat: Series 66 Hi-Build Epoxoline: DFT 4.0 to 6.0 mils.
5. Finish Coat: Series 73 Endura-Shield: DFT 2.0 to 3.0 mils.
6. Total DFT: 9.0 to 14.0 mils.
7. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.
8. Note: Factory Coated Pumps and Valves shall not be coated by Contractor.

B. Below Ground:
1. System Type: Coal tar epoxy.
2. Surface Preparation: In accordance with manufacturer's instructions.
3. Finish Coat: Series 46H-413 Hi-Build Tneme-Tar: DFT 14.0 to 20.0 mils.
4. Total DFT: 14.0 to 20.0 mils.
5. Finish Color: Black.
6. Note: Factory Coated items shall not be coated.

C. Interior Exposed:
   1. System Type: Epoxy.
   2. Surface Preparation: In accordance with manufacturer's instructions.
   3. Primer: Series 66 Hi-Build Epoxoline: DFT 3.0 to 5.0 mils.
   4. Finish Coat: Series 66 Hi-Build Epoxoline: DFT 4.0 to 6.0 mils.
   5. Total DFT: 7.0 to 11.0 mils.
   6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

D. Immersion:
   1. System Type: Coal tar epoxy.
   2. Surface Preparation: In accordance with manufacturer's instructions.
   3. Finish Coat: Series 46H-413 Hi-Build Tneme-Tar: DFT 14.0 to 20.0 mils.
   4. Total DFT: 14.0 to 20.0 mils.
   5. Finish Color: Black.

2.06 COATING SYSTEMS FOR PVC

A. Exterior Exposed:
   1. System Type: Epoxy/urethane.
   2. Surface Preparation: Scarify.
   3. Primer: Series 66 Hi-Build Epoxoline: DFT 2.0 to 3.0 mils.
   4. Finish Coat: Series 73 Endura-Shield: DFT 2.0 to 3.0 mils.
   5. Total DFT: 4.0 to 6.0 mils.
   6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

B. Interior Exposed:
   1. System Type: Epoxy.
   2. Surface Preparation: Scarify.
   3. Primer: Series 66 Hi-Build Epoxoline: DFT 2.0 to 3.0 mils.
   4. Finish Coat: Series 66 Hi-Build Epoxoline: DFT 2.0 to 3.0 mils.
   5. Total DFT: 4.0 to 6.0 mils.
   6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

2.07 COATING SYSTEMS FOR INSULATED PIPE

A. Interior/Exterior Exposed:
   1. System Type: Acrylic.
   2. Surface Preparation: Clean and dry.
   3. Primer: Series 6 Tneme-Cryl: DFT 2.0 to 3.0 mils.
   4. Finish Coat: Series 6 Tneme-Cryl: DFT 2.0 to 3.0 mils.
   5. Total DFT: 4.0 to 6.0 mils.
   6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

2.08 COATING SYSTEMS FOR PRECAST CONCRETE AND CONCRETE MASONRY UNITS

A. Exterior Exposed:
   1. System Type: Acrylate.
   2. Surface Preparation: SSPC-SP 13/NACE 6. Clean and dry.
   3. Primer: Series 156 Enviro-Crete: DFT 4.0 to 8.0 mils.
   4. Finish Coat: Series 156 Enviro-Crete: DFT 4.0 to 8.0 mils.
   5. Total DFT: 8.0 to 16.0 mils.
   6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

B. Interior Exposed:
   1. System Type: Epoxy.

2. Surface Preparation: SSPC-SP 13/NACE 6. Brush-off blast.
3. Primer: Series 66 Hi-Build Epoxoline: DFT 4.0 to 6.0 mils.
4. Finish Coat: Series 66 Hi-Build Epoxoline: DFT 4.0 to 6.0 mils.
5. Total DFT: 8.0 to 12.0 mils.
6. Finish Color: See Schedule of Colors. If not specified, as selected by Owner from manufacturer's standard colors.

2.09 COATING SYSTEMS FOR CONCRETE FLOORS

A. See Section 03300 - "Cast-In-Place Concrete".

2.10 COATING SYSTEMS FOR CONCRETE MASONRY UNITS

A. Exterior
   1. Primer: Two-Component, heavy-duty cementitious acrylic block filler
      a. Cement-Plex 875 B62W200/B42V201, @ 13.0 - 25.0 mils DFT, as manufactured by The Sherwin Williams Co.
   2. Finish: One Component, Pigmented Acrylic
      a. DTM Acrylic Coating, Gloss or Semi Gloss, B66 Series, @ 2.5 - 4.0 mils DFT per coat (two coats), as manufactured by The Sherwin Williams Co.

B. Interior
   1. Primer: Two-Component
      a. 1.PrepRite Masonry Primer, B28W300, @ 1.0 - 1.5 mils DFT, as manufactured by The Sherwin-Williams Company
   2. Finish: One-Component, Pigmented Alkyd Coating, Gloss
      a. Industrial Enamel VOC, B54Z Series, @ 2.0 - 3.0 mils DFT per coat (two coats), as manufactured by The Sherwin-Williams Co.

2.11 ACCESSORIES

A. Coating Application Accessories:
   1. Accessories required for application of specified coatings in accordance with manufacturer's instructions, including thinners.
   2. Products of coating manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which coating systems are to be applied. Notify Engineer of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

3.02 PROTECTION OF SURFACES NOT SCHEDULED TO BE COATED

A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.

B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.03 SURFACE PREPARATION OF STEEL

A. Prepare steel surfaces in accordance with manufacturer's instructions.

B. Fabrication Defects:
   1. Correct steel and fabrication defects revealed by surface preparation.
   2. Remove weld spatter and slag.
   3. Round sharp edges and corners of welds to a smooth contour.
   4. Smooth weld undercuts and recesses.
   5. Grind down porous welds to pinhole-free metal.
   6. Remove weld flux from surface.

C. Ensure surfaces are dry.

D. Immersion or Below Grade Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 10/NACE 2.

E. Exterior Exposed or Interior Exposed Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3.

F. Interior or Immersion Surfaces, Severe Exposure: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 5/NACE 1.

G. Marginally Prepared Surfaces (Maintenance): Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with manufacturer's instructions.

H. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.

I. Shop Primer: Prepare shop primer to receive field coat in accordance with manufacturer's instructions.

3.04 SURFACE PREPARATION OF NONFERROUS METAL

A. Prepare galvanized steel and nonferrous metal surfaces in accordance with manufacturer's instructions.

B. Surface preparation recommendations will vary depending on substrate and exposure conditions.

C. Ensure surfaces are dry.

D. Immersion Service: Clean surfaces by abrasive blasting.

E. Remove Rust From Galvanized Steel:
   1. Remove white rust from galvanized steel by hand or power brushing.
   2. Remove rust from old galvanized steel in accordance with SSPC-SP 2 or SP 3.
   3. Do not damage or remove galvanizing.

F. Increase mechanical adhesion under moderate to severe conditions, such as exterior exposure or chemical environments, by abrasive blast and/or chemical cleaning.

3.05 SURFACE PREPARATION OF DUCTILE OR CAST IRON

A. Prepare ductile or cast iron surfaces in accordance with manufacturer's instructions.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

3.06 SURFACE PREPARATION OF PVC

A. Prepare PVC surfaces in accordance with manufacturer's instructions.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

C. Scarify PVC surfaces.

3.07 SURFACE PREPARATION OF INSULATED PIPE

A. Prepare insulated pipe surfaces in accordance with manufacturer's instructions.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

3.08 SURFACE PREPARATION OF CONCRETE

A. Interior, Wet Substrate:
   1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
   2. Allow concrete to cure for a minimum of 28 days.
   3. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.

4. Abrasive blast surface to remove laitance and solid contaminants and to provide clean, sound substrate with uniform anchor profile.
5. Fill holes, pits, voids, and cracks with Tnemec 63-1500 Filler and Surfacer.
6. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.

B. Exterior:
1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
2. Allow concrete to cure for a minimum of 7 days.
3. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.
4. Level concrete protrusions and mortar spatter.
5. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.

C. Exterior, Previously Painted:
1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
2. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.
3. Remove chalk and old paint not tightly bonded to surface.
4. Patch cracks in accordance with manufacturer's instructions.
5. Level concrete protrusions and mortar spatter.
6. Determine compatibility of primer over unknown previously-applied coatings by preparing a test patch.
7. Ensure surfaces are clean, dry, and free of oil, grease, and other contaminants.

3.09 SURFACE PREPARATION OF CONCRETE FLOORS

A. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

C. Allow concrete to cure for a minimum of 28 days before coating.

D. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.

3.10 SURFACE PREPARATION OF POROUS CONCRETE MASONRY UNITS

A. Prepare porous concrete masonry unit surfaces in accordance with manufacturer's instructions and SSPC-SP 13/NACE 6.

B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

C. Allow mortar to cure for a minimum of 28 days before coating.

D. Level protrusions and mortar spatter.

3.11 APPLICATION

A. Apply coatings in accordance with manufacturer's instructions.

B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.

C. Keep containers closed when not in use to avoid contamination.

D. Do not use mixed coatings beyond pot life limits.

E. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.

F. Uniformly apply coatings at spreading rate required to achieve specified DFT.

G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.

H. Stripe paint with brush critical locations on steel such as welds, corners, and edges using specified primer.

3.12 DISINFECTION

A. Disinfection of Water Contact Surfaces and Filling of Water Storage Tanks:
   1. Do not disinfect water contact surfaces or fill water storage tanks until application of coating systems is complete, coatings have fully cured, and field quality control inspection is complete.
   2. Allow number of days in accordance with manufacturer's instructions and as directed by Engineer for full cure of coating systems on water contact surfaces before flushing, disinfecting, or filling with water.
   3. Disinfection: AWWA C 652 or as directed by Engineer.

3.13 REPAIR

A. Materials and Surfaces Not Scheduled To Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.

B. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.

C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.14 CLEANING

A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.15 PROTECTION OF COATING SYSTEMS

A. Protect surfaces of coating systems from damage during construction.

3.16 ONE-YEAR INSPECTION

A. Owner will set date for one-year inspection of coating systems.

B. Inspection shall be attended by Owner and Contractor.

C. Repair deficiencies in coating systems as determined by Engineer in accordance with manufacturer's instructions.

3.17 SCHEDULES

A. Schedule of Colors:
   1. Raw Water: Olive Green
   2. Anaerobic Lagoon Effluent: Olive Green
   3. Clarified Water: Aqua
   4. Potable Water: Dark Blue
   5. Backwash Waste: Light Brown
   6. Activated Sludge: Light Gray
   7. Return Sludge: Dark Brown
   8. Waste Sludge: Dark Brown
   9. Primary Coagulant: Orange
   10. Ammonia: White
   11. Carbon Source: Black
   12. Caustic: Yellow with Green Band
   13. Chlorine: Yellow
   14. Lime Slurry: Light Green
   15. Polymers: Orange with Green Band
   16. Sulfuric Acid: Yellow with Red Band
   17. Compressed Air: Dark Green
   18. Fire Protection: Red

B. Coating Systems in this section do not apply to Precast Concrete Tanks. Refer to section 03481-Precast Post Tension Concrete Tanks.

END OF SECTION

SECTION 22 05 33
HEAT TRACING FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 REFERENCE STANDARDS

A. IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications; 2012.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other trades to provide ground fault protection for electric heat tracing circuits as required by NFPA 70.

B. Coordinate the work with other trades to provide circuit breaker ratings suitable for installed circuit lengths.

1.04 SUBMITTALS

A. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, maintenance and repair data, and parts listings.

B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

B. Acceptable Installers: Familiar with the installation of heat-trace cabling and equipment, subject to compliance with requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 CABLE OUTER JACKET MARKINGS

A. Name of manufacturer, trademark, or other recognized symbol of identification.

B. Catalog number, reference number, or model.

C. Month and year of manufacture, date coding, applicable serial number, or equivalent.

D. Agency listing or approval.

2.02 CONNECTION KITS

A. Furnish with NEMA 4X rating for prevention of corrosion and water ingress.

2.03 ACCESSORIES

A. Provide Accessories As Indicated or As Required for Complete Installation, Including but Not Limited To:
   1. High temperature, glass filament tape for attachment of heating cable to metal piping.
   2. Aluminum self-adhesive tape for attachment of heating cable to plastic piping.
   3. Heat-conductive putty.
   4. Cable ties.
   5. Silicone end seals and splice kits.
   6. Installation clips.

7. Warning labels for attachment to exterior of piping insulation. Refer to Section 22 05 53.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping and equipment are ready to receive work.

B. Verify field measurements are as shown on shop drawings.

C. Verify required power is available, in proper location, and ready for use.

3.02 PREPARATION

A. Clean all surfaces prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer.

3.03 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Comply with installation requirements of IEEE 515.1 and NFPA 70, Article 427.

C. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.

D. Comply with all national and local code requirements.

E. Identification:
   1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 ft including cladding over each valve or other equipment that may require maintenance.

3.04 FIELD QUALITY CONTROL

A. Field Testing and Inspections:
   1. Commission system in accordance with installation and operation manual.
   2. Inspect for sources of water entry and proper sealing.
   3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
   4. Minimum Acceptable Insulation Resistance: 20 megohms or greater at a test voltage of 2500 VDC for polymer insulated trace heaters.
   5. Test heating cable integrity with megohmmeter at the following intervals:
   6. Measure voltage and current at each unit.

3.05 PROTECTION

A. Protect installed products from damage until completion of project.

END OF SECTION

SECTION 26 05 02
ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, material, equipment, fees, services and permits to install the complete electrical system as shown on the Drawings and Specifications. Upon completion of construction, the system shall be in perfect working condition.

1.02 GENERAL INFORMATION

A. All electrical equipment shall be installed in a practical manner to function properly, to be easily maintainable, and to fit building construction requirements. All Drawings are diagrammatic and the Contractor shall use judgement to interpret these Drawings accordingly. Items not shown or specified which are required to produce a complete, operative and finished system shall be provided by the Contractor at no additional cost.

B. Contractor shall be responsible for coordinating the work with the local electric utility. As requested by the electric utility, the contractor shall provide construction documents and projected loads. Contractor shall provide concrete pads, trenching, conduits, conductors and trench backfilling as required by the local utility.

1.03 GENERAL CONDITIONS AND APPLICABLE SECTIONS

A. All conditions and other pertinent Sections of these Specifications shall be reviewed by the Contractor. All parts of these Specifications (including sections covering other trades) concerning the electrical installation shall be complied with every respect. It shall be the responsibility of the Electrical Contractor to be familiar with the complete set of Drawings and Specifications.

1.04 REGULATORY REQUIREMENTS

A. The installation of all work is to be done in strict accordance with all applicable local ordinances and state of statutes. In case of conflict, the code having immediate jurisdiction is to govern. The methods to be used in the installation of the equipment and materials must meet or exceed these requirements. Statements in the Specifications or on the Drawings are not to be construed to permit deviation from the requirements of the governing codes and standards. Where the application of a standard or code appears to be in conflict with the requirements of the Contract Documents, the Engineer will determine which will govern.

B. Codes: Requirements of the following codes shall be minimum standard except where the Drawings and Specifications dictate a more stringent requirement. Where differences exist between these codes, the most stringent shall apply.
   1. The National Electric Code (NEC), latest edition, as amended or supplemented by the authority having local jurisdiction over this project.
   2. Occupational Safety and Health Administration (OSHA), as contained in the Code of Federal Regulations, Title 29, Part 1910, Subpart S.

C. When the minimum requirements of the Drawings and Specifications exceed code requirements, the Drawings and Specifications shall be used to determine the minimum requirements.

D. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.05 PERMITS

A. All permits that are legally required to execute this contract shall be obtained and paid for by the Contractor.

1.06 MISCELLANEOUS COSTS

A. All fees or charges on this project by outside agencies such as: the local utility company, other contractors, consultants, etc., shall be the responsibility of the Contractor.

1.07 DESCRIPTION OF WORK

A. The work covered by this Specification shall include all labor, equipment, fees, services and permits required to install the complete electrical system as shown on the Drawings and detailed herein. The work shall include, but shall not be limited to, the following:
   1. Installation of the facility lighting and electrical service including main service, conductors, conduit, panelboards, and other electrical equipment as shown on the Drawings. The facility's electrical service shall be as shown on the drawings.
   2. Grounding system.

1.08 DRAWINGS

A. The Drawings are an integral part of the Drawings and Specifications and everything indicated on the Drawings or in the Specifications shall be part of the Contract. In addition, all labor and materials required to provide a complete and workable installation for all the various electrical systems, shall be included in the Contractor's bid, even though each item involved is not necessarily mentioned or shown. In this situation, all materials shall be an equivalent quality as the material shown or specified for each system.

B. If any errors, omissions or obscurities are encountered in the Drawings or Specifications, the Contractor shall promptly notify the Engineer and request directions.

1.09 SUBSTITUTION OF EQUIPMENT

A. Substitutions - See Section 01600 - Product Requirements.

B. Certain manufacturer's trade names are designated herein for the purpose of setting standards of quality, design, dimensions, and to provide a standardization of spare parts.

1.10 SYSTEM TEST

A. An operating test shall be conducted after the installation is complete, and at such time as the Engineer may direct. A demonstration showing that the equipment will operate in accordance with these Specifications is required. The test will be performed in the presence of the Engineer or his designated representative. This test shall also include testing of any ground fault devices in accordance with manufacturer's recommendations. All instruments and personnel required to perform this test shall be furnished by the Contractor, and the power will be furnished by the Owner.

1.11 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Within ten (10) days of award of contract, the successful bidder shall present to the Owner a list of equipment, manufacturers and Subcontractors he/she proposes to use on this project.

C. The Contractor shall provide six (6) copies of manufacturer's brochures detailing ratings, dimensions, power requirements, etc., of the proposed equipment. This shall be provided within thirty (30) days of award of contract and shall be bound into one complete set. The brochures shall be indexed and tabulated, with all equipment identified as designated on the Drawings and with all pertinent data clearly indicated.

D. The cover sheet of each separate brochure shall be stamped showing job title, Contractor's name, and date. Each page containing pertinent data shall be so stamped, with the supporting information on equipment underlined or otherwise noted. The name and number of each piece of equipment shall also be noted. A separate sheet shall be submitted for each piece of equipment. Unless a different submittal format has been previously approved by the Owner, all submittals not in compliance with the above requirements shall be returned without consideration.

E. Descriptive data shall be included showing dimensions, voltage rating, current rating, weight, capacity, delivery time, and other pertinent data. Data shall be submitted in a timely manner so that no delay is caused. The Owner reserves the right to go directly to the manufacturer to obtain any details he considers necessary, if the Contractor fails to comply. Any cost incurred because of this failure, shall be borne by the Contractor.

F. If the equipment presented has different characteristics than specified, or operating characteristics are affected because of equipment substitution, computations shall be presented to clearly show the effect and the proposed solution. The Contractor bears the burden of proof of equality of equipment. Equipment not meeting specification requirements shall not be approved and disapproval will not be cause for the Contractor to change his/her bid. Materials not approved shall be revised and resubmitted within ten (10) days.

G. Submittal approval does not void the requirements of conformance with Drawings and Specifications. All submittals shall be thoroughly checked by the Contractor for proper dimensions, voltage, quantities, etc.

H. Before ordering the following equipment, the Contractor shall make submittals:
1. Lighting and distribution panelboards
2. Lighting fixtures and mounting brackets
3. Wiring devices
4. Conduit and conduit fittings
5. Wire
6. Safety switches and fuses
7. Misc. starters and control stations
8. Variable Frequency Drives
9. Programmable Logic Controllers
10. Motor Control Centers
11. Padmount transformers
12. Medium voltage switchgear

1.12 WET AND CORROSIVE LOCATIONS

A. In exterior areas and interior "wet and corrosive areas" all equipment shall be equipped with weatherproof stainless steel enclosures.

B. In wet and corrosive locations, all rods and miscellaneous material shall be either aluminum or stainless steel. No galvanized or painted metal shall be allowed in these locations.

1.13 GUARANTEE

A. A written certificate shall be furnished guaranteeing all materials, equipment and labor furnished to be free of all defects for a period of one (1) year after the date of final acceptance of the work by the Owner. If any defects appear within this stipulated time, such repair/replacement shall be completed without charge.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All materials and equipment shall conform to standards set by National Electric Code (NEC), Underwriter's Laboratories, state and local agencies. Materials shall be new and of equal or greater quality than those specified.

B. All miscellaneous hardware and materials used for mounting and installation of the electric system shall be galvanized.

PART 3 EXECUTION

3.01 GENERAL INFORMATION

A. Cooperation with all other individuals involved on this project is required to insure that the work will properly fit the building and other Contractors' requirements are met.

B. Circuit sizes and electrical requirements of equipment specified under other sections of these specifications shall be verified by the Contractor to ensure that their requirements are consistent with the Drawings. If a discrepancy exists, it shall be brought to the Engineer's attention before proceeding with the work.

C. Coordinate all electrical work with architectural and other trades, to insure proper execution of work and general progress for the entire project.

3.02 DRAWINGS

A. The general arrangement of conduits and wiring in the conduits are shown on the electrical Drawings in a manner as to be a guide to the Contractor. Certain special equipment requirements and larger conduits are detailed. Dimensions on the Drawings are to be utilized to determine the rough-in locations. Exact locations shall be determined by the Contractor in the field giving consideration to piping and equipment location requirements of other contractors. The Contractor shall make his/her own field measurements and assumes full responsibility of same.

3.03 MINOR LOCATION CHANGES

A. Minor location changes of switches, receptacles, and miscellaneous outlets shall be permitted to be made by the Engineer, or Owner prior to roughing in, where construction conflicts or operation advantage warrant the change. These minor changes shall be made at no cost by the Contractor.

3.04 LOCATIONS

A. The locations of equipment furnished under other sections of the specifications shall be located by referring to other Contractor's shop drawings prior to locating. The outlines of equipment shown on the Mechanical and Electrical Drawings are intended only as a guide to indicate relative locations of the electrical work. Refer to Architectural and Structural Drawings for construction details. If conflicts prevent installation of electrical work at the locations indicated, deviations shall be made subject to acceptance by the Engineer, and without compensation.

3.05 GROUPING OF CIRCUITS

A. Shown diagrammatically on the Drawings are circuit grouping, cable or conduit runs, and home runs. The number of conductors are shown to clarify the operation of each system. Proper conductors and conduits shall be installed by the Contractor to produce an operative system as detailed by the Drawings and Specifications.

3.06 HOME RUNS

A. All home runs shall be circuited as shown on the Drawings unless approval is obtained from the Engineer. The alternative presented must show exact conduit routing, junction box location and total circuit wattage. If the change is accepted by the Engineer, the Contractor shall note all appropriate information on the record drawing. No two ungrounded conductors shall be connected to the same ungrounded phase in the panel. No sharing of neutrals is allowed.

3.07 CONDUIT

A. All conduits installed shall be neat, parallel to building lines, and properly anchored. All conduit sleeves and fittings shall be furnished and installed by the Contractor.

3.08 EQUIPMENT BY OTHERS - INSTALLED AND WIRED BY ELECTRICAL CONTRACTOR

A. The wiring for all electrical equipment including motors and other electrically operated equipment specified in other sections of the Specifications shall be furnished and installed by the Contractor unless otherwise noted. All circuits shall be completed and left in satisfactory working condition except where noted on the Drawings or in other Sections. The suitability of equipment supplied by other trades shall be checked by the Contractor by consulting wiring diagrams. The Electrical Subcontractor shall supply and install all cords and plugs necessary for equipment connections.

B. The Contractor shall furnish all labor and materials for rough-in and final connections to electrical equipment including disconnect switches, wiring, conduit, outlets and plates and other material not specified in the other equipment sections under the individual item, but necessary for a complete and working system. Any of the above items specified under other equipment sections shall be furnished loose to the Electrical Subcontractor for installation.

C. No additional compensation shall be considered for failure to properly interpret responsibility of other trades.

D. The Contractor shall locate all equipment by consulting shop drawings and coordinating locations with other trades, Owner and General Contractor.

3.09 CONTROL WIRING

A. The Electrical Subcontractor shall furnish and install control wiring for the mechanical equipment, heating, ventilation, and air conditioning equipment. The Contractor shall refer to the Mechanical Drawings and Specifications for information regarding the control wiring.

3.10 CUTTING AND PATCHING

A. Workmen skilled in the particular trade involved shall make all patches of other work, where required. The right is reserved to have the Contractor whose work is involved to make the repair, and backcharge the Contractor responsible for the damage.

3.11 EQUIPMENT NAMEPLATES

A. Permanent nameplates shall be furnished and installed by the Contractor for each electrical device other than lighting outlets, wall switches and convenience receptacles. In addition, each component unit mounted on a panel or cabinet shall have a permanent nameplate. The name or legend as approved by the Engineer shall be engraved on the nameplate. In addition, the fuse, breaker or main lug only size shall be engraved on the nameplate. It shall be permanently attached with machine screws or sheet metal screws, and shall in general be no smaller than 3/4" x 2". Nameplates may be white core laminated bakelit or plastic; however, all nameplates shall be of the same type with same type engraving.

3.12 INSTALLATION

A. All penetrations by electrical raceways or equipment through walls or floors shall be sealed with fire retardant silicone foam equal to CTC PR 855 as supplied by Chase Technology Corporation, or with 3M Fire Barrier CP 25 Caulk and Fire Barrier Putty 303 as manufactured by the Electro-Products Division of the 3M Company or with Firestop Caulk as manufactured by Nelson Electric, a unit of General Signal.

B. Installer shall have the technical qualifications, experience, trained personnel and facilities to accomplish the installation in accordance with manufacturer's instructions and the best practices of the trade.

3.13 TEMPORARY CONSTRUCTION FACILITIES

A. Furnish and install temporary power and lighting, as the needs require, for construction and safety purposes. It shall be the responsibility of the Contractor to obtain and pay for any utility charges associated with "construction power".

3.14 DAMAGED AND DEFECTIVE WORK

A. Remove and replace damaged and defective work or materials, as directed by the Engineer, with no extra compensation. All repairs to the work shall be made with new materials or a complete new piece of equipment shall be provided, as directed by the Engineer.

3.15 OPERATING MANUALS

A. Provide the Engineer with four copies of hard bound manuals for the project, ten days prior to final acceptance of completion of the project. Manuals shall include copies of all corrected and approved shop drawings, schedules, catalog data, illustrations, performance curves, rating data, wiring diagrams, control diagrams, manufacturer's recommendations, operating instructions, maintenance instructions, spare parts lists, and other pertinent information for the specified equipment and systems. Manuals shall include a type written schedule of each motor, giving nameplate data, switch and fuse/breaker size and voltage, and phase(s) at motor terminals.

3.16 RECORD DRAWINGS

A. The Electrical Contractor shall be responsible for maintaining record drawings showing all deviations from the electrical plans. This record set shall not be used for construction, and shall be dedicated solely to maintaining an accurate record of the electrical construction. Upon completion of the work, these Record Drawings shall be turned over to the Owner.

3.17 CLEANING

A. The Contractor shall help keep the Project neat and daily remove debris caused by his/her work.

END OF SECTION

SECTION 26 05 03
ELECTRICAL MATERIALS AND METHODS

PART 1 MATERIALS AND WORKMANSHIP

1.01 MATERIALS

A. All materials supplied must meet all provisions of the Drawings and Specifications and shall be new.

B. The Engineer must approve any material not represented with a catalog number or quality standard.

C. All material shall be shipped to the job site in the original container which shall be properly marked with the size, type and dates of inspection and shipment.

D. All materials shall be the latest design of that manufacturer.

1.02 WORKMANSHIP

A. Workmen skilled in electrical work shall be utilized on this project. Careless or improper workmanship shall be reworked/repaired at no cost to the Owner. The Engineer shall make all determinations on quality of workmanship.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 INSTALLATION

A. For all wiring installations specified herein, or noted on the Drawings, all wiring shall be installed in raceways. The Contractor shall avail himself of the detailed drawing sheets for information relating to slab thickness, reinforcing, column sites, finish lines, chases, ceiling construction and finishes, and shall be guided accordingly in the installation of his work.

END OF SECTION

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SECTION 26 05 19
POWER WIRES AND CONNECTORS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Electrical power wire and cable systems shall include all wire, cable, connectors and other accessories required to provide the complete power system indicated on the Drawings and Schedules.

1.02 QUALITY ASSURANCE

A. Wire, cable and connectors shall comply with all applicable standards.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

PART 2 PRODUCTS

2.01 CONDUCTORS

A. All wire and cable shall meet the requirements of the latest edition of the National Electric Code (NEC) and shall be soft drawn copper unless otherwise noted. Wire and cable shall be new and permanently marked with size, grade of insulation, voltage and manufacturer's name on outer covering at regular intervals.

B. Each conductor and the neutral conductor shall be factory color coded with a separate color for each. The color code indicated below shall be used consistently throughout the electrical system installation, unless otherwise specified:
   1. Phase 480 V 240 V 208 V
   2. A Brown Black Black
   3. B Orange Orange Red
   4. C Yellow Blue Blue
   5. Neutral Gray w/ White Tape White White
   6. Ground Green Green Green

C. Type THWN or THHN wire shall be installed in raceways above grade in permanent dry locations.

D. Type THW or THWN wire shall be used in raceways exposed to moisture, in concrete slabs on fill or below grade.

2.02 CONNECTORS

A. Connectors on circuits with copper conductors shall be power cable compression type, hex screw, or bolt clamp type. Connectors shall be highly conductive and corrosion resistant material.

B. Connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents.

C. Splices and joints shall be insulated with material approved for the particular use, location, voltage and temperature.

PART 3 EXECUTION

3.01 INSTALLATION

A. All cable shall be continuous from origin to panel or equipment termination without running splice unless otherwise specified.

B. No more than three circuits shall be contained in each home run for branch circuits, unless otherwise noted on the Drawings.

C. Wraparound labels with numbering designations shall mark control wiring in each box and at each termination. It shall correspond with a detailed wiring diagram. All control wiring shall be stranded.

D. The Contractor shall use due care to prevent damage to the conductor and insulation during installation. Conductors shall not be installed in conduit or raceways until the raceway system is complete.

E. The Contractor is required to conduct insulation tests with a 500 volt DC megger after installation is complete. This test will be performed in the presence of the Engineer, and the Contractor shall furnish all equipment and personnel necessary to conduct the test.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding electrodes.

B. Grounding conductors.

C. Equipment grounding conductors.

D. Bonding.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

B. IEEE Std 80-1986

C. IEEE Std 837-1989

1.03 SYSTEM DESCRIPTION

A. Furnish all labor, materials, services, and equipment required in conjunction with a grounding system as indicated in the Contract Documents.

1.04 QUALITY ASSURANCE

A. Installer Qualifications.
   1. An electrician experienced in the type of work to be performed shall be designated as Field Supervisor and shall be present at the site during all working hours.

B. Regulatory Requirements.
   1. Applicable provisions of NFPA 70.
   2. Provisions specified in this Section.
   3. Manufacturing workmanship and materials shall comply with applicable provisions of NEMA, ANSI, ICEA and UL Standards.
   4. Electrical equipment shall be UL listed and comply with UL standards in all cases where UL has published lists and standards applicable to the type of equipment required to be provided.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

PART 2 PRODUCTS

2.01 GROUND RODS

A. UL listed copper bonded steel, 5/8 inch diameter by 8 feet long.

B. Acceptable Manufacturers:
   1. Blackburn, St. Louis, MO
   2. Carolina Galvanizing, Aberdeen, NC
   3. Knight Metalcraft, Portland, TN
   4. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GROUNDING ELECTRODE CABLE

A. Bare stranded soft temper copper, ASTM B3. Cable to be sized per National Electric Code requirements.

2.03 GROUNDING CONDUCTORS

A. Size equipment ground conductors as indicated on Drawings. If the size is not indicated, size in accordance with NFPA 70, NEC TABLE 250-94 and 250-95.

B. THW insulated copper: ASTM B3

C. Conductors #10 AWG and smaller: Solid

D. Conductors #8 AWG and larger: Concentric stranded

E. Color code: Equipment grounds shall have green colored insulation or a green tape band at the end of the conductors.

2.04 GROUND CONNECTIONS

A. All conductor to conductor, conductor to ground rod and conductor to structure connections of #6 AWG and larger sized conductors shall be permanent CADWELD exothermic welded connections. Ground conductors spliced with a CADWELD exothermic welded connection shall be considered as a continuous conductor. All grounding connections to equipment shall use bolted lugs. When the conductor is #6 or larger, the lug shall be joined to the conductor by CADWELD exothermic process.

B. All connections of #8 AWG and smaller and all connections to conduit, equipment or other items where the ground conductor must be removable shall be made using mechanical connections.

C. All mechanical ground connectors shall be UL listed and shall be certified to have been tested to and passing IEEE Std 837-1989 for both above grade and below grade installations. If not certified to IEEE Std 837-1989, the conductor shall be sized using the fusing formula in IEEE Std 80-1986.

D. Acceptable Manufacturers:
   1. AMP Inc., Harrisburg, PA
   2. Burndy Corp., Norwalk, CT
   3. ERICO Products, Inc., Cleveland, OH
   4. T & B Corp., Bridgewater, NJ
   5. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 GENERAL

A. Provide positive grounding of AC system neutrals, electrical equipment and enclosures and conductor enclosure systems (conduit, wireways, etc.) at main disconnect device. Provide an effective, permanent and continuous grounding path for circuits, equipment and conductor enclosures. The grounding path must have the capacity to conduct safely fault current likely to be imposed on it, and which shall have sufficiently low impedance to limit voltage to ground and to facilitate operation of circuit protective devices in the circuit. Clean all contact surfaces to which ground connections are to be made. Remove nonconductive coatings such as paint, lacquer and oil film from threads and other contact surfaces to assure electrical connection and continuity. Make connections to insure a permanent and effective electrical connection. Make connections to equipment and equipment enclosures with terminal lugs welded to the conductor with the CADWELD Process.

3.02 GROUNDING ELECTRODE SYSTEM

A. Main Grounding Electrodes.
   1. The grounding electrode system shall be as noted below and shown on the Drawings. All electrodes from all sub-systems shall be bonded together. Separate and isolated electrodes shall not be utilized anywhere!
      a. Natural Electrodes.
         1) A metal underground water pipe in direct contact with the earth for 10 feet (3 meters) or more. The electrical path shall not contain any insulated joints.
         2) The metal frame of a building or structure which is intentionally connected to the earth through one or more ground connections of sufficiently low impedance and

having sufficient current-carrying capacity to conduct any possible voltage that may occur.

B. Man Made Electrodes
   1. All Man Made Electrodes shall be free of paint, varnish or any other non-conductive coatings. When more than one electrode is used, each electrode shall be at least 10 feet(1.8 meters) from any electrode of another sub-system. Further, all sub-system electrodes shall be bonded together.
      a. Rod Electrodes.
         1) Rod electrodes of iron or steel shall have their outer surface coated to inhibit corrosion and shall be at least 5/8 inch (15.9 mm) in diameter. The rod electrodes shall not be less than 8 feet long.
   2. The electrode shall be installed in a vertical position and at least 8 feet (2.4 m) of length is in contact with the soil. When rock bottom is encountered preventing vertical installation to 8 feet (2.4 m), the rod may be driven at an angle not exceeding 45 degrees from the vertical. The top of the rod shall be at or below grade.

C. Gas Piping:
   1. Metal gas piping system shall not be used as a grounding electrode.

D. Bonding:
   1. Bond building structural steel, metallic water piping, fire protection piping, chilled water piping and heating piping to the main grounding electrodes. All electrodes shall be bonded together. Use pipe clamps to connect to pipes. Use stranded bare copper for the bonding conductor.

3.03 EQUIPMENT AND ENCLOSURE GROUNDING SYSTEM

A. Make mechanical connections and couplings on metal conduit systems and to enclosures wrench tight. On metallic conduits for circuits rated 100 amperes and higher, install grounding bushings at switchboards, panelboards and pull boxes and connect to panel or switchboard grounding lug or the next grounding bushing in the pull box. Use continuous copper conductor sized in accordance with NEC Table 250-95. Install green insulated equipment ground wire sized in accordance with NEC Table 250-95 or as indicated. On circuits over 250 volts to ground, install grounding bushings where the metal conduits enter enclosures through concentric, eccentric or oversize knockouts in accordance with NEC Article 250-76. Connect bonding jumper sized in accordance with NEC Table 250-95 to enclosure ground point and adjacent grounding bushings.

3.04 TESTING

A. The Contractor shall perform a test of the grounding network after it has been installed and before any equipment has been placed in operation. The resistance between absolute earth and the grounding electrode system shall not exceed 25.0 ohms. The Electrical Subcontractor shall be responsible for installing two additional 10 foot driven ground rods within 50 feet of the transformer pad if the test results exceed 25.0 ohms. This shall include the necessary grounding electrode conductor.

END OF SECTION

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SECTION 26 05 34
RACEWAYS, CONDUITS, AND TRENCHES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. An electrical conduit system shall be furnished and installed in accordance with the Drawings and the following Specifications. Conduit shall include all fittings and supports.

1.02 QUALITY ASSURANCE

A. Electrical conduit and associated materials shall conform with the requirements of all applicable standards.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

PART 2 PRODUCTS

2.01 CONDUIT

A. Galvanized rigid steel conduit may be used for underground or in poured concrete and shall be used in all electrically hazardous locations.

B. Three-fourths (3/4") inch shall be the minimum size conduit allowed.

C. Rigid nonmetallic conduit may be used for service entrance, feeders, and branch circuits with the following specific requirements:
   1. Conduit will be Schedule 40 PVC
   2. The conduit shall be embedded in the soil below the aggregate and shall be at least 12 inches below floor surface.
   3. PVC conduits shall not be used in suspended floor slabs.
   4. All conduit bends subject to physical damage and turning up through the floor shall be PVC coated galvanized rigid steel.
   5. A grounding conductor shall be provided in each conduit.

D. Aluminum rigid conduit shall be utilized in all exterior above-grade locations and in all wet and corrosive interior locations.
   1. Aluminum rigid conduit shall also be used in other areas as shown on the drawings.

E. In wet and corrosive locations, all sealtights shall be Carflex manufactured by Carlon, and all fittings shall be by Carlon and shall be liquid tight, non-metallic.

F. EMT may be used in office areas, toilets and laboratories, unless otherwise specified. Fittings shall be compression type, set-screw fittings are not acceptable.

G. A grounding conductor shall be installed in each conduit. Conduit shall not be used as a grounding conductor.

H. An individual neutral conductor will be run with each 120 volt or 277 volt, single phase, single pole circuit

2.02 CONDUIT FITTINGS

A. Conduit, elbows and couplings shall be as manufactured by the Youngstown Sheet and Tube Company or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Conduit systems shall be continuous from outlet to outlet, from outlets to cabinets and pull or junction boxes. They shall be rigid steel, electrical metallic tubing (EMT), rigid nonmetallic polyvinyl (PVC), or polyvinyl chloride coated rigid electrical conduit as specified herein or as indicated on the Drawings. Lock nuts and bushings shall secure the system in such a way as to be electrically continuous throughout. Conduit ends shall be capped to prevent entrance of foreign materials during construction.

B. Conduits shall be run parallel to building lines and long sweep bends shall be utilized.

C. If No. 4 or larger conductors enter a cabinet, pullbox, junction box or auxiliary gutter, the conductors shall be protected by a bushing. Also, on all conduits one and one-fourth inches (1 1/4") and larger, insulated bushings shall be utilized.

D. Ropes shall be installed in all empty or spare conduits to facilitate the pulling of future conductors.

E. The Contractor shall provide sleeves and inserts, correctly located in the structure, as required for his/her work.
   1. Inserts shall be steel and of proper size for loads encountered.
   2. Sleeves shall be provided for all conduit passing through concrete or masonry walls, partitions, concrete slabs or beams. Install during construction to avoid later cutting. Sleeves placed horizontally in walls or in any position in beams shall be standard weight ASTM A-5E steel pipe or length equal to thickness of wall or beam. Those placed vertically in non-waterproof floors shall be 20 gauge galvanized sheet steel of length equal to thickness of slab, flared and nailed to the form, or fastened to reinforcing fabric and filled with sand during pouring to prevent deformation. Sleeves in floors with waterproof membrane shall be provided with flanges or flashing rings and shall be clamped or flashed into the membrane. All sleeves shall be of sufficient diameter to clear conduit by 1/4" all around except sleeves on lines subject to movement by expansion shall clear the conduit by at least 1" all around.
   3. Sleeves around conduit through exterior walls shall be caulked watertight with oakum and plastic cement.

F. Equipment shall be installed in accordance with manufacturer's recommendations to conform with the details and applications indicated.
   1. Provide necessary support for all equipment and appurtenances as required. This includes, but is not limited to, frames or supports for items such as transformers, fans, electrical panels and other similar items requiring supports. Floor mounted equipment shall be set on a 4" high concrete housekeeping pad.

3.02 TRENCHING

A. Whenever possible, all exterior low voltage conduit and wiring systems shall be installed with a minimum of 24" of cover, unless shown otherwise. Banks of trenches shall be kept as vertical as practicable, and where required, shall be properly sheeted and braced. Rock shall be excavated to a minimum depth of 4" below trench depth specified. Over-depth shall be backfilled with loose moist sand and thoroughly tamped. Any water accumulated in the trench shall be removed by pumping before backfilling commences.

B. Trenches shall be backfilled with excavated materials approved for backfilling or other materials free from large clods of earth or stone, deposited in thoroughly and carefully compacted 6" layers, until the conductor/conduit has a cover of not less than 18". The remainder of the material shall be backfilled into the trench, moistened, and tamped in 12" layers.

C. Existing utility lines to be retained, whether known or uncovered during excavation operations, shall be protected from damage during operations, shall be protected from damage during excavation and backfilling and, if damaged, shall be restored to original condition.

END OF SECTION

SECTION 26 09 50
LIGHTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all electric lighting fixtures complete with lamps, as shown on the Lighting Fixture Schedule.

1.02 QUALITY ASSURANCE

A. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.03 LIGHTING FIXTURE SUPPLIERS

A. The design base fixtures are shown on the Lighting Fixture Schedule which is part of the construction document package. Approved suppliers are shown below:
   1. Suppliers as noted on the Lighting Fixture Schedule
   2. Or Approved Equal
   3. Substitutions: See Section 01 60 00 - Product Requirements.

PART 2 PRODUCTS

2.01 LIGHT FIXTURES

A. All fluorescent ballasts shall be electronic and shall be in compliance with Specification 26 09 52.

B. LED, Metal halide and high pressure sodium fixtures shall be furnished as specified on the Lighting Fixture Schedule. Ballast shall be for the scheduled fixture and suited to the electrical system specified.

C. All components shall conform to the general requirements and to U.L. standards for the following:
   1. Attachments, plugs and receptacles
   2. Ballasts, fluorescent - lamp
   3. Cabinets and boxes
   4. Conduit, flexible steel
   5. Fixtures, electric lighting
   6. Flexible cord and fixture wire
   7. Lampholders, edison base
   8. Lampholders, starters and starter holder for fluorescent lamps
   9. Lamps, portable electric
   10. Wire connectors and soldering lugs
   11. Wires and cables, rubber covered
   12. Wires, asbestos and asbestos-varnished, cloth insulated
   13. Wires, thermoplastic - insulated
   14. Wires, weatherproof and slow burning

D. Lighting Fixture Wiring
   1. Fixture wiring shall be large enough to handle the individual or combined power loads of each fixture, but in no case shall it be smaller than # 14, type AF stranded wire. The fixtures shall be U.L. listed for use in wet locations for "Wet" areas as noted on the Drawings. In the other areas they shall be U.L. listed. They shall carry IBEW wiring and fabrication labels.
   2. General lighting system branch circuit conductors shall be installed in conduit from the panelboards to outlets and between outlets as indicated on the Drawings.
   3. No. 12 wire shall be the smallest conductor used for any lighting branch circuits.

E. Lighting Fixture Locations
   1. Lighting fixture locations are carefully coordinated with ceiling patterns, outlets, walls, etc. Nonsymmetrical layouts are not acceptable unless previously approved. The fixtures shall be coordinated with the ceiling support system. The Contractor shall carefully review the Reflected Ceiling Plan and check for any changes before locating fixtures.

PART 3 EXECUTION

3.01 INSTALLATION

A. Lighting fixtures shall be suspended from structural members or from ceiling structural members, minimum 1-1/2" channels, by standard bar hangers, or other approved means. Under no circumstances will they be supported from the ceiling, including exit lights.

END OF SECTION

SECTION 26 09 51
LAMPS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Lamps shall be furnished and installed in all light fixtures in accordance with the Light Fixture Schedule.

1.02 QUALITY ASSURANCE

A. Products from the following manufacturers have been determined to be acceptable:
   1. Phillips
   2. Sylvania
   3. General Electric
   4. Or Approved Equal
   5. See Section 01 60 00 - Product Requirements

B. All lamps furnished on this project shall be guaranteed for 100% of manufacturer's published life data.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.03 DELIVERY, STORAGE, AND PROTECTION

A. Store lamps indoors and protect from physical damage.

B. Handle lamps carefully to prevent breakage.

PART 2 PRODUCTS

2.01 FLUORESCENT LAMPS

A. Fluorescent lamps shall be of the wattage and voltage as indicated on the Fixture Schedule. Lamps shall have an average rated life of not less than 18,000 hours. Lumen output at 70% rated life shall be not less than 80% of initial output. Any lamp failing during the first 200 days of burning shall be considered defective and shall be replaced without cost by the Electrical Contractor.

2.02 HIGH INTENSITY DISCHARGE LAMPS

A. High Intensity discharge lamps shall be of the wattage and voltage as indicated on the Fixture Schedule. Lamps shall have an average rated life of not less than 18,000 hours. Lumen output at 70% rated life shall be not less than 80% of initial output. Any lamp failing during the first 200 days of burning shall be considered defective and shall be replaced without cost by the Electrical Contractor.

2.03 LED LAMPS

A. LED lamps shall have the output and color temperature as noted on the drawings. Rated lamp life shall be a minimum of 50,000 hours.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.02 TEMPORARY LIGHTING

A. Temporary lighting shall be installed by the Contractor as required. Lighting shall be installed to provide 15 fc in work locations as required by the General Contractor or the Owner.

B. After the permanent fixtures have been installed, the temporary lighting may be supplied by utilizing the new fixtures. New lamps shall be installed throughout, when directed by the Engineer, approximately thirty days prior to final acceptance. Lamps previously in use shall become the property of the Contractor.

3.03 SPARE LAMPS

A. Three spare lamps for each type installed, or 5% of each type installed, whichever is greater, shall be turned over to the Owner upon completion of the work.

END OF SECTION

SECTION 26 09 52
FLUORESCENT BALLASTS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Electronic ballasts shall be used in all fluorescent fixtures as detailed in these specifications.

1.02 QUALITY ASSURANCE

A. Manufacturers: Electronic ballasts shall be the product of firms regularly engaged in the manufacture of electronic ballasts of the types required. The firm's products shall have been in satisfactory use in similar situations for not less than 5 years.

B. Products from the following manufacturers have been determined to be acceptable:
   1. Advance
   2. Or Approved Equal
   3. See Section 01 60 00 - Product Requirements

C. CBM Labels: Provide fluorescent lamp ballasts which comply with Certified Ballast Manufacturer's Association standards and carry the CBM label.

D. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.03 SUBMITTALS

A. Submit manufacturer's data on the proposed equipment. Data shall be sufficient to verify all ratings and requirements as called for in these specifications.

PART 2 PRODUCTS

2.01 ELECTRONIC BALLASTS

A. If electronic ballast is not available for a particular fixture, then energy saving ballasts shall be utilized.

B. Ballasts shall operate at an input frequency of 60 Hz and an input voltage of 108 to 132 volts.

C. Ballasts shall operate lamps at a frequency of 25 to 35 kHz with no detectable flicker.

D. Ballasts that operate as a parallel circuit shall permit other lamps to maintain full output after failure of companion lamp(s).

E. Rapid-start ballasts shall provide soft/stable start of rapid-start lamps and maintain full cathode heat during operation.

F. Ballasts shall comply with FCC and NEMA limits governing EMI and RFI and shall not interfere with operation of other normal electrical equipment.

G. Ballasts shall meet all applicable ANSI standards.

H. Ballasts shall not be affected by lamp failure and shall deliver normal lamp life.

I. Ballasts shall be high power factor, 85% or greater.

J. Operating temperature shall not exceed 60 degree C at any point on the case during normal operation.

K. Ballasts shall be potted, in a steel case and shall contain no PCBs.

L. Ballasts shall be marked with manufacturer's name, part number, supply voltage, power factor, open circuit voltage, current draw for each lamp type, and UL listing.

M. Ballasts used in exterior or unheated applications shall be capable of starting/operating the fixture at -20 degrees F.

N. Input current 3rd harmonic content shall not exceed 6%. Total harmonic distortion shall be less than 10%.

PART 3 EXECUTION

3.01 INSTALLATION

A. Electronic ballasts shall be factory installed if possible. Otherwise, contractor shall follow ballast manufacturer's installation instructions and any applicable requirements of the NEC.

B. Ballasts shall be firmly attached to the light fixtures housing.

C. Any ballasts found to be defective during the light fixture testing stage shall be replaced.

END OF SECTION

SECTION 26 09 53
EMERGENCY LIGHTING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. All emergency and exit lighting shall be furnished and installed in accordance with the Drawings and the following Specifications.

1.02 QUALITY ASSURANCE

A. Emergency and exit lighting shall meet all applicable UL, NFPA, NEC and OSHA rules and regulations.

B. Manufacturers: Firms regularly engaged in the manufacture of emergency fixtures and components of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
   1. Or Approved Equal
   2. Substitutions: See Section 01 60 00 - Product Requirements

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements of this Section. Provide products as indicated in Light Fixture Schedule (refer to Electrical Drawings).

B. Acceptable Substitutions: See Section 01600 - Product Requirements for substitution procedures. All substitutions for emergency and exit lighting shall be approved in advance by the Engineer.

2.02 EMERGENCY LIGHTING

A. Provide emergency lighting as noted on the Drawings. Emergency lighting shall be complete including, but not limited to, housings, lamps, lamp holders, reflectors, ballasts, starters and wiring.

B. Provide individual battery packs to provide emergency power, as noted on the Drawings.

C. All emergency lighting shall include an exposed test switch with an LED indicator.

2.03 EXIT LIGHTING

A. Provide exit lighting as noted on the Drawings. Exit lighting shall be complete including, but not limited to, housings, lamps, lamp holders, reflectors, ballasts, starters and wiring.

B. Provide individual battery packs to provide emergency power, as noted on the Drawings.
   1. Battery packs shall be capable of energizing fixture for a minimum of 90 minutes.

C. All exit lights shall be equipped with an exposed test switch with an LED indicator.

PART 3 EXECUTION

3.01 INSTALLATION OF EMERGENCY AND EXIT LIGHTING

A. Install all emergency and exit lighting at locations and heights as indicated in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NFPA, OSHA and with recognized industry practices to ensure that requirements are fulfilled.

B. Coordinate with other electrical work as appropriate to properly interface installations with other work.

C. Fasten fixtures securely to structural supports.

D. Exercise great care when handling lenses, avoiding contact with oily and/or foreign substances.

E. Clean fixtures of dirt and debris upon completion of installation. Protect installed fixtures from damage during remainder of project.

3.02 FIELD QUALITY CONTROL

A. Upon completion of installation of emergency and exit lights, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. At the time of Substantial Completion, replace lamps in light fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by Engineer.

3.03 GROUNDING

A. Provide tight equipment grounding connections for each light fixture installation.

END OF SECTION

SECTION 26 12 00
PAD MOUNTED TRANSFORMERS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish and install the pad mounted transformer(s) as specified herein and as shown on the contract drawings.

1.02 REFERENCES

A. The pad mounted transformer(s) and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and ANSI.

1.03 QUALITY ASSURANCE

A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Transformers shall be provided by:
   1. ABB
   2. Cooper
   3. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

PART 2 PRODUCTS

2.01 RATINGS

A. The ratings of the transformer shall be as follows or as shown on the drawings:
   1. kVA Rating - As Shown on the Drawings/ OA
   2. HV - As shown on drawings
   3. HV BIL - 95 kV
   4. HV Taps + 2 2 1/2% full capacity
   5. LV - As Shown on the Drawings - Grounded Wye
   6. LV BIL - 30 kV

2.02 CONSTRUCTION

A. The unit shall be mineral oil filled and shall be in accordance with the latest edition of the NEC. The transformer shall carry its continuous rating with average winding or temperature rise by resistance that shall not exceed 65 degree C rise, based on an average ambient of 300C over 24 hours with a maximum of 400C. (the transformer shall carry its continuous rating with average winding temperature rise by resistance that shall not exceed 550C, based on average ambient of 300C over 24 hours with a maximum of 400C. The insulation system shall allow an additional 12% kVA output at 650C average winding temperature rise by resistance, on a continuous basis, without any decrease in normal transformer life.

B. The transformer shall be designed to meet the sound level standards for liquid transformers as defined in NEMA and ANSI.

C. All high-voltage windings shall have insuldur paper or equal insulation between layers of the windings. All windings shall be copper.

D. The main transformer tank and attached components shall be designed to withstand pressures 25% greater than the required operating design value without permanent deformation. Construction shall consist of carbon steel plate reinforced with external sidewall braces. All seams and joints shall be continuously welded. Each radiator assembly shall be individually welded and receive a quality control pressurized check for leaks. The entire tank assembly shall receive a similar leak test before tanking. A final six-hour leak test shall be performed.

E. The transformer(s) shall be compartmental type, self-cooled, and tamper resistant for mounting on a pad. The unit shall restrict the entry of water (other than flood water) into the compartments so as not to impair its operation. There shall be no exposed screws, bolts, or other fastening devices which are externally removable. The transformer(s) shall consist of a transformer tank and full-height, bolt-on high- and low-voltage cable terminating compartments located side-by-side separated by a rigid metal barrier. Each compartment shall have separate doors, designed to provide access to the high-voltage compartment only after the low-voltage has been opened. There shall be at least one additional fastening device accessible only after the low-voltage door has been opened, which must be removed to open the high-voltage door. Doors shall be mounted flush with the cabinet frame. The low-voltage door shall have a handle-operated, three-point latching mechanism designed to be secured with a single padlock. A hex-head bolt shall be incorporated into the low voltage door latching mechanism. Both high- and low-voltage doors shall be incorporated into the low voltage door latching mechanism. Both high- and low-voltage doors shall be equipped with liftoff type stainless steel hinges and door stops to secure them in the open position.

F. Compartment sills, doors and covers shall be removable to facilitate cable pulling and installation. The high-voltage door shall be on the left with the low-voltage door on the right. Compartments shall be designed for cable entry from below and shall be sized to the minimum dimensions of ANSI C57.12.26.

G. Transformer(s) shall be supplied with a welded or bolted main tank cover and be of a sealed-tank construction designed to withstand a pressure of 7 psig without permanent distortion. The tank cover shall be domed to shed water and be supplied with a tamper-resistant access handhole sized to allow access to internal bushing and switch connections. The transformer shall remain effectively sealed for a top-oil temperature of -50C to 1050C. When necessary to meet the temperature rise rating specified above, flat cooling panels of the common header type shall be provided.

H. The transformer manufacturer shall certify that the transformer is Non-PCB containing no detectable PCBs. Do not provide nonflammable transformer liquids including askarel and insulating liquids containing tetrachloroethylene, perchloroethylene, chlorine compounds, or halogenated compounds.

I. When high-voltage taps are specified above, full-capacity taps shall be provided with a tap changing mechanism designed for deenergized operation. The tap changer operator shall be located within one of the compartments.

J. The coil windings shall be of the two winding type, designed to reduce losses and manufactured with the conductor material as specified above. The windings shall incorporate a secondary sheet conductor to maximize short-circuit strength. All insulating materials shall be rated 650C rise, 800C hot-spot operation.

K. The core material shall be high-grade, grain oriented, non-aging silicon core steel with high magnetic permeability, low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below saturation to allow for a minimum of 10 percent overvoltage excitation. The cores shall be properly annealed to reduce stresses induced during the manufacturing processes and reduce core losses.

L. The core frame shall be designed to provide maximum support of the core and coil assembly. The core frame shall be welded or bolted to ensure maximum short-circuit strength. The core and coil assembly shall be designed and manufactured to meet the short-circuit requirements of ANSI C57.12.90. The core and coil assembly shall be baked in an oven prior to tanking to "set" the epoxy coating on the Kraft paper and remove moisture from the insulation prior to vacuum filling.

M. Transformer shall be vacuum-filled with the appropriate fluid as indicated above. The process shall be of sufficient vacuum and duration to insure that the core and coil assembly are free of moisture prior to filling the tank.

2.03 FINISH

A. Each transformer shall be painted utilizing an initial phosphatizing cleaning treatment, followed by manufacturer's standard paint process baked on to a total of three (3) to five (5) mils average thickness. Outdoor liquid transformer units shall include suitable outdoor paint finish. Units shall be painted Pad-mount Green, Munsell No. 7GY3.29/1.5.

2.04 ACCESSORIES

A. Transformer features and accessories shall include: Dial-type thermometer, Liquid level gauge, Pressure-vacuum gauge, One (1) inch drain valve with sample valve, Pressure relief valve, Non-PCB label, One (1) inch upper fill/ filter press connection, and additional accessories as shown on drawings.

B. Transformers shall be dead front construction.

C. Each transformer shall be equipped with 9 KV lightning arresters mounted on the bushings of the transformer.

D. Each transformer shall be equipped with 4" IR windows in both the medium voltage and low voltage doors. IR windows shall have a clear view of the terminations within each compartment.

E. Transformer shall be equipped with 200 amp bushings.

2.05 PRIMARY FUSING

A. Provide bayonet draw-out overload sensing fuse in series with an under oil current limiting fuse.

2.06 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards

B. Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes of one unit only of a given rating on this project.
   1. Ratio tests on the rated voltage connection and on all tap connections.
   2. Polarity and phase-relation tests on the rated voltage connections.
   3. No-load loss at rated voltage on the rated voltage connection.
   4. Exciting current at rated voltage on the rated voltage connection.
   5. Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes of one unit only of a given rating on this project.
   6. Applied potential test.
   7. Induced potential tests.

PART 3 EXECUTION

3.01 GENERAL

A. INSTALL A 10' DRIVEN GROUND ROD AT EACH PADMOUNT TRANSFORMER. BOND TO TRANSFORMER, TRANSFORMER ENCLOSURE.

END OF SECTION

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SECTION 26 13 21
AIR INTERRUPTER SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Medium-voltage air interrupter switches.

B. Medium-voltage fuses.

1.02 REFERENCE STANDARDS

A. IEEE C37.20.3 - IEEE Standard for Metal-Enclosed Interrupter Switchgear; Institute of Electrical and Electronic Engineers; 2001.

B. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).

1.03 SUBMITTALS

A. Shop Drawings: Indicate outline dimensions, enclosure construction, shipping splits, lifting and supporting points, electrical single line diagram, and equipment electrical ratings.

B. Product Data: Provide data for components and accessories.

1.04 QUALITY ASSURANCE

A. Products: Listed, classified, and labeled as suitable for the purpose intended.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect interrupter switches from weather and moisture by covering with heavy plastic or canvas and by maintaining heating within enclosure in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D Products; HVL: www.schneider-electric.us.

B. Or Approved Equal
   1. In accordance with Section 01 60 00

2.02 AIR INTERRUPTER SWITCHES

A. Description: IEEE C37.20.3, switchgear assembly of individual air interrupter switches in free-standing cubicles, securely bolted together to form an integrated structure, suitable for installation where accessible by general public.
   1. System voltage as shown on drawings.

B. Enclosure: Weatherproof.
   1. Include continuous ground bus through switchgear assembly, securely connected to frame of each cubicle.
   2. Main Bus: Copper.
   3. Finish: Manufacturer's standard baked enamel paint 2 mils thick.

2.03 COMPONENTS

A. Interrupter Switch: Fused two position load interrupter switch.

B. Continuous Rating: 200 amperes.

2.04 ACCESSORIES

A. Surge Arrestors: Station class, rated 15 kV; mount in incoming line compartment.

B. Space Heaters: For 120 external source, sized by switchgear manufacturer.

C. Operating Handle: Permanently mounted, lockable in both positions, interlocked to prevent opening fuse compartment door with switch in CLOSED position.

2.05 MEDIUM-VOLTAGE FUSES

A. Manufacturers:
   1. Bussman.
   2. Or Approved Equal
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: Enclosed current limiting, non-expulsion type suitable for use outdoors in enclosure.

2.06 SOURCE QUALITY CONTROL

A. Provide factory inspection and testing in accordance with IEEE C37.20.3.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install on concrete pad as indicated on Drawings.

3.02 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Sections 7.5.1.1., 7.5.1.2., and 7.5.1.3.

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 34 - Conduit: Flexible conduit connections.

1.02 REFERENCE STANDARDS

A. IEEE C57.94 - Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers; Institute of Electrical and Electronic Engineers; 1982 (R2006).

B. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers; Institute of Electrical and Electronic Engineers; 1999 (R2004).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

D. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; National Electrical Contractors Association; 2009.

E. NEMA ST 20 - Dry-Type Transformers for General Applications; National Electrical Manufacturers Association; 2014.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2014

G. NEMA TP 1 - Guide for Determining Energy Efficiency for Distribution Transformers; National Electrical Manufacturers Association; 2002.

H. NEMA TP 2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers; National Electrical Manufacturers Association; 2005.

I. NEMA TP 3 - Standard for the Labeling of Distribution Transformer Efficiency; National Electrical Manufacturers Association; 2000.

J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).

K. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.

M. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D Products: www.schneider-electric.us.

B. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

C. Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
   1. Altitude: Less than 3,300 feet.
   2. Ambient Temperature:
      a. Greater than 10 kVA: Not exceeding 104 degrees F.
      b. Less than 10 kVA: Not exceeding 77 degrees F.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Insulation System and Allowable Average Winding Temperature Rise:
   1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
   2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

C. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.

D. Winding Taps:
   1. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.

E. Energy Efficiency: Standard efficiency complying with NEMA TP 1.
   1. Test efficiency according to NEMA TP 2.
   2. Label transformer according to NEMA TP 3.

F. Sound Levels: Standard sound levels complying with NEMA ST 20.

G. Transformer Enclosure: Comply with NEMA ST 20.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor clean, dry locations: Type 2.
      b. Outdoor locations: Type 3R.
   2. Construction: Steel.
      a. 15 kVA and Larger: Ventilated.
   3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
   4. Provide lifting eyes or brackets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1.

B. Install transformers in accordance with manufacturer's instructions.

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 26 05 34, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Provide grounding and bonding in accordance with Section 26 05 26.

G. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

H. Where not factory-installed, install lugs sized as required for termination of conductors as shown on the drawings.

3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

3.04 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 28 13 - Fuses: Fuses for fusible switches and spare fuse cabinets.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

B. NECA 407 - Standard for Installing and Maintaining Panelboards; National Electrical Contractors Association; 2009.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2013.

E. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association; 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association; 2013 (ANSI/NEMA PB 1.1).

G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).

H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 67 - Panelboards; Current Edition, Including All Revisions.

L. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

M. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

N. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

O. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.

1.06 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
   1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric, Square D Products

B. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 4X, stainless steel.
   2. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
   3. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

L. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

M. Load centers are not acceptable.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase and Neutral Bus Material: Copper.
   2. Ground Bus Material: Aluminum.

D. Circuit Breakers:
   1. Provide bolt-on type.
   2. Provide electronic trip circuit breakers where indicated.

E. Enclosures:
   1. Provide surface-mounted enclosures unless otherwise indicated.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Phase and Neutral Bus Material: Copper.
   3. Ground Bus Material: Copper.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
   1. Provide surface-mounted or flush-mounted enclosures as indicated.
   2. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Switches:
   1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
   2. Fuse Clips: As required to accept indicated fuses.
   3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

B. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
   2. Interrupting Capacity:
      a. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   3. Conductor Terminations:
      a. Lug Material: Copper, suitable for terminating copper conductors only.
   4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
      a. Provide the following field-adjustable trip response settings:
         1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
         2) Long time delay.
         3) Short time pickup and delay.
         4) Instantaneous pickup.
         5) Ground fault pickup and delay where ground fault protection is indicated.
   6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
   7. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
   8. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.

2.06 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required supports in accordance with Section 26 05 29.

E. Install panelboards plumb.

F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

H. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

I. Provide grounding and bonding in accordance with Section 26 05 26.

J. Install all field-installed branch devices, components, and accessories.

K. Provide fuses complying with Section 26 28 13 for fusible switches as indicated.

L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

M. Provide filler plates to cover unused spaces in panelboards.

3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 200 amperes. Tests listed as optional are not required.

D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

E. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 24 19
MOTOR-CONTROL CENTERS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Housekeeping pads.

1.02 REFERENCE STANDARDS

A. NECA 402 - Recommended Practice for Installing and Maintaining Motor Control Centers; National Electrical Contractors Association; 2007.

B. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; National Electrical Manufacturers Association; 2000 (R2005), with errata, 2008.

C. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers; National Electrical Manufacturers Association; 1995 (R2008).

D. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; National Electrical Manufacturers Association; 2000 (R2010).

E. NEMA ICS 6 - Industrial Control and Systems: Enclosures; National Electrical Manufacturers Association; 1993 (R2006).

F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time/current curves of all equipment and components.

1.04 QUALITY ASSURANCE

A. Products: Listed, classified, and labeled as suitable for the purpose intended.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with NEMA ICS 2.3. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Rockwell International, Allen-Bradley

B. Schneider Electric, Square D

C. Or Approved Equal

D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DESCRIPTION

A. Configuration: NEMA ICS 2, Class I, Type A motor control center.

B. Main Overcurrent Protection: Molded case circuit breaker.

C. Feeder Tap Units: Molded case thermal-magnetic circuit breakers.

D. Voltage Rating: 480 volts, three phase, four wire, 60 Hertz.

E. Horizontal Bus: Copper and rated as shown on drawings.

F. Vertical Bus: Copper.

G. Configuration: Units front mounting only, accessible from the front only.

2.03 AUTOMATIC CONTROLLERS

A. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Coil operating voltage: 120 volts, 60 Hertz.

C. Overload Relay: NEMA ICS 2; bimetal.

D. Enclosure: NEMA ICS 6, Type 1.

2.04 ACCESSORIES

A. Auxiliary Contacts: NEMA ICS 2, 2 normally open contacts in addition to seal-in contact.

B. Cover Mounted Pilot Devices: NEMA ICS 5, standard duty oiltight type.

C. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.

D. Pushbuttons: Unguarded type.

E. Indicating Lights: Transformer, LED type.

F. Selector Switches: Rotary type.

G. Control Power Transformers: 120 volt secondary, as scheduled. Provide fused primary, secondary, and bond unfused leg of secondary to enclosure.

2.05 DISCONNECTS

A. Thermal Magnetic Circuit Breakers: Integral thermal and instantaneous magnetic trip in each pole; UL listed.

2.06 SURGE PROTECTIVE DEVICES

A. Provide surge protection located in the motor control center.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are suitable for motor control center installation.

B. Verify that field measurements are as indicated on shop drawings.

3.02 PREPARATION

A. Provide housekeeping pads under the provisions of Section 03 30 00.

3.03 INSTALLATION

A. Install motor control centers in accordance with NECA 402.

B. Tighten accessible bus connections and mechanical fasteners after placing motor control center.

C. Select and install heater elements in motor starters to match installed motor characteristics.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The wiring devices are shown by symbols on the Drawings as part of the overall electrical systems and in the Legend and Schedules.

1.02 QUALITY ASSURANCE

A. Wiring devices shall be "specification grade" or better.

B. Products from the following manufacturers have been determined to be acceptable.
   1. General Electric
   2. Hubbell
   3. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

PART 2 PRODUCTS

2.01 DEVICES

A. Provide wiring devices of the type, color, and electrical rating for the service indicated.

B. The types of the electrical wiring devices required for the project include the following:
   1. Receptacles
      a. General Duty Duplex: Duplex general duty type receptacles shall be 2 pole, 3 wire grounding with green hexagonal equipment ground screw, ground terminal internally connected to mounting yoke, 20 ampere, 125 volts, with metal plaster ears, side wiring only, NEMA configuration 5-20R unless and except where otherwise indicated. All receptacles shall be ivory colored, style 5362.
      b. Weatherproof Receptacles: Weatherproof receptacles shall consist of the receptacle type indicated, mounted in a box with a gasketed, weatherproof, cast metal cover plate and separate cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring hinged flap. The weatherproof integrity shall not be affected when heavy duty specification attachment plugs are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.
      c. GFI Receptacles: Ground fault interrupter receptacles shall be feed through type capable of protecting connected downstream receptacles on single circuit, ivory, grounding type, UL rated Class A, Group 1, 20 ampere rating, 125 volts with solid state ground fault sensing and signaling, with 5 milliampere ground fault trip level, equipped with 20 ampere plug configuration, NEMA 5-20R.
      d. All other receptacles shall be of the appropriate type and voltage.
      e. All isolated ground receptacles shall be Hubbel No. IG 5352 or approved equal.
   2. Toggle Switches: Wall switches shall be general duty, totally enclosed with bodies of phenolic compound, butt contact, quiet AC type, with an integral mounting strap with provisions for side wiring with captively held binding screws, ivory, color-coded for current rating, style 1200.
      a. 120 volt circuits: 20 amperes at 120 volts AC
      b. 277 volt circuits: 20 amperes at 277 volts AC

3. Device plates shall be one piece type, single or multiple gang switch and duplex outlet wall plates for wiring devices, provide metal screws for securing plates to devices, screw heads colored to match finish of plate, and wall plates possessing the following additional features as indicated on the Drawings.
   a. For walls in wet and corrosive areas, plates shall be aluminum or stainless steel with rounded or beveled edges.
   b. In normal areas, plates shall be aluminum.
   c. Plastic device plates shall be noncombustible, mar-proof thermosetting, with 0.100 inch thickness minimum. Color shall match the wiring device.

PART 3 EXECUTION

3.01 TESTING

A. Test wiring devices to ensure electrical continuity of grounding connections, after energizing circuitry, demonstrate compliance with requirements of the project. Test each receptacle for proper polarization and ground continuity.

END OF SECTION

SECTION 26 28 18
MOTOR AND CIRCUIT DISCONNECTS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish and install all disconnects as noted on the Drawings.

1.02 QUALITY ASSURANCE

A. The following manufacturers are approved on this project:
   1. Square D
   2. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements.

B. Motor and circuit disconnects shall comply with all applicable standards.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

PART 2 PRODUCTS

2.01 SAFETY SWITCHES

A. Shall be fusible or non-fusible as shown on the Drawings.

B. Shall have the following features:
   1. Switch mechanism shall be the quick make, quick-break type.
   2. Copper blades, visible in the OFF position.
   3. An arc chute for each pole.
   4. External operating handle shall indicate ON and OFF positions and shall have lock-open padlocking provisions.
   5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position defeatable by a special tool to permit inspection.
   6. Where fuses are required, fuse holders shall be provided that accept only Class R fuses.
   7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
   8. Enclosures:
      a. Shall be the NEMA types shown on the Drawings for the switches.
      b. Where the types of switch enclosures are not shown, they shall be NEMA Type 1 for indoor and NEMA Type 4X (stainless steel) for outdoor.
      c. NEMA 4X enclosures shall be used in "wet and corrosive" interior locations.

C. Shall be heavy duty and horsepower rated as required, unless indicated otherwise.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install safety switches where indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and in accordance with recognized industry practices, to ensure that products serve the intended function.

END OF SECTION

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SECTION 26 29 13
ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

B. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; National Electrical Manufacturers Association; 2000 (R2005), with errata, 2008.

C. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; National Electrical Manufacturers Association; 2000 (R2010).

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).

E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.02 SUBMITTALS

A. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

1.03 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric, Square D Products

B. Rockwell International, Allen-Bradley

C. Or Approved Equal

D. Substitutions: See Section 01 60 00 - Product Requirements

2.02 AUTOMATIC CONTROLLERS

A. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Overload Relays: NEMA ICS 2; bimetal.

2.03 ACCESSORIES

A. Auxiliary Contacts: NEMA ICS 2, 2 normally open contacts in addition to seal-in contact.

B. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.

C. Control Power Transformers: 120 volt secondary, as scheduled. Provide fused primary, secondary, and bond unfused leg of secondary to enclosure.

2.04 DISCONNECTS

A. Combination Controllers: Combine motor controllers with disconnects in common enclosure. Obtain IEC Class 2 coordinated component protection.

B. Thermal Magnetic Circuit Breakers: Integral thermal and instantaneous magnetic trip in each pole; UL listed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.

B. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

C. Provide supports in accordance with Section 26 05 29.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

3.02 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION

SECTION 26 29 23
VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 DESCRIPTION

A. VF (Variable frequency) drives shall be utilized to control the speed of the motors, as shown on the drawings.

1.02 QUALITY ASSURANCE

A. VF drives shall be designed, constructed, and tested in accordance with NEMA, UL, NEC and IEEE recommendations when applicable.

B. Each VF drive shall be marked with an identifying UL label within the enclosure. Controllers that are not UL listed will not be considered.

C. Manufacturers: VF drives shall be the product of firms regularly engaged in the manufacture of VF drives of the type required. The firm's products shall have been in satisfactory use in similar situations for not less than 5 years.

D. VF drives shall be pretested (burned-in) at full load and full speed and cycled on a dynamometer in an ambient of no less than 40 degrees C.

E. VF drive shall comply with FCC rules and regulations Part 15, Subpart J, regarding radio frequency interference.

F. Total harmonic distortion shall be less than 10% with less than 4% 5th harmonic content.

G. Products from the following manufacturers are acceptable
   1. Allen Bradley
   2. Square D
   3. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements

H. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.03 SUBMITTALS

A. Submit manufacturer's data on the proposed VF drives. Data shall be sufficient to verify all ratings and requirements as called for in these specifications and shown on the Drawings.

1.04 DELIVERY, STORAGE, AND PROTECTION

A. Store drives indoors and protect from weather.

B. Handle drives carefully to prevent damage, denting or scoring finish.

PART 2 PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES

A. The VF drive shall convert 480 volts, +10% -5%, three phase, 60 Hz utility power to an adjustable frequency and voltage output for speed control from 10% to 100% of base speed. The VF drive shall be designed for variable torque and constant torque applications and shall be programmable. The electrical contractor shall determine the torque requirements by coordinating with the equipment suppliers.

B. Drives 75 horsepower and larger shall be12 pulse type or greater.

C. Acceleration and deceleration ramp rates shall be independently adjustable from 6 seconds to 60 seconds for soft starting and controlled stopping.

D. Current limit means shall be adjustable from 75% to 120% of motor full load current.

E. Automatic restarting upon application of power after a loss of line power shall not trip out the drive or blow any fuses.

F. Short-time rating shall be 150% of continuous rated output current for one minute.

G. Automatic speed reference port shall be isolated and shall be field convertible for a 4 to 20 ma or 0 - 10 v dc process control signal.

H. Protection:
   1. Unit shall be UL listed for 42,000 rms symmetrical amp fault withstand capability.
   2. Current limiting input fuses.
   3. Coordinated protection shall prevent component failures for the following:
      a. Output phase-to-phase short circuit
      b. Output ground fault
      c. Input undervoltage condition
      d. VF drive over-temperature condition
      e. Instantaneous overload
      f. DC bus overvoltage condition
      g. Sustained overload exceeding 115% of controller continuous rated output current
      h. Shoot-through condition

I. Diagnostic and status indicators
   1. VF drive shall be equipped with indicators to display status functions for the following:
      a. Bus overvoltage, ground fault, undervoltage, instantaneous overcurrent, over-temperature, overload timer, overload power up delay, drive enable, power supply, and motor current limit.

J. Pilot devices and meters
   1. The following devices shall be mounted on the front cover of the drive: Power on pilot light, run pilot light, drive fail pilot light, manual speed potentiometer, speed indicator, "hand-off-automatic" selector switch.

K. VF drives shall be equipped with an internal disconnect.

L. VF drive shall be suitable for the following service conditions:
   1. Elevation: To 3300 feet without derating.
   2. Ambient temperature range: 0 to 40 degree C.
   3. Humidity: To 95% non-condensing

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which drives are to be installed. Do not proceed with the work until all unsatisfactory conditions have been corrected in a manner acceptable for proper installation.

3.02 INSTALLATION

A. Install drives in accordance with manufacturer's written instructions, applicable requirements of the NEC and National Electrical Contractors Association "Standard of Installation", to insure the drives serve their intended purposes.

B. Anchor enclosures firmly to walls or structural surfaces, ensuring that they are permanently and mechanically secure.

C. Coordinate installation of drives with cable and raceway installation work.

D. Provide electrical connections within enclosures.

END OF SECTION

SECTION 26 29 30
PROGRAMMABLE LOGIC CONTROLLERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall provide programmable logic controllers (PLC) that will provide for control of process equipment, process oriented machinery, and process systems.

1.02 QUALITY ASSURANCE

A. PLC shall be manufactured by Allen Bradley.

B. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.03 REFERENCES

A. MIL STD 461B CS02: RFI/EMI Susceptibility.

B. NEMA Pub No. ICS2-230.42: Showering Arc Test.

C. ANSI C37.90a: Surge Withstand.

D. IEEE 472.

E. NFPA 70 (NEC).

F. UL508.

G. IEC 801-3: RFI Immunity.

H. IEC 801-5: Ground Continuity.

I. IEC 801-2: Electrostatic Discharge

J. IEC 61000-4-3: Electromagnetic Field.

K. IEC 61000-4-4: Fast transients.

L. IEC 61131-3: Programming Languages.

1.04 DEFINITIONS

A. AI: Analog Input

B. AO: Analog Output

C. Fixed: A PLC style consisting of a fixed number of I/O, a processor, and a power supply all in one enclosure. Some fixed PLCs have limited expansion ability.

D. CPU: Central Processing Unit

E. DI: Digital Input

F. Distributed I/O: Hardware that has been specially designed to function as Remote I/O.

G. DO: Digital Output

H. HMI: Human-Machine Interface

I. I/O Input and/or Output

J. Modular: A PLC style consisting of cards that are assembled to comprise a complete unit. All I/O, CPU, and Power Supply are dedicated cards. Typically, these cards are inserted into a chassis.

K. Master/Slave: Communication between devices in which one device, the master, controls all communications. The other devices, the slaves, respond only when queried by the master. Typically used in a Remote I/O application.

L. Peer to Peer: Communication between two or more devices, typically PLC's, in which each device can control the communication exchange.

M. PID: Control action, proportional plus integral plus derivative.

N. PLC: Programmable Logic Controller

O. Remote I/O: Remote I/O is any and all I/O that is located remotely from the processor. Remote I/O can be over a variety of communication protocols and can use standard rack based I/O, or special Remote I/O hardware referred to as Distributed I/O.

P. SCADA: Supervisory Control and Data Acquisition

1.05 SUBMITTALS

A. Product Data: For each type of PLC include dimensions, mounting arrangements, and weights. Also include, manufacturer's technical data on features, performance, electrical ratings, characteristics, terminal connections, and finishes.

B. Operation and Maintenance Data: Provide for each PLC component literature detailing routine maintenance requirements (if any).

C. Any requirements in this specification that cannot be met, shall be so noted on the submittal information.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer shall maintain, within 200 miles of Project site, a facility, system integrator, or panel shop capable of providing training, parts, and coordination of emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations:
   1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third party vendors will be acceptable.
   2. To insure reliability and compatibility with all aspects of the control system, all PLC equipment shall be from the same vendor as the SCADA software, Operator Interface Terminals, and Power Distribution Equipment.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for PLCs, minimum clearances between PLCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances, or with PLC vendors required distances if they are greater than the distances indicated.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver PLC components in packaging designed to prevent damage from static electricity, and physical damage..

B. Store PLCs according to manufacturers' requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect PLCs from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the PLC from all forms of electrical and magnetic energy that could reasonably cause damage.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: 0 to 55 deg C.
   2. Humidity: Less than 95 percent (noncondensing).
   3. Altitude: Not exceeding 6500 feet (3000 m).

1.09 PRODUCT PROTECTION

A. Control panel designer shall provide independent line fuses or circuit breakers, per the manufacturer's recommendation, for each power Supply, Input Module, Output Module, and other modules with separately derived power requirements.

B. Control panel designer shall insure that communication signals, 4-20mA signals, embedded HART signals, are properly conditioned for the PLC and protected from all sources of radiated energy or harmonics.

1.10 SPARE I/O

A. Each PLC will be sized to handle the required I/O plus a percentage of spares. When calculating spare I/O count, all fractional I/O points will be rounded up to the next whole I/O point. The resultant I/O count will be rounded up to next whole I/O card. When configuring spare I/O counts, use the following criteria:
   1. Analog Inputs (AI): Required for the PLC plus 20%.
   2. Analog Outputs (AO): Required for the PLC plus 20%.
   3. Digital Inputs (DI): Required for the PLC plus 20%.
   4. Digital Outputs (DO): Required for the PLC plus 20%.

1.11 SPARE PARTS

A. Furnish spare parts as described below for each type of PLC. Material shall be packaged for long term storage and identified with labels describing contents. Coordinate with each PLC-based control panel vendor to optimize the amount of spares that are provided.
   1. I/O Cards: Provide as a minimum a spare of each type of card identified. Provide an additional spare for every ten cards of a specific type installed.
   2. Processors: Provide as a minimum a spare for each type of CPU identified.
   3. PLC oriented Power Supplies: Provide as a minimum a spare of each type of power supply identified. Provide an additional spare for every ten power supplies of a specific type installed.
   4. Memory Cards: Provide as a minimum a spare of each type of card identified. Provide an additional spare for every ten cards of a specific type installed
   5. Specialty Modules: Provide as a minimum a spare of each type of module identified. Provide an additional spare for every ten modules of a specific type installed
   6. "Fixed" PLCs: Provide as a minimum a spare of each type of PLC identified. Provide an additional spare for every ten PLCs of a specific type installed.

PART 2 PRODUCTS

2.01 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:

B. Qualified Manufacturers:
   1. Only manufacturers that have been selling PLCs for a minimum of 5 years will be considered acceptable.

2.02 PROGRAMMABLE LOGIC CONTROLLERS

A. GENERAL:
1. The PLC shall collect data, perform process control functions, communicate with other PLCs, and distribute process information along the local area network.
2. The PLC shall be able to have its program downloaded from a remote workstation over the local area network, and be locally programmed from a portable laptop computer.
3. The executive firmware of all intelligent modules shall be stored in Flash memory and shall be able to be updated in the field using standard programming tools. Executive firmware files shall be readily available via a public web site.
4. The PLC shall have provisions for communicating unsolicited messages (report by exception) to an operator interface to reduce network traffic.
5. The PLC shall be field expandable to allow for the expansion of the system by the simple addition and configuration of hardware.
6. Each component shall include a clearly visible faceplate with appropriate data such as the manufacturer's model number and a brief description of the component's function.
7. All cables and connectors shall be as specified by the manufacturer. Cables shall be assembled and installed per the manufacturer's recommendations.
8. Each discrete point shall have a light emitting diode on the face of the module to indicate point status. Green shall indicate that the point is logic level "1", also referred to as "on" or "high".
9. The PLC shall utilize Ethernet protocols that meet the following:
   a. Protocols that are assigned to port 502 of the TCP/IP stack by the IANA (Internet Assigned Numbers Authority).
   b. Devices must utilize embedded web pages, or a physical means such as DIP switches, to be recognized and properly addressed on the network. Ethernet protocols that require network management software, or utilize configuration files that must be downloaded to Ethernet devices, for proper network addressing, and recognition are not acceptable.
   c. Will not rely on third party vendors to meet the above criteria.

B. PLC PROGRAMMING REQUIREMENTS:
1. All specified PLC platforms will be programmed using the same programming software package. PLCs that use multiple software programming packages under similar trade names will not be accepted. The programming software will have the following:
   a. Use of all textural and graphic languages specified in IEC 61131-3.
   b. An additional language dedicated to organization of the PLCs programs and function blocks. This language shall be in Sequential Function Chart (SFC) format.
   c. Addressing shall be as follows.
      1) Digital and Analog I/O will be mapped to fixed addresses.
      2) Processor status will be mapped to fixed addresses
      3) Internal words and other internal data can either be unmapped, or mapped to fixed addresses. If unmapped, the programming software will determine the location.
      4) Internal words, I/O and other non-processor status data will be able to be addressed by an alpha numeric pneumonic. This name will be used in unmapped variables, and in lieu of the address for mapped variables.
   d. Ability to store and retrieve instruction comments, program comments, rung comments, and other comments and notes in the PLC processor.
   e. Ability to convert from one supported PLC platform to another supported platform. Conversion shall be accomplished by exporting the program code, and importing to a new program with the desired PLC platform and configuration.
   f. The PLC programming software shall have the following tools for monitoring and troubleshooting the PLC program.
      1) Power flow animation for graphical languages.

2) A breakpoint capability to automatically halt the program just before a certain sequence is initiated.
3) Ability to advance the program step by step to insure proper operation.
4) Ability to create watch points for desired variables. These watch points will display the real time value of the variable.
5) Monitoring of step activity times within the SFC language.
6) The use of color to indicate execution progress.
7) The ability to create HMI like screens for enhanced troubleshooting and program monitoring.
8) Ability to create a table that will track a chosen variety of variables.

g. The PLC programming software shall allow creation of standard programming blocks. The blocks will be as follows:
1) The programmer will see each instance of a given block. To reduce PLC memory size, and increase processing speed, the programming software will use one instance for each type of DFB. The PLC will automatically manage calls and execution to insure proper code execution.
2) The programming blocks will contain programming sections. Each programmer added section can be designated as any of the four IEC languages.
3) The programming block will be able to be inserted into all four of the IEC languages in the main program. This ability will not be dependent on the languages used inside the block.
4) An internal database using unmapped variables. The variables associated with this block will be separate from the PLC database to prevent mapping conflicts.
5) Each block will appear to be a single instruction in the programming environment. The designer of the block will be able to designate pin assignments and names. These pins will be used to connect to the PLC database.

2. The Systems Integrator and/or PLC Programmer shall provide at a minimum 40 man hours to meet with the Engineer and Operators on-site to review the necessary control function, theory of operation, and sequence of operation for the system. These 40 man hours shall be provided within 60 days after the Notice to Proceed.

C. PLC ENVIRONMENTAL REQUIREMENTS:
1. The PLCs must meet or exceed the following environmental requirements:
a. Minimum temperature range:
1) Operating: 0-55 degrees C (+32 to +131 degrees F)
2) Storage: -25 to +70 degrees C (-13 to +158 degrees F)
b. Relative humidity: 30 to 95% non-condensing.
c. Altitude:
1) Operation 0-6,500 feet minimum
2) Storage 0-9,800 feet minimum
d. Degree of protection: NEMA 1 (IP20)
e. Vibration resistance in accordance with at least one of the following:
1) Installed rating:
(a) DIN rail mounted PLC: 10-57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz, and
(b) Panel or plate mounted PLC: 2-25 Hz, amplitude 1.6mm, acceleration 25-200 Hz.
2) In compliance with IEC 60068 and IEC 61131.
f. Shock resistance: 147m/s^2 for 11ms.

D. PLC:
1. Description: A PLC designed for up to 1024 points of I/O. This PLC shall offer enhanced processing and communication options and shall be a chassis mounted modular system. The PLC shall be programmed using IEC 61131-3 compliant programming software

2. Processor Features:
   a. Upon power loss, the PLC shall insure memory is transferred to flash memory before PLC ram powers down. PLCs with a battery backup will not be accepted.
   b. The PLC shall have on board status lights to indicate the following various functions:
      1) Green RUN lamp that will illuminate while the program is executing
      2) Red ERR lamp that will illuminate when a fault occurs in the processor
      3) Red I/O Lamp that will illuminate upon an I/O failure or configuration fault.
      4) Yellow SER COM lamp will illuminate when activity is present on the serial port
3. General I/ O Cards: The PLC shall have a series of general I/O cards. They will be as follows:
   a. Analog Inputs: All Analog input cards will offer isolation between channels.
      1) Four (4) channel +/- 10V, 0-20mA, B,E Thermocouple, Pt 100, Pt 1000, Ni 1000, 2 or 4-wire temperature probes input card.
      2) Four (4) channel RTD and Thermocouple card.
      3) Eight (8) channel RTD and Thermocouple card.
   b. Analog Outputs: All analog output cards will offer isolation between channels,
      1) Two (2) channel +/- 10V, 0-20mA output card
   c. Discrete Inputs:
      1) Sixteen (16) channel sink 24VDC input cards
      2) Sixteen (16) channel source 24VDC input cards
      3) Sixteen (16) channel 120VAC input card
      4) Thirty two (32) channel sink 24VDC input card
      5) Sixty four (64) channel sink 24VDC input card
   d. Discrete Outputs:
      1) Sixteen (16) channel 24VDC (0.5A/channel) protected transistor source output card
      2) Sixteen (16) channel 24VDC (0.5A/channel) protected transistor sink output card
      3) Thirty-two (32) channel 24VDC (0.5A/channel) protected transistor source output card
      4) Sixty-Four (64) channel 24VDC (0.5A/channel) protected transistor sink output card
      5) Eight (8) channel 24VDC 24VDC/240VAC isolated relay output card
      6) Sixteen (16) channel 24VDC/240VAC relay output card
      7) Sixteen (16) channel 48-240VAC (1A/channel) protected triac output card.
4. Specialized I/O Cards: The PLC shall have a series of application specific I/O cards. These will be as follows:
   a. High speed counter card: Eight (8) channels at 10 KHz, 16 bits. Two (2) inputs at 24VDC per channel. The card shall also be capable of handling four (4) incremental encoders in 32 bit.
   b. High performance high speed counter card: 2 channels at 60 KHz at 32 bits. Six (6) inputs at 24VDC and Two (2) reflex outputs per channel.
5. Communication Capabilities: The PLC shall have a support 10/100Mb Modbus TCP Ethernet, ASi V2 Master, Modbus, ASCII, CAN open, and Unitelway without the need for third party modules.
   a. Ethernet capabilities: When Ethernet communication is utilized, the PLC shall support the following capabilities:
      1) 10/100MB Ethernet with connection via RJ45 connectors.
      2) A memory card slot for storage of memory.
      3) Built-in web server supplied with pre-developed and installed system diagnostics screens viewable from any commercial web-browser, and the capability of adding custom developed screens.
      4) Support for bus, star, ring and tree topographies.
      5) Support for CSMA/CD methodology to access the network and prevent collisions.

6) Modbus TCP messaging
7) Use of ARP and RARP protocols to insure IP and MAC address correspondence.
8) Ability to be configured as a BootP client or DHCP server.
9) Ability to be configured as Faulty Device Replacement (FDR) server.
   (a) When configured, a replaced FDR compatible device will ask the FDR server for parameters. When this request is received, the PLC will transfer the desired IP address and all configuration parameters to the replaced device.
10) Support of SNMP
11) Global Data support for up to 64 station in each group.
12) I/O scanning that allows automatic read and write of remote I/O without programming over Modbus TCP protocol.

6. Power Supplies: The PLC shall have chassis mounted power supplies to power the chassis backplane, and provide power for the processor and applicable modules. The power supplies shall be available in both 24 VDC and 115 VAC models. The available power ratings will be from 16 to 36W.
7. Chassis: The PLC shall have chassis to mount processors, power supplies, and other applicable cards. The chassis shall come in 4, 6, 8, and 12 position configurations. The chassis will be designed to mount individual enclosed cards. The chassis shall not have top, bottom, or side walls. The cards will be secured to the chassis via a screw connection.
8. Other:
   a. Programming cable: The PLC shall utilize a USB to Mini B cable for programming. This cable shall be compatible with those designed for downloading digital cameras to USB compatible PC. Accordingly, this cable shall be available through most traditional retail stores serving the consumer electronics market.
   b. Alarming: The PLC shall have a configurable alarming capability. Each alarm point can be configured to display an alphanumeric message in the alarm buffer. The alarm buffer can be displayed via a web page, or on an operator interface screen.
   c. Connector cables:
      1) Unterminated connector cables shall be available for interfacing to the discrete and analog cards. These cables shall have one end terminated to HE10 terminal block modules. The other end shall be unterminated to allow custom interface to panel devices. The cable shall be available in 3, 5, and 10 meter lengths.
      2) Terminated connector cables shall be available for interfacing to the discrete and analog cards. These cables shall have one end terminated to interface to terminal block, or FCN socket, cards. The other end shall be terminated to interface with HE10 terminal block modules. These shall be available in lengths of 0.5, 1, 3, 5, and 10 meters.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, surfaces, and substrates to receive PLCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Anchor PLCs within enclosures as recommended by the PLC manufacturer.

B. Provide spacing around PLC as required by the PLC manufacturer to insure adequate cooling. Insure that the air surrounding and penetrating the PLC has been ambiently conditioned to maintain the required temperature and humidity range of the PLC.

C. Wires entering and exiting PLC components shall be sized to comply with the PLC manufacturers requirements. Doors on all components shall be able to be fully closed when all the wires are installed.

D. Ventilation slots shall not be blocked, or obstructed by any means.

E. For chassis mounted PLCs, no wiring, wire ducts, or other devices shall obstruct the removal of cards from the rack.

F. PLC lights, keys, communication ports, and memory card slots shall be accessible at all times. Lights shall be visible at all times when enclosure door is opened.

3.03 IDENTIFICATION

A. Identify PLC components, and wiring according to all applicable codes, standards and contract document sections.

B. Each I/O point shall be identified on the door of PLC I/O cards or on the surface of each "Fixed" or "Fixed" style PLC.

3.04 FIELD QUALITY CONTROL

A. Field Service: The PLC based control panel supplier shall provide a qualified service representative to perform the following:
   1. Inspect PLCs, wiring, components, connections, and equipment installation. Test and adjust supplied programmable controllers, components, and equipment.
   2. Assist in field testing of equipment including pre-testing and adjusting of controllers and its associated application program if necessary.
   3. Report results in writing.

3.05 DEMONSTRATION

A. Control panel supplier shall provide a qualified service representative to train Owner's maintenance personnel to adjust, operate, and maintain PLCs. Manufacturer's standard training will be sufficient unless specified elsewhere.

END OF SECTION

SECTION 26 29 40
HUMAN MACHINE INTERFACE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Contractor shall provide Human Machine Interface Terminals and associated configuration software for control and visualization of process equipment, process oriented machinery, and process systems.

1.02 REFERENCES

A. NFPA 70 (NEC)
B. UL508
C. EN61131-2
D. IEC 61000-6-2
E. FCC (Class A)
F. UL 1604
G. CSA C22-2 #14
H. ANSI/NEMA ICS 6
I. API RP550
J. ISA S5.4
K. IAS S20
L. ISA S50.1
M. ISA S51.1

1.03 DEFINITIONS

A. AI: Analog Input
B. AO: Analog Output
C. Control Panel Designer: A firm or individual that is responsible for designing the layout of control panels. This entity will choose the devices to be included in the panel, and will decide on the actual layout.
D. CPU: Central Processing Unit
E. DI: Digital Input
F. DO: Digital Output
G. HMI: Human-Machine Interface
H. I/O Input and/or Output
I. Node: A network connection point. Examples include a PLC, PC, Operator Interface Terminal, Switch, Server, etc.
J. OIT: Operator Interface Terminal: A terminal usually embedded in a control panel that allows the operator to view and modify control system parameters. Operator Interface Terminals are not capable of running commercially available software.
K. Operator Station: A terminal that runs a commercially available operating system such as Windows or Linux. An Operator Station will usually execute the SCADA software. Operator Stations are usually desktop mounted personal computers. However, they may be computers that are designed to be embedded in the doors of control panels and motor control centers (MCC)
L. PID: Control action, proportional plus integral plus derivative.
M. PLC: Programmable Logic Controller.

N. SCADA: Supervisory Control and Data Acquisition. A SCADA System is a computer (typically a personnel computer), or a group of computers and servers running a software dedicated for SCADA purposes. This SCADA software can exchange over industrial networks, with PLC's, VFD's, and other industrial devices. Typically, the SCADA software will allow for trending, graphic display, alarm tracking, and reporting of data.

O. SCADA System Supplier: A company that takes a commercially available SCADA software package, and then develops a project-specific application. This company will typically supply hardware to run the SCADA software and project-specific application.

1.04 SUBMITTALS

A. For each type of Operator Interface Terminal include dimensions, mounting arrangements, and weights. Also include, manufacturer's technical data on features, performance, electrical ratings, characteristics, terminal connections, and finishes.

B. Each Operator Interface Terminal type shall have a separate check sheet. This check sheet shall be an acknowledgement of all criteria in this specification. The check sheet will consist of three columns. The leftmost column will indicate the referenced section of the specification. The middle column will indicate whether the indicated specification criteria are met, not met, or has a variance. The rightmost column will be used to describe reasons for variances or for not meeting the specified criteria. Each row on the check sheet will be for a dedicated specification section or sub-section. Each organization delineation will have its own dedicated row. For instance, you cannot accept section 1.5B and its corresponding subparagraphs in a single row. You must accept 1.5B in a row, and 1.5B1 in another row.

C. Operator Interface Terminal supplier shall be responsible for providing accurate and complete submittals in a timely fashion so as to not cause delay to the project schedule.

D. Once submitted, Operator Interface Terminal suppliers shall not proceed with their associated work until the reception of submittals marked as “Approved” or “Approved as noted”.

E. Operation and Maintenance Data: Provide for each Operator Interface Terminal component literature detailing routine maintenance requirements (if any).

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer shall have, within 200 miles of Project site, a facility, system integrator, or panel shop capable of providing training, parts, and coordination of emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations:
   1. All Operator Interface Terminals shall be from a single manufacturer.
   2. Operator Interface Terminals shall be from the same manufacturer of the PLC equipment.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for Operator Interface Terminals, minimum clearances between Operator Interface Terminals, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances, or with Operator Interface Terminal vendors required distances if they are greater than the distances indicated.

G. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver Operator Interface Terminals in packaging designed to prevent damage from static electricity, and physical damage.

B. Store Operator Interface Terminals according to manufacturers' requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect Operator Interface Terminals from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the Operator Interface Terminals from all forms of electrical and magnetic energy that could reasonably cause damage.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: 0 to 50 deg C.
   2. Humidity: Less than 85 percent (non-condensing).
   3. Altitude: Not exceeding 2000 meters (6500 feet).

1.08 PRODUCT PROTECTION

A. Control panel designer shall insure that communication signals are properly conditioned for the Operator Interface Terminal and protected from all sources of radiated energy or harmonics.

B. The Operator Interface Terminal shall be powered from the associated control panel and protected by dedicated fuses or a breaker in the control panel

PART 2 - PRODUCTS

2.01 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. Qualified Manufacturers:
      a. Only manufacturers that have been selling Operator Interface Terminals for a minimum of 5 years will be considered acceptable.
      b. Allen Bradley is an acceptable supplier.
      c. Or Approved Equal
      d. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GENERAL:

A. One operator interface terminal shall be supplied at each PLC location.

B. All of the Operator Interface Terminals shall comply with the following general requirements as a minimum.
   1. Certifications: The Operator Interface Terminal will have certifications by CE, CSA, UL Class 1 Division 2 T4A or T5 (UL and CSA), and C-Tick
   2. Power Supply: The Operator Interface terminal will have a nominal voltage of 24VDC with a range of 19.2-28.8Volts DC. The power supply will have a voltage cut of </= 10milliseconds maximum and an Inrush current of </= 50A Maximum. Connection of power will be via a 3 terminal screw terminal block. This block will be pitched at least 5mm, and will have a tightening torque of 0.5Nm.
   3. Real-time Clock: All Operator Interface Terminals shall have a built-in real-time clock.
   4. LED Diagnostics: A single LED visible from the front panel, without the need to open the control panel door, will be used to indicate status of the terminal. The LED will be green during normal operation, orange if the back-lighting is faulty, and red under various fault conditions. Units using multiple LEDs, or LED's visible from the back of the unit will not be acceptable.

5. To protect the owner's ability to competitively bid future projects, the Ethernet network shall utilize open protocols that are in the public domain. This protocol shall be the Modbus TCP/IP Network. Equipment to convert a non-public domain Ethernet protocol to a public domain protocol shall not be accepted.

2.03 ENVIRONMENTAL REQUIREMENTS:

A. All of the Operator Interface Terminals shall be capable of withstanding the following criteria as a minimum.
   1. Temperature: The Operator Interface Terminal shall be rated to operate in a range of 0-50° C. (32-122 ° F.). The unit shall be able to withstand a range of -20-60° C. (-4-140 ° F.) while in storage.
   2. Relative Humidity: The Operator Interface Terminal shall be capable of handling a minimum of non-condensation humidity of 0-85%.
   3. Altitude: The Operator Interface Terminal shall be designed to operate between 0-6500 feet above sea level minimum without derating.
   4. Degree of Protection: The Operator Interface Terminal shall have a front panel rating of IP 65 and conform to IEC 60529. This rating shall be a NEMA 4X rating suitable for indoor use only. The back panel rating shall be IP 20 and conform to IEC60529.
   5. Shock Resistance: The Operator Interface Terminal shall conform to IEC 60068-2-27; Semi-sinusoidal Pulse for 11ms, and 15gn on 3 axes.
   6. Vibration: The operator Interface Terminal shall conform to IEC 60068-2-6. The Terminal shall be capable of 5-9Hz at 3.5 mm, and 9-150Hz at 1g.
   7. Electrostatic Discharge: The Operator Interface Terminal shall conform to IEC61000-4-2, level 3.
   8. Electromagnetic Interference: The Operator Interface Terminal shall conform to IEC 61000-4-3, 10 V/m.
   9. Electrical Interference: The Operator Interface Terminal shall conform to IEC 61000-4-4, level 3.

2.04 OPERATOR INTERFACE TERMINAL

A. Description: Terminals shall be color, touch screen and sized as shown on the drawings.

B. Operator interface terminals shall be Rockwell PanelView Plus 6.

C. RAM: The Operator Terminal shall be supplied with lithium batteries to back up 512Kb SRAM.

D. Communication Ports: The Operator Interface Terminals shall have the following:
   1. For screen sizes of 5 inches or greater viewable area, an RJ-45 port, and an integral 9-way male SUB-D connector, dedicated to serial communications shall be provided. The 9-way SUB-D connector shall support RS232/RS485 Communications. The RJ-45 port shall support RS485 communications. Additionally, a standard type A host USB connector shall be provided for application downloading. Operator Interface Terminals relying on the same port for communications and downloading shall not be acceptable.
   2. The terminal will be supplied with an integral RJ-45 port dedicated to Ethernet TCP/IP communications.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, surfaces, and substrates to receive Operator Interface Terminals for compliance with requirements, installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Select Operator Interface Terminals based upon I/O, memory, communication, expansion, and other criteria. If multiple Operator Interface Terminal-based control panels will be supplied from different vendors, coordinate with other vendors to insure that Operator Interface Terminals are of identical brand and are equipped to utilize identical communication networks.

3.03 INSTALLATION

A. Anchor Operator Interface Terminals within enclosures as recommended by the Operator Interface Terminal manufacturer.

B. Provide spacing around Operator Interface Terminals as required by the Operator Interface Terminals manufacturer to insure adequate cooling. Insure that the air surrounding and penetrating the rear and sides of the Operator Interface Terminal has been ambiently conditioned to maintain the required temperature and humidity range of the Operator Interface Terminal.

C. Wires entering and exiting Operator Interface Terminals shall be sized to comply with the manufacturers requirements.

D. During installation, upper ventilation slots shall be covered to prevent accidental debris entry. However, during normal operation ventilation slots shall not be blocked, or obstructed by any means.

3.04 IDENTIFICATION

A. Identify Operator Interface Terminal components, and wiring according to all applicable codes, standards and contract document sections.

3.05 FIELD QUALITY CONTROL

A. Field Service: The Operator Interface Terminal-based control panel supplier shall provide a qualified service representative to perform the following:
   1. Inspect Operator Interface Terminal, wiring, components, connections, and equipment installation. Test and adjust supplied Operator Interface Terminals, components, and equipment.
   2. Report results in writing.

3.06 DEMONSTRATION

A. Control panel supplier shall provide a qualified service representative to train Owner's maintenance personnel to adjust, operate, and maintain Operator Interface Terminals. Manufacturer's standard training will be sufficient unless specified elsewhere.

END OF SECTION

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SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Clearing and protection of vegetation.

B. Removal of existing debris.

1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

C. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.

D. Section 31 22 00 - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Site Plan: Showing:
   1. Vegetation removal limits.
   2. Areas for temporary construction and field offices.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill Material: As specified in Section 31 22 00 - Grading

PART 3 EXECUTION

3.01 SITE CLEARING

A. Comply with other requirements specified in Section 01 70 00.

B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 EXISTING UTILITIES AND BUILT ELEMENTS

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Protect existing structures and other elements that are not to be removed.

3.03 VEGETATION

A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.

B. Do not begin clearing until vegetation to be relocated has been removed.

C. Do not remove or damage vegetation beyond the limits indicated on drawings.
   1. 40 feet outside the building perimeter.
   2. 10 feet each side of surface walkways, patios, surface parking, and utility lines less than 12 inches in diameter.
   3. 15 feet each side of roadway curbs and main utility trenches.
   4. 25 feet outside perimeter of pervious paving areas that must not be compacted by construction traffic.

5. Exception: Specific trees and vegetation indicated on drawings to be removed.

D. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:
   1. At vegetation removal limits.
   2. Around other vegetation to remain within vegetation removal limits.

E. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.

F. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
   1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
   2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
   3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
   4. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
   5. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.

G. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.

H. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.04 DEBRIS

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 31 22 00
GRADING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required for the removal of topsoil, rough grading, finish grading, and removal and disposal of topsoil and sub-soil which is within the limits of the work necessary for construction in accordance with the specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the Drawings or established by the Engineer.

1.02 RELATED REQUIREMENTS

A. Section 31 10 00 - Site Clearing.

B. Section 31 23 16 - Excavation.

C. Section 31 23 23 - Fill: Filling and compaction.

D. Section 31 23 16.13 - Trenching: Trenching and backfilling for utilities.

1.03 SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: See Section 31 23 23.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect from damage above- and below-grade utilities to remain.

D. Notify utility company to remove and relocate utilities.

E. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.

F. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.

G. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.

B. Do not remove topsoil when wet.

C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.

D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

E. When excavating through roots, perform work by hand and cut roots with sharp axe.

F. See Section 31 23 23 for filling procedures.

G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.

H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.04 SOIL REMOVAL

A. Stockpile topsoil to be re-used on site; remove remainder from site.

B. Stockpile excavated subsoil on site.

C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.05 FINISH GRADING

A. Before Finish Grading:
   1. Verify building and trench backfilling have been inspected.
   2. Verify subgrade has been contoured and compacted.

B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products.

C. Where topsoil is to be placed, scarify surface to depth of 3 inches.

D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.

E. Place topsoil in areas where seeding are indicated.

F. Place topsoil where required to level finish grade.

G. Place topsoil to the following compacted thicknesses:
   1. Areas to be Seeded with Grass: 6 inches.
   2. Shrub Beds: 18 inches.
   3. Flower Beds: 12 inches.

H. Place topsoil during dry weather.

I. Remove roots, weeds, rocks, and foreign material while spreading.

J. Near plants spread topsoil manually to prevent damage.

K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

L. Lightly compact placed topsoil.

3.06 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.

B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

C. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

D. Top Surface of Finish Grade: Plus or minus 1/2 inch.

3.07 REPAIR AND RESTORATION

A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.

B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Engineer as to remedy.

C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 FIELD QUALITY CONTROL

A. See Section 31 23 23 for compaction density testing.

3.09 CLEANING

A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.

B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

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SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required for all excavation required to complete the Work as shown on the Drawings and as specified herein.

1.02 RELATED REQUIREMENTS

A. Section 31 22 00 - Grading: Soil removal from surface of site.

B. Section 31 22 00 - Grading: Grading.

C. Section 31 23 23 - Fill: Fill materials, filling, and compacting.

D. Section 31 23 16.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

1.03 PROJECT CONDITIONS

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. See Section 31 22 00 for additional requirements.

3.03 EXCAVATING

A. Excavation shall include the loosening, loading, removing, and transporting and disposing of all materials, wet or dry, necessary to be removed for the purpose of construction; all dewatering, bailing, sheeting and bracing necessary to maintain trenches and pits in a safe and workable condition and sufficiently dry to enable proper execution of the work. Shoring construction to be designed by professional engineer licensed in the state in which the Work is to be located.

B. Underpin adjacent structures that could be damaged by excavating work.

C. Excavate to accommodate new structures and construction operations.

D. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

E. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

F. Do not interfere with 45 degree bearing splay of foundations.

G. Cut utility trenches wide enough to allow inspection of installed utilities.

H. Hand trim excavations. Remove loose matter.

I. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.

J. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23.

K. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; any such excavation under or adjacent to the 45 degree bearing splay of new or existing structures which may cause a weakening of the structure shall be filled with concrete, as directed by the Engineer, at the expense of the Contractor.

L. Where the bottom of the excavation at subgrade is found to be unstable, frozen, excessively soft or loose or to include deleterious materials such as ashes, cinders, all types of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material which, in the judgement of the Engineer should be removed, such unsuitable material shall be removed to expose firm native soils to the width and depth directed by the Engineer and at no cost to the Owner.

M. Where the bottom of the excavation at subgrade is found to consist of material which is unstable to such a degree that, in the opinion of the Engineer, it cannot be removed and replaced with an approved material compacted as required in place to support the pipe properly, a foundation for the structure consisting of piling, timbers or other materials, shall be constructed in accordance with Drawings prepared by the Engineer. The Contractor shall be reimbursed for this Extra Work in accordance with Section 01 20 00 - Price and Payment Procedures.

N. Provide suitable means to promptly and effectively remove water from all excavations and keep such excavations dry until the work or structures to be built therein have been satisfactorily completed.

O. Provide for all dewatering necessary in order that the construction may proceed in a safe workmanlike manner.

P. Provide for the disposal of the water removed from the excavation in such a manner as shall not create a nuisance, cause water pollution, cause injury to public health, private property, any portion of the work completed or in progress, the surface of the streets, or any impediment to the use of the site.

Q. In no case shall water be permitted to run over the excavated subgrade or foundation or through the conduits.

R. Provide well points, pumps or other approved means to keep the ground water sufficiently low, in the opinion of the Engineer, to permit the placing of concrete, masonry, or pipe in first class condition; and sufficiently long thereafter to protect the concrete, masonry, or joints against washing or damage.

S. Grade top perimeter of excavation to prevent surface water from draining into excavation.

T. Remove excavated material that is unsuitable for re-use from site.

U. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.

V. Remove excess excavated material from site.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.

B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

3.05 PROTECTION

A. All excavation work is to be conducted in accordance with OSHA Safety and Health Regulations for Construction (29 CFR 1926; Subpart P - Excavations).

B. For pipe and utility trenches, excavations shall be dug such that the pipe can be laid to the alignment and depth required.

C. Excavations shall be braced and drained that the workmen may work therein safely and efficiently.

D. For pipe and utility trenches, the width of the trench shall be ample to permit the pipe to be laid and jointed properly, and the backfill to be placed and compacted in accordance with Section 02316.

E. Excavations shall be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting and bracing, and handling of fittings.

F. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

G. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION

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SECTION 31 23 16.13
TRENCHING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required for the trenching for site utilities as shown on the Drawings and as specified herein.

1.02 SECTION INCLUDES

A. Backfilling and compacting for utilities outside the building to utility main connections.

1.03 RELATED REQUIREMENTS

A. Section 31 22 00 - Grading: Site grading.

B. Section 31 23 16 - Excavation: Building and foundation excavating.

C. Section 31 23 23 - Fill: Backfilling at building and foundations.

1.04 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

B. Subgrade Elevations: Indicated on drawings.

1.05 REFERENCES

A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.

B. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.

C. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.

D. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

C. Compaction Density Test Reports.

1.07 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where indicated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. See Section 02316 Fill and Backfill.

2.02 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.

B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

C. If tests indicate materials do not meet specified requirements, change material and retest.

D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. See Section 31 22 00 for additional requirements.

3.03 TRENCHING

A. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Cut trenches wide enough to allow inspection of installed utilities.

E. Hand trim excavations. Remove loose matter.

F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

G. Remove excavated material that is unsuitable for re-use from site.

H. Remove excess excavated material from site.

3.04 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

A. Backfill to contours and elevations indicated using unfrozen materials.

B. Fill up to subgrade elevations unless otherwise indicated.

C. Employ a placement method that does not disturb or damage other work.

D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.

G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.

H. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

I. Correct areas that are over-excavated.
   1. Thrust bearing surfaces: Fill with concrete.
   2. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.

J. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
   2. At other locations: 95 percent of maximum dry density.

K. Reshape and re-compact fills subjected to vehicular traffic.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

A. Use general fill unless otherwise specified or indicated.

B. Utility Piping:
   1. Bedding: Use granular fill.
   2. Cover with general fill.
   3. Fill up to subgrade elevation.
   4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.

C. At Pipe Culverts:
   1. Bedding: Use granular fill.
   2. Cover with general fill.
   3. Fill up to subgrade elevation.
   4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.

3.07 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.08 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.

B. Compaction density testing will be performed on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D3017, or ASTM D6938.

C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor").

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

E. Frequency of Tests: one (1) test per 2,500 SF per lift.

3.09 CLEANING

A. Leave unused materials in a neat, compact stockpile.

B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

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SECTION 31 23 23
FILL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to complete all fill and backfill required to complete the Work as shown on the Drawings and as specified herein.

1.02 RELATED REQUIREMENTS

A. Section 01 57 13 - Temporary Erosion and Sedimentation Control: Slope protection and erosion control.

B. Section 31 22 00 - Grading: Site grading.

C. Section 31 23 16 - Excavation: Removal and handling of soil to be re-used.

D. Section 31 23 16.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

1.03 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

B. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010

B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2012.

C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.

D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012.

E. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.

F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.

G. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

H. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.

I. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Materials Sources: Submit name of imported materials source.

C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where designated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill: Subsoil excavated on-site.
   1. Graded.
   2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
   3. Conforming to ASTM D2487 Group Symbol CL.

B. Structural Fill - Granular Soil Fill Type conforming to ASTM D 2487 Group Symbol GW, GP, GM, SM, SW, and SP classified in accordance with the Unified Soil Classification System (USCS). Furthermore, the material to be utilized as structural fill should have a Plasticity Index (PI) less than 20. Free of lumps larger than 3 inches, rocks larger than 2 inches, organic matter, and debris.

C. Drainage Fill - ASTM C 33 Size AASHTO 57 stone: Crushed stone or gravel; washed, free of clay, shale, organic matter.

D. Dense Graded Aggregate Fill - Well graded aggregate crushed stone. Conforming to the State of the State in which the Project is located Department of Transportation standards.

E. Concrete for Fill: Lean concrete.

F. Granular Fill - Gravel: Angular crushed washed stone; free of shale, clay, friable material and debris.
   1. Graded in accordance with ASTM D2487 Group Symbol GW.

G. Granular Fill - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter.
   1. Grade in accordance with ASTM D2487 Group Symbol GM.

H. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
   1. Grade in accordance with ASTM D2487 Group Symbol SW.

I. Topsoil: Topsoil excavated on-site.
   1. Unclassified.
   2. Graded.
   3. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.
   4. Acidity range (pH) of 5.5 to 7.5.
   5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
   6. Conforming to ASTM D2487 Group Symbol OH.

2.02 ACCESSORIES

A. Vapor Retarder: 10 mil thick, polyethylene.

2.03 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.

B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

C. If tests indicate materials do not meet specified requirements, change material and retest.

D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the Work are as indicated.

B. Identify required lines, levels, contours, and datum locations.

C. See Section 31 22 00 for additional requirements.

D. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

E. Verify structural ability of unsupported walls to support imposed loads by the fill.

3.02 PREPARATION

A. Prior to the construction of foundations, ground slabs or roads/parking lots, or the placement of fill in structural areas, all existing organic bearing materials, frozen or wet, excessively soft or loose soils, and other deleterious materials should be removed and wasted.

B. After the stripping operations have been completed, the exposed subgrade soils should be inspected by the Geotechnical Engineer. The exposed subgrade materials should be sealed with a smooth-drum roller and proofrolled utilizing a heavily-loaded dump truck or other pneumatic tired vehicle of similar size and weight, if conducted during dry weather. If the site is wet at the time of stripping and filling, then the Contractor should first install surface drainage features (swales, drains, sloping surface, etc.). The inspecting engineer should determine the means to evaluate the stripped subgrade if the operation is scheduled when the site is wet. The purpose of subgrade sealing and proofrolling is to provide surficial densification and to locate any isolated areas of soft or loose soils requiring undercutting. Proofrolling is not advised in wet areas which may destabilize under repeated vehicular loading. Precipitation may result in standing water (perched water) at low areas. If the water is allowed to pond, the natural soils may deteriorate and overexcavation or subgrade improvement may be necessary at those areas. The Geotechnical Engineer should be consulted to evaluate subgrade conditions during construction. The Geotechnical Engineer may require the use of lightly loaded equipment to proofroll in an effort to not destabilize the subgrade.

C. For the proofrolling and fill compaction operations, fill limits should be extended at least five feet beyond the wastewater treatment facility boundaries including new road/parking lot and ancillary structures.

D. Scarify subgrade surface to a depth of 6 inches to identify soft spots.

E. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

F. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

G. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

A. For the proofrolling and fill compaction operations, fill limits should be extended at least five feet beyond the wastewater treatment facility boundaries including new road/parking lot and ancillary structures. Fill to contours and elevations indicated using unfrozen approved materials.

B. Fill to contours and elevations indicated using unfrozen materials.

C. Fill up to subgrade elevations unless otherwise indicated.

D. Employ a placement method that does not disturb or damage other work.

E. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

F. Maintain optimum moisture content of fill materials to attain required compaction density.

G. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.

H. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.

I. Slope grade away from building minimum 2 inches in 10 ft. Make gradual grade changes. Blend slope into level areas.

J. Correct areas that are over-excavated.
   1. Load-bearing foundation surfaces: Use structural fill, flush to required elevation, compacted to 100 percent of maximum dry density.
   2. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.

K. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 97 percent of maximum dry density.
   2. At other locations: 95 percent of maximum dry density.

L. Reshape and re-compact fills subjected to vehicular traffic.

3.04 FILL AT SPECIFIC LOCATIONS

A. Use general fill unless otherwise specified or indicated.

B. Under Interior Slabs-On-Grade:
   1. Use granular fill.
   2. Depth: 4 inches deep.
   3. Compact to 95 percent of maximum dry density.

C. At Foundation Walls and Footings:
   1. Use general fill.
   2. Fill up to subgrade elevation.
   3. Compact each lift to 90 percent of maximum dry density.
   4. Do not backfill against unsupported foundation walls.
   5. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

D. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
   1. Drainage fill: Section 33 46 00.
   2. Cover drainage fill with general fill.
   3. Fill up to subgrade elevation.
   4. Compact to 95 percent of maximum dry density.

E. Over Buried Utility Piping, Conduits, and Duct Bank in Trenches:
   1. Bedding: Use dense graded aggregate fill.
   2. Cover with general fill.
   3. Fill up to subgrade elevation.
   4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.

F. Under Interior Tank Slabs-On-Grade:
   1. Use dense graded aggregate fill.
   2. Depth: 6 inch thick layer. Unless otherwise indicated on the plans or as required by geotechnical engineer.
   3. Compact 97 percent of maximum dry density.

G. At Lawn Areas:
   1. Use general fill.
   2. Fill up to 6 inches below finish grade elevations.
   3. Compact to 95 percent of maximum dry density.
   4. See Section 31 22 00 for topsoil placement.

3.05 TOLERANCES

A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.

B. Top Surface of Filling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.06 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D3017, or ASTM D6938.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor").

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

E. Frequency of Tests: one (1) test per 2,500 SF per lift.

F. Proof roll compacted fill at surfaces that will be under slabs-on-grade, paving, and tanks.

3.07 CLEANING

A. Leave unused materials in a neat, compact stockpile.

B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

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SECTION 40 23 36
PROCESS PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and all pipe and appurtenances as shown on the Drawings and specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Section 31 23 23 - Fill.

B. Section 09 91 23 - Paints and Coatings.

1.03 REFERENCES

A. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers; 1998.

B. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 1996 (ANSI/ASME B31.9).

C. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2001.

D. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2002.

E. ASTM A 74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2003.

F. ASTM A 105 - Standard Specification for Steel Pipe Flanges.

G. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

H. ASTM C 564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2003.

I. ASTM D 1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 1999.

J. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2000.

K. ASTM D 2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2002a.

L. ASTM D 2846/D 2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 1999.

M. ASTM D 2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2002).

N. ASTM F 493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 1997.

O. AWWA C104/A21.4 - ANSI Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water (1995).

P. AWWA C110 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm Through 1200 mm), for Water and Other Liquids; American Water Works Association; 1998.

Q. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; 2000 (ANSI/AWWA C111/A21.11).

R. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; 2002 (ANSI/AWWA C151/A21.51).

S. AWWA C153 - American National Standard for Ductile-Iron and Gray-Iron Compact Fittings for Water and Other Liquids; American Water Works Association.

T. AWWA C200 - Steel Water Pipe - 6 inches and Larger (1997).

U. AWWA C206 - Field Welding of Steel Water Pipe (1997).

V. AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 inches Through 144 inches (2001).

W. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings (2001).

X. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances (2005)

Y. AWWA C604 - Installation of Steel Water Pipe - 4 In. and Larger (2006)

Z. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water (2005)

AA. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 1999 (ANSI/AWWA C651).

AB. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution; American Water Works Association; 1997 (ANSI/AWWA C900).

AC. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. for Water Transmission and Distribution (1997).

AD. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2001.

AE. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Cast Iron Soil Pipe Institute; 1997.

AF. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 1993.

AG. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2002.

AH. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 1998.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

A. All non-metallic below grade piping shall be installed with a 12 gauge coated copper wire attached to the crown of the pipe with duct tape in not less than 2 places per length of pipe to provide detectors a means of locating buried lines.

B. Upon completion of backfilling for trenches, the Contractor shall be responsible for matching the existing surface conditions.

C. Identify and label all visible pipe with markings indicating the direction of flow.

1.06 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of Virginia plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 SANITARY SEWER PIPING, BURIED

A. Ductile Iron Pipe: AWWA C151/A21.51, minimum pressure class 350 psi
   1. Fittings:
      a. 90 Bends: Ductile or gray iron, standard thickness, conforming to AWWA C110 (ANSI 21.10).
      b. All other Bends/Fittings: Ductile or gray iron, conforming to AWWA C153 (ANSI 21.53).
   2. Joints: AWWA C111/A21.11, rubber gasket with 3/4 inch diameter rods and concrete thrust blocks as indicated on the Drawings.
   3. Flanges: ASME B16.1 - 125 pound template.
   4. Lining: AWWA C104 (ANSI 21.4).

2.02 PROCESS AND WATER PIPING, BURIED

A. Ductile Iron Pipe: AWWA C151/A21.51, minimum pressure class 350 psi
   1. Fittings:
      a. 90 Bends: Ductile or gray iron, standard thickness, conforming to AWWA C110 (ANSI 21.10).
      b. All other Bends/Fittings: Ductile or gray iron, conforming to AWWA C153 (ANSI 21.53).
   2. Joints: AWWA C111/A21.11, rubber gasket with 3/4 inch diameter rods and concrete thrust blocks as indicated on the Drawings. Under slabs and foundations, restrained joint fittings shall be provided.
   3. Flanges: ASME B16.1 - 125 pound template.
   4. Lining: AWWA C104 (ANSI 21.4).
   5. Fittings: Ductile or gray iron, standard thickness.

B. PVC Pipe: AWWA C900 and AWWA C905, minimum pressure class 150 psi
   1. Provisions must be made for expansion and contraction at each joint with an elastomeric gasket.
   2. Fittings:
      a. 90 Bends: Ductile or gray iron, standard thickness, conforming to AWWA C110 (ANSI 21.10).
      b. All other Bends/Fittings: Ductile or gray iron, conforming to AWWA C153 (ANSI 21.53).
   3. Joints: Under slabs and foundations, restrained joint fittings shall be provided.
   4. Random lengths shall not be less than 10 feet long.

2.03 PROCESS AND WATER PIPING, ABOVE GRADE

A. Steel Pipe 8 Inches and Smaller: ASTM A 53/A 53M, Schedule 40, Black Steel; unless otherwise noted to be galvanized.
   1. Fittings and unions: AWWA C206 and AWWA C208 with a minimum working pressure of 150 psi.
   2. Screw Joints: Perfectly tight with a still mixture of graphite and mineral oil, or an approved, non-toxic, non-hardening pipe joint compound applied to the male threads only.
   3. Flanges: AWWA C207.
   4. The interior of the pipe shall not be coated
   5. The exterior of the pipe shall be coated in accordance with Section 09900.

B. Steel Pipe 10 Inches and Larger: ASTM A 53/A 53M and AWWA C200, Schedule 20, Black Steel; unless otherwise noted to be galvanized.
   1. Fittings and unions: AWWA C206 and AWWA C208 with a minimum working pressure of 150 psi.
   2. Flanges: Flanges shall be steel slip on or welding neck type, raised face, Class 150, conforming to ASTM A 105 and ANSI B16.5.
   3. Pipe shall have beveled ends for welding.
   4. Pipe ends shall be provided to suit the field joints indicated on the Drawings.
   5. Field welded joints shall be single (outside) lap or butt type conforming to AWWA C206.
   6. The interior of the pipe shall not be coated.
   7. The exterior of the pipe shall be coated in accordance with Section 09900.

C. Ductile Iron Pipe: AWWA C151/A21.51, minimum pressure class 350 psi
   1. Fittings: Ductile or gray iron, standard thickness, conforming to AWWA C110 (ANSI 21.10).
   2. Joints: AWWA C111/A21.11, rubber gasket with 3/4 inch diameter rods and concrete thrust blocks as indicated on the Drawings.
   3. Flanges: ASME B16.1 - 125 pound template.
   4. Lining: AWWA C104 (ANSI 21.4).

2.04 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.

B. Flanges for Pipe Size Over 1 Inch:
   1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:
   1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
   2. Sealing gasket: "C" shape composition sealing gasket.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.05 PIPE HANGERS AND SUPPORTS

A. Process Piping:
   1. Conform to ASME B31.9.
   2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
   3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
   6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

B. Plumbing Piping - Water:
1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.06 PIPE PENETRATION SEALS

A. Wall/floor penetration seals shall be used to continuously fill the annular space between pipe and wall/floor. Wall/floor penetration seals, once expanded, shall provide a seal between the pipe and wall/floor opening.

B. Where walls or floors have pipe penetrations that are continuously wet on one or both sides, the use of wall sleeves with water stops shall be employed along with the wall/floor penetration seal to achieve a watertight seal between pipe and wall/floor opening.

C. The wall/floor opening size and/or type shall be selected according to recommendations found in seal penetration manufacturer's representative catalog. The wall/floor opening refers to a steel or plastic sleeve, coredrilled hole or cast-formed hole.

D. Penetration Seal Rubber Links
1. The wall/floor penetration seal shall be made of mechanically interlocked, solid synthetic rubber links. There shall be a sufficient quantity of links about the pipe that once expanded, shall achieve a 20-PSI hydrostatic seal between pipe and wall/floor opening.
2. The elastomer element shall be EPDM elastomer.
3. Penetration seal pressure plates shall be molded of glass reinforced nylon.
4. Hardware Fasteners shall consist of stainless steel bolts and hex nuts.

E. Wall Sleeves
1. Cast in place concrete wall sleeves are to be fabricated from galvanized heavy wall welded or seamless carbon steel pipe. All sleeves are to have a 2" wide, full perimeter water stop, welded on both sides.

2.07 TRACER WIRE AND ACCESS BOXES

A. All new non-metallic buried piping shall be installed with tracer wire. Metallic pipes do not require a tracer wire. Metallic pipe systems require access points along the route for direct connection. The tracer wire shall be installed continuously along the new pipe route with access points at 300 feet maximum. The tracer wire shall be brought to the ground surface at the access points. Access points may include valve boxes, handholes, manholes, vaults, or other covered access devices. Access point covers shall be clearly marked with a pipe description. Splices in the tracer wire shall be connected by means of a split bolt or compression type connector to ensure continuity. Wire nuts shall not be used. A waterproof or corrosion-proof connector for direct bury applications shall be used. After installation, the tracer wire shall be tested to verify continuity of the tracer wire system.

B. For locations where valve boxes are not present, the tracer wire access point shall be composed of one SnakePit Tracer Wire Access Box, or approved equal, installed at each proposed access point.

C. At each valve location, a loop of wire is to be brought up the outside of the valve box and looped inside the box through a hole drilled two (2) inches below the bottom of the lid.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install to the required lines and grades with fittings, valves, and accessories at the required locations; spigots centered in the bells; and all valves and appurtences properly aligned. The laying of pipe shall conform to the applicable portions of AWWA C600, AWWA C604, or AWWA C605.

C. Pressure test all piping in accordance with AWWA C600, AWWA C604, or AWWA C605 to a minimum test pressure of 150 psi, unless otherwise indicated.

D. All piping and fittings shall be rigidly supported.

E. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

F. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls, except as indicated otherwise on the Drawings.

G. Install piping to maintain headroom, conserve space, and not interfere with use of space.

H. Group piping whenever practical at common elevations.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

J. Deflections from a straight line or grade made necessary by vertical or horizontal curves or offsets shall not exceed the manufacturer's recommendations. If the required alignment requires deflections in excess of those recommended, the Contractor shall either provide special bends, as approved by the Engineer, of a sufficient number of shorter lengths of pipe to provide angular deflections within the required limit.

K. Laying of pipe shall be commenced immediately after the excavation is started, and every means must be used to keep pipe laying closely behind the trenching. The Engineer may stop the trenching when, in the opinion of the Engineer, the trench is open too far in advance of the pipe laying operation. Pipe may be laid in the best manner adapted to securing speed and good results.

L. Inspect pipe and fittings for defects and all lumps, blisters, excess coal-tar coating and other foreign material shall be removed from the bell and spigot end of each cast iron or PVC pipe, or inside of PVC couplings and fittings. All pipe, couplings, adapters, and other pipe connections shall be wiped clean and dry before the pipe is laid.

M. After placing a length of pipe in the trench, center the spigot end in the bell and force the spigot end into the bell end.

N. Secure the pipe in place with approved backfill material tamped under it except at the bells. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimensions to insure each uniform space.

O. Prevent dirt from entering the joint space.

P. The cutting of cast iron pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.

Q. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

R. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.

S. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

T. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

U. Provide restrained joint fittings under all slabs.

V. Provide support for utility meters in accordance with requirements of utility companies.

W. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 91 23.

X. Excavate in accordance with Section 31 23 16 for work of this Section.

Y. Backfill in accordance with Section 31 23 23 [] for work of this Section.

Z. Install bell and spigot pipe with bell end upstream.

AA. Install valves with stems upright or horizontal, not inverted; unless indicated otherwise on the Drawings.

AB. PVC Pipe: Make solvent-welded joints in accordance with ASTM D 2855.

AC. Sleeve pipes passing through partitions, walls and floors.

AD. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

AE. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Prime coat exposed steel hangers and supports. Refer to Section 09900. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
8. Support cast iron drainage piping at every joint.

3.04 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

E. Provide spring loaded check valves or as otherwise indicated on the drawings on the discharge of all water and wastewater pumps.

3.05 ERECTION TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe size: 1/2 inches to 1-1/4 inches:
         1) Maximum hanger spacing: 6.5 ft.
         2) Hanger rod diameter: 3/8 inches.
      b. Pipe size: 1-1/2 inches to 2 inches:
         1) Maximum hanger spacing: 10 ft.
         2) Hanger rod diameter: 3/8 inch.
      c. Pipe size: 2-1/2 inches to 3 inches:
         1) Maximum hanger spacing: 10 ft.
         2) Hanger rod diameter: 1/2 inch.
      d. Pipe size: 4 inches to 6 inches:
         1) Maximum hanger spacing: 10 ft.
         2) Hanger rod diameter: 5/8 inch.
      e. Pipe size: 8 inches to 12 inches:
         1) Maximum hanger spacing: 14 ft.
         2) Hanger rod diameter: 7/8 inch.
      f. Pipe size: 14 inches and Over:
         1) Maximum hanger spacing: 20 ft.
         2) Hanger rod diameter: 1 inch.
   2. Plastic Piping:
      a. All Sizes:
         1) Maximum hanger spacing: 5 ft.
         2) Hanger rod diameter: 3/8 inch.

END OF SECTION

SECTION 40 23 37
VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all tools, supplies, materials, equipment, and labor necessary for furnishing, epoxy coating, installing, adjusting, and testing of all valves and appurtenant work, complete and operable as shown on the Drawings and specified herein. Where buried valves are shown, furnish and install valve boxes to grade, with covers, extensions, and tee handles.

B. Furnish all labor, materials, equipment, and incidentals required and all valves and appurtenances as shown on the Drawings and specified herein.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 REFERENCES

A. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

B. ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.

C. ANSI/ASME B1.20.1 General Purpose Pipe Threads (inch).

D. ANSI/ASME B31.1 Power Piping.

E. ASTM A 36 Specification for Structural Steel.

F. ASTM A 48 Specification for Gray Iron Castings.

G. ASTM A 126 Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

H. ASTM A 536 Specification for Ductile Iron Castings

I. ASTM B 61 Specification for Steam or Valve Bronze Castings.

J. ASTM B 62 Specification for Composition Bronze or Ounce Metal Castings.

K. ASTM B 148 Specification for Aluminum-Bronze Castings.

L. ASTM B 584 Specification for Copper Alloy Sand Castings or General Applications.

M. ANSI/AWWA C500 Gate Valves for Water and Sewerage Systems.

N. ANSI/AWWA C504 Rubber-Seated Butterfly Valves.

O. ANSI/AWWA C506 Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valves Types.

P. ANSI/AWWA C507 Ball Valves 6 inches through 48 inches.

Q. AWWA C508 Swing-Check Valves for Waterworks Service, 2 inches Through 24 inches NPS.

R. AWWA C550 Protective Interior Coatings for Valves and Hydrants.

S. SSPC-SP-5 White Metal Blast Cleaning.

T. MSS-SP-70 Manufacturers Standardization Society of the Valve and Fitting Industry; Cast Iron Gate Valves. Flanged and Threaded Ends.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Shop drawings of all valves and operators including associated wiring diagrams and electrical data (if required).

C. Valve Schedule: Submit a complete valve schedule of all valves being supplied including each valve location, size, type, end connections, and operator type.

D. Valve Labeling: Submit a schedule of valves to be labeled indicating in each case the valve location and the proposed wording for the label.

1.04 QUALITY ASSURANCE

A. The Contractor shall demonstrate that each valve installed as a part of a piping system will operate under field conditions in a manner consistent with the design of the system.

1.05 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

PART 2 PRODUCTS

2.01 GENERAL

A. Valves shall be suitable for use in raw wastewater and sewage applications.

B. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

C. Valves and appurtenances shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.

D. Valves and appurtenances shall have the name of the manufacturer, nominal size, flow directional arrows, working pressure for which they are designed, cast in raised letters or indelibly marked upon some appropriate part of the body.

E. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of the same working pressure as the pipe they are connecting to, whichever is higher and suitable for the pressures noted where they are installed.

F. Valves and appurtenances shall be of the same nominal diameter as the pipe or fittings they are connected to.

G. Provide all special adaptors as required to ensure compatibility between valves, appurtenances and adjacent pipe.

H. Valves and operators located outdoors but not within a building; within maximum 2 feet above liquid; in vaults; or where otherwise noted shall be especially designed for submerged service where water may completely submerge the valve and operator. All other units shall be as a minimum weather tight.

I. The Contractor shall furnish all valves, operators, actuators, valve-operating units, stem extensions, and other accessories as shown, specified, or required to install a fully functional valve. All valves shall have the name of the manufacturer and the site of the valve cast on the body or bonnet or shown on a permanently attached plate in raised letters. All valves and gates shall be new and of current manufacture. All shut-off valves, 6-inch and larger, shall have operators with position indicators. Where buried, these valves shall be provided with valve boxes and covers containing position indicators, and valve extensions. Shut-off valves mounted higher than 6 feet above working level shall be provided with chain operators.

J. Gate Valve Stems: Manually operated valves shall have silicon-bronze stems conforming to ASTM B 584-875, having minimum tensile strength of 60,000 psi, a minimum yield point of 24,000 psi, and elongation of 16% in 2 inches.

K. Protective Coating: Except where otherwise specified, ferrous surfaces, exclusive of stainless steel surfaces, in the water passages of all valves 4-inch and larger, as well as the exterior surfaces of all submerged valves, shall be coated as specified in Section 099000 - Paints and Coatings. Flange faces of valves shall not be coated.

L. Valve Operators: Where shown, certain valves and gates shall be furnished with electric operators, provided by the valve or gate manufacturer. All operators of a given type shall be furnished by the same manufacturer. Where these operators are supplied by different manufacturers, the Contractor shall coordinate their selection to provide uniformity of each type of electric operator. All valve operators, regardless of type, shall be installed, adjusted, and tested by the valve manufacturer at the manufacturing plant.

M. Nuts and Bolts: All nuts and bolts on valve flanges and supports shall be Type 316 stainless steel.

2.02 VALVE OPERATORS

A. The valve manufacturer shall supply and integrally, rigidly mount all operators, including any type of manual or powered operators, on valves at the factory. The valves and their individual operators shall be shipped as a unit.

B. Unless otherwise noted, valves shall be manually operated; nonburied valves shall have an operating wheel, handle or lever mounted on the operator; buried valves and those with operating nuts shall have a non-rising stem with an AWWA 2 inch nut. At least four tee handles shall be provided. Tee handles shown on the Drawings shall be permanently installed and rigidly supported.

C. Except as otherwise shown on the Drawings or specified herein, all valves 3 inch diameter or larger, with the valve center line located 6 feet or more above the operating floor, shall be provided with chain wheel operators complete with chain guides and hot dipped galvanized steel chain, which loop within 4 foot of the operating floor.

D. All operators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.

E. Gear Operators:
   1. Unless otherwise noted on the Drawings, gear operators shall be provided for all valves larger than 12 inch diameter and all buried valves with the operating shaft mounted horizontally (butterfly, plug, etc.).
   2. Gear operators shall be of the worm or helical gear type with output shaft perpendicular to the valve shaft, having a removable hand wheel mounted on the output shaft. Unless noted they shall conform to AWWA C504.
   3. Operators shall be capable of being removed from the valve without dismantling the valve or removing the valve from the line.
   4. Gearing shall be machine-cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take all thrusts and seals and to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow the reduction mechanisms to operate in lubricant and be of the same material as the valve body.
   5. Maximum handwheel size shall be 24 inch diameter.

F. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.

G. Additional valve operators are included with the individual valve types and as noted on the Drawings.

2.03 GATE VALVES

A. Manufacturers:
   1. Clow
   2. American R/D
   3. Kennedy
   4. Mueller
   5. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements.

B. General:
   1. Gate valves shall meet or exceed the requirements of AWWA standard C500 covering solid wedge gate valves.
   2. Buried and submerged valves shall be furnished with mechanical joints and stainless steel hardware.
   3. Exposed valves shall be furnished with Class 125 flanged ends; provide valves.
   4. Valves shall be non-rising stem, opening by turning stem left or right and provided with 2" square operating nut or handwheel with the word 'open' and an arrow cast in the metal to indicate direction to open.
   5. The wedge shall be of cast iron completely encapsulated with rubber.
   6. The sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond ASTM D429.
   7. Valves shall be supplied with o-ring seals at all joints. No flat gaskets allowed.
   8. Stems for non-rising stem assemblies shall be cast bronze with integral collars in full compliance with AWWA. The non-rising stem stuffing box shall be the o-ring seal type with two o-rings located above thrust collar and one o-ring below. The two o-rings above the thrust collar shall be replaceable with valve fully open and subjected to full rated working pressure.
   9. There shall be two low torque thrust bearings located above and below the thrust collar. The stem nut shall be independent of the wedge and shall be made of solid bronze. There shall be a smooth, unobstructed waterway free of all pockets, cavities and depressions in the seat area.
   10. The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior, complying with AWWA C-550 and be NSF 61 approved. Each value shall have maker's name, pressure rating and year in which manufactured cast on the body.
   11. Prior to shipment from the factory, each valve shall be tested by hydrostatic pressure equal to AWWA (twice the specified working pressure) requirements.
   12. Non-rising stem valves shall use a double O-Ring stem seal, except that packing shall be used where geared operators are required.
   13. Flanged valves to have face-to-face dimensions per ANSI B16.1 and flanges per ANSI B16.10.
   14. Provide geared operator and chainwheel, chain and chain guides for valves with handwheel centerline more than 6 foot above operating level.
   15. Unless otherwise indicated, valves 12 inch and smaller shall be capable of installation in the vertical or horizontal position, and sealing in both directions at the rated pressure.
   16. Valves shall be installed with the stem within the upright vertical position to the 90 degrees horizontal position. Valves shall not be installed with the stem projected downward.

C. Buried Valves:
   1. Conform to the requirements above, except mechanical joint bell ends per AWWA standard C111.
   2. All exposed valve hardware (nuts, bolts, washers, etc.) including bonnet, bonnet cover, stuffing box, gear adaptor and joints shall be Type 304 stainless steel.
   3. Non-rising stem design, double O-Ring seals for non-geared valves and shall incorporate packing for geared valves.
   4. Provide valve box, 2 inch operating nut and extension stem and stem cover.

D. Tapping Valves and Sleeves:
   1. Tapping valves shall comply with the above specifications except they shall have the flanged end and port opening modified for tapping service. Valve shall be capable of passing a full nominal sized cutter without damage to the valve. The tapping sleeve shall be gray cast iron or ductile iron mechanical joint type.

2.04 KNIFE GATE VALVES

A. Manufacturers:
   1. Orbinox

2. DeZurik
3. Or Approved Equal
    a. Substitutions: See Section 01 60 00 - Product Requirements.

B. Valves shall be flanged type, unless otherwise indicated on the drawings rated for a working pressure of 150 psi.

C. Face-to-face dimensions per MSS SP-81 with BI-DIRECTIONAL shut-off.

D. Valve shall have a maximum leakage rate of no more than 20 CC per inch of diameter per minute at 40 psi in both directions without the use of O-rings, guides or wedges obstructing the port.

E. The seating material shall be metal-to-metal or made from a resilient EPDM or Viton material and completely field replaceable.

F. To prevent atmospheric leakage, the valve features an adjustable packing assembly consisting of multiple layers of braided packing around gate, evenly compressed by a one-piece packing gland.

G. The valve is to have 100% full port flow with no guides or wedges obstructing the port.

H. The gate shall be finished ground on both sides, and made from stainless steel.

I. The body material shall be 304 stainless steel.

J. Valve is equipped with a manual handwheel operator assembly featuring a cast ductile iron handwheel, a heavy duty foot mounted yoke with an acid resistant bronze stem nut, including a 304 stainless steel rising stem.

K. The gate shall be a beveled knife edge.

L. All wetted surfaces shall be Type 316 stainless steel.

M. Packing gland bolts shall be Type 316 stainless steel with plated, self-locking nuts.

N. The valves shall have full port straight through opening.

O. Flanges shall be drilled to match connecting pipe.

2.05 PLUG VALVES

A. Manufacturers:
1. Val Matic
2. Milliken
3. American R/D; www.american-rd.com
4. Or Approved Equal
    a. Substitutions: See Section 01 60 00 - Product Requirements.

B. Plug valves shall be of the offset disc type, 1/4 turn, non-lubricated, serviceable (able to be repacked) under full line pressure and capable of sealing in both directions at the rated pressure.

C. The valves shall be designed, manufactured and tested in accordance with American Water Works Association Standards ANSI/AWWA C517.

D. Flanged valves shall have flanges with drilling to ANSI B16.1, Class 125.

E. Mechanical Joint valves shall fully comply with ANSI/AWWA C111/A21.11.

F. The plug shall be of one-piece construction and made of ASTM A126 Class B cast iron with a resilient facing per ASTM D2000-BG and ANSI/AWWA C504 requirements

G. Radial shaft bearings shall be constructed of self-lubricating type 316 stainless steel. The top thrust bearing shall be Teflon. The bottom thrust bearing shall be Type 316 stainless steel. Cover bolts shall be corrosion resistant with zinc plating.

H. The disc shall be completely out of the flow path when open.

I. All plug valves shall have a minimum port area of 100 percent.

J. Valve bodies shall be of cast iron, ASTM A 126, Grade B, or of ductile iron, ASTM A 536 and of the top entry, bolted bonnet design, cast with integral flanges conforming to the connecting piping. All exposed bolts, nuts and wasters shall be zinc or cadmium-plated, except for buried or submerged plug valves, which shall have Type 316 stainless steel hardware.

K. Shaft bearings shall be permanently lubricated, rigidly backed TFE, stainless steel or bronze at both upper and lower stem journals. The operator shaft shall have easily replaceable seals, which shall be externally adjustable and repackable without removing the bonnet from the valve, or shall have self-adjusting packing.

L. The valve seating surface shall provide full 360 degree seating by contact of a resilient seating material on the disc mating with welded-in 99% high nickel content overlay seating surface in the body.
   1. The seating design shall be resilient and of the continuous interface type having consistent opening and closing torques and shall be non-jamming in the closed position. Screw-in seats shall not be acceptable.
   2. Discs shall have a full resilient facing of neoprene or EPDM.

M. Actuators: The methods of mounting the actuator to the valve shall provide an air gap between the two. Actuator shall clearly indicate valve position and an adjustable stop shall be provided. Construction of actuator housing shall be semi-steel. Hardware on actuators shall be of the same materials as the valve.
   1. 8 inch and smaller valves shall be equipped with a 2 inch square nut for direct quarter turn operation. The packing gland shall include a friction collar and an open position memory stop. The friction collar shall include a nylon sleeve to produce friction without exerting pressure on the valve packing.
   2. When specified, 4 inch and larger valves shall include a totally enclosed and sealed worm gear actuator with position indicator (above ground service only) and externally adjustable open and closed stops. The worm segment gear shall be ASTM A536 Grade 65-45-12 ductile iron with a precision bore and keyway for connection to the valve shaft. Bronzeradial bearings shall be provided for the segment gear and worm shaft. Alloy steel roller thrust bearings shall be provided for the hardened worm.
   3. All gear actuators shall be designed to withstand, without damage, a rim pull of 200 lb. on the handwheel and an input torque of 300 ft-lbs for nuts.
   4. Buried service actuators shall be packed with grease and sealed for temporary submergence to 20 feet of water.
   5. Exposed worm shafts shall be stainless steel.

N. Each plug valve shall be provided with its own securely attached lever. Provide adjustable limit stops for both opening and closing and a clearly marked position indicator.

O. Plug valves shall be installed so that the direction of flow through the valve and the shaft orientation is in accordance with the manufacturer's recommendations. Unless otherwise noted, shaft shall be horizontal, with plug opening up.

2.06 BUTTERFLY VALVES

A. Manufacturers:
   1. Crane Valve Company
   2. Crispin Valve; www.crispinvalve.com
   3. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements.

B. Butterfly valves and operators up to 72 inch diameter shall conform to AWWA C504, Class B, except as otherwise noted on the Drawings.

C. Butterfly valves for above grade shall have face to face dimensions in accordance with Table 2 of AWWA C504 Standard for short-body valve.

D. The valve body shall be constructed of close grain cast iron per ASTM A 126, Class B with integrally cast hubs for shaft bearing housings of the through boss-type. Permanently self-lubricating body bushings shall be provided and shall be sized to withstand bearing loads. Stuffing box of liberal dimensions shall be provided at the operator end of the vane shaft.

E. The valve shaft shall be of Type 316 stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque.

F. The butterfly valve operator shall conform to the requirements of AWWA C504, as applicable and as specified herein.

G. Gearing for the actuators where required shall be totally enclosed in a gear case in accordance with AWWA C504.

H. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 6 feet above floor.

2.07 SWING CHECK VALVES

A. Manufacturers:
   1. Val Matic
   2. Milliken
   3. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements.

B. Swing check valves shall meet the requirements of AWWA C508.

C. Valves shall be provided with flanges in accordance with ANSI B16.1, Class 125.

D. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve. The 4 inch valve shall be capable of passing a 3 inch sphere. The seating surface shall be on a 45 degree angle to minimize disc travel. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator, without special tools or removing the valve from the line.

E. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator.

F. The disc shall be of one-piece construction, precision molded with an integral o-ring type sealing surface, and contain alloy steel and nylon reinforcement in the flexible hinge area. The flex portion of the disc shall be warranted for twenty-five years. Non-Slam closing characteristics shall be provided through a short 35 degree disc stroke and a memory disc return action.

G. The valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking, or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures. The test results shall be independently certified.

H. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 class B for 30 inches and larger. Optional body materials include ASTM A-351 Grade CF8M, stainless steel (sizes 3" through 8").

I. The exterior and interior of the valve shall be coated with an ANSI/NSF 61 approved fusion bonded epoxy coating.

J. The valves shall be iron body, bronze mounted, single disc with a 150 psi working water pressure.
   1. When there is no flow through the line, the disc shall hang lightly against its seat in practically a vertical position. When open, the disc shall swing clear of the waterway.
   2. Check valves shall have bronze seat and body rings, extended bronze hinge pins and bronze nuts on the bolts of bolted covers.

3. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: All valves, gates, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as shown and specified. All gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.

C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

D. All valves shall be field tested following installation to demonstrate that the valve operates under field conditions in a manner consistent with the design of the system.

E. When joining PVC pressure pipe to fittings and accessories, pipe ends shall be cut square, deburred, beveled and cleaned in accordance with pipe manufacturer's recommendations. Bevel requirements for PVC pipe bell and PVC push-on fitting joints are the same as a factory bevel. If push on or mechanical joint butterfly valves are used, PVC pipe ends shall be beveled in accordance with the valve manufacturer's installation instructions.

END OF SECTION

SECTION 40 91 10
PROCESS AND INSTRUMENTATION EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to install and test, complete and ready for operation, two (2) dissolved oxygen meters, one (1) pH meter, and one (1) ORP meter, as shown on the Drawings and as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 SYSTEM DESCRIPTION

A. The Dissolved Oxygen Meters shall be provided for continuous on-line measurement of dissolved oxygen in wastewater within a range of 0-15 mg/L in the activated sludge reactor tanks.

B. The pH/ORP Meters shall be provided for continuous on-line measurement of the pH and ORP in wastewater in the activated sludge reactor tanks.

1.03 DESIGN REQUIREMENTS

A. Controllers (Signal Process Controllers):
   1. Quantity: Two (2)
      a. FEB/Anoxic Reactor #1A
      b. FEB/Anoxic Reactor #1B
   2. Current Output: 4-20 mA (per sensor)
   3. Enclosure: NEMA 4X Pipe Mount with Sun screen and weather protection shield
   4. Power Supply: 120 Vac
   5. Light Emitting Diode (LED) Readout: 4 digits
   6. Capable of connecting a minimum of 2 sensors

B. Dissolved Oxygen Sensors:
   1. Quantity: Two (2)
   2. Locations:
      a. FEB/Anoxic Reactor #1A
      b. FEB/Anoxic Reactor #1B
   3. Measuring Electrode: Gold
   4. Isolated Reference Electrode: Silver
   5. Auxiliary Electrode: Silver
   6. Test Electrode: Gold
   7. Automatic Temperature Compensation
   8. Cable Length: 30 Feet (min.)
   9. Material: 316 Stainless Steel Body
   10. Mounting Type: Pivoting bracket for berm side slope
   11. Performance Requirements
      a. Measurement range: 0.01 to 20.00 mg/L
      b. Resolution: 0.01 mg/L
      c. Accuracy
         1) Less than 5 ppm: ± 0.1 ppm
         2) Greater than 5 ppm: ± 0.2 ppm
      d. Repeatability: ± 0.1 ppm
      e. Response Time:
         1) Less than 40 seconds to 90% at 20 °C

2) Less than 60 seconds to 95% at 20 °C
f. Temperature sensor: PT100 integrated, external sensor
g. Temperature range: 0 to 50 °C
h. Temperature accuracy: ± 0.2°C

C. ORP Sensors:
1. Quantity: Two (2)
2. Locations:
a. FEB/Anoxic Reactor #1A
b. FEB/Anoxic Reactor #1B
3. ORP Electrode Type: Platinum
4. ORP Range: +/- 2000mv
5. Temperature Range: 20 to 175 degrees Fahrenheit
6. Maximum Pressure: 100 psi
7. Cable Length: 30 Feet (min.)
8. Integral preamplifier
9. Automatic Temperature Compensation (ATC).
10. Mounting Type: Pivoting Bracket for berm side slope

D. pH Sensors (included with ORP Probe):
1. Quantity: Two (2)
2. Locations:
a. Nitrification Reactor #2
3. pH Electrode Type: Spherical Glass
4. pH Range: 2 to 12
5. Temperature Range: 20 to 175 degrees Fahrenheit
6. Maximum Pressure: 100 psi
7. Cable Length: 30 Feet (min.)
8. Integral preamplifier
9. Automatic Temperature Compensation (ATC).
10. Mounting Type: Pivoting Bracket for berm side slope

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data and installation instructions.

C. Shop Drawings: Indicate mounting and wiring details.

D. Certificates: Certify that products of this section meet or exceed specified requirements.

E. Operation and Maintenance Data: calibration requirements and procedures, routine cleaning and maintenance requirements for proper operation.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with manufacturer's instructions and Section 01 60 00 - Product Requirements for additional provisions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hach

B. Cerlic

C. Endress-Hauser

D. Or Approved Equal
1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DO SENSOR

A. Sensor housing shall be 316 stainless steel.

B. Sensor shall plug into the controller. The sensor shall have built-in self-identity logic so controller acknowledges sensors identity and calibration points which are stored in the sensors memory.

C. Sensor to air calibrate over bucket of water to match saturated air solubility chart.

D. Sensor shall have three (3) flushing nozzles which can be used with flushing solenoid valve assembly. Flushing media can be 60 psig air or water.

E. Electrode shall be designed to operate at least 12 months at 3-5 mg/L operation between replacement and should not require recalibration more than once every 6 months.

2.03 CONTROLLERS

A. Microprocessor-based sensor controller.

B. Change digital sensors connected to the controller by unplugging and plugging sensors as necessary.

C. Change analog sensors modules connected to the controller by unplugging and plugging analog sensor modules as necessary.

D. The controller uses a menu-driven operation system.

E. The controller display is graphic dot matrix LCD with LED backlighting.

F. The controller is equipped with a real-time clock.

G. The controller is equipped with two security levels.

H. The controller is equipped with a data logger with RS-232 capability.

I. The controller is equipped with an SD card reader for data download and controller software upload.

J. Four electromechanical, UL rated, SPDT relays (Form C) are provided for user-configurable contacts rated 100 to 230 Vac, 5 Amp at 30 Vdc resistive maximum.
   1. The following can be programmed:
      a. Alarm
      b. Warning
      c. Timer/scheduled cleaning
      d. Feeder control
      e. Event control
      f. Pulse width modulation
      g. Frequency modulation
   2. The following can be assigned:
      a. Primary value measurement I
      b. Secondary value measurement I
      c. 3rd value measurement I
      d. 4th value measurement I
      e. Primary value Measurement II
      f. Secondary value measurement II
      g. 3rd value measurement II
      h. 4th value measurement II
      i. Real time clock
      j. Calculated values

K. Two analog 0/4-20 mA outputs are provided with a maximum impedance of 500 ohms.
   1. The following can be programmed:
      a. Alarms:
         1) Low alarm point

2) Low alarm point deadband
3) High alarm point
4) High alarm point deadband
5) Off delay
6) On delay

b. Controls:
1) Linear
2) Bi-linear
3) Logarithmic
4) PID

2. The following can be assigned:
a. Primary value measurement I
b. Secondary value measurement I
c. 3rd value measurement I
d. 4th value measurement I
e. Primary value measurement II
f. Secondary value measurement II
g. 3rd value measurement II
h. 4th value measurement II
i. Calculated values

L. The controller can be equipped with four additional 4-20 mA outputs with a maximum impedance of 500 ohms.

M. The controller can be equipped with the following forms of communication:
1. MODBUS RS-232
2. MODBUS RS-485
3. Profibus DP

N. All user settings of the controller are retained for 10 years in flash memory.

O. The controller is equipped with a system check for:
1. Power up test (monitoring and shutdown)
2. Total power draw
3. Memory devices
4. Temperature mother board

2.04 ACCESSORIES

A. Provide a AC Power / Signal protection device between all transmitters and PLC Control Panels for lightning and surge suppression for AC power and low voltage signal lines.
1. Enclosure shall be a NEMA 4X polycarbonate case
2. Input Voltage: 120VAC / 60 Hz
3. Power "ON" indicator
4. 15 Amp replaceable fuse
5. UL Rated

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.02 INTERFACE WITH OTHER WORK

A. Signal converter shall send 4-20 mA signal to PLC.

3.03 STARTING EQUIPMENT

A. Provide manufacturer's field representative to prepare and start equipment.

B. Adjust for proper operation within manufacturer's published tolerances.

C. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION

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SECTION 40 91 20
MAGNETIC FLOW METERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to install and test, complete and ready for operation, seven (7) magnetic flow meter(s) as shown on the Drawings and as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Division 26 - Electrical

1.03 SYSTEM DESCRIPTION

A. The process fluid to be measured will be raw wastewater from the processing plant.

B. Fluid temperature will range from 5 degrees C to 45 degrees C

1.04 DESIGN REQUIREMENTS

A. FEB Effluent/DAF Influent Pump Station Flow Meter:

1.	Quantity:	One (1)
2.	Size:	10 inch
3.	Liner Material:	Neoprene
4.	Process Connection:	Flange ANSI Class 150
5.	Flange Material:	Carbon Steel
6.	Electrode Material:	AISI 316 Ti (316 SS)
7.	Enclosure:	NEMA 6 (10 feet of water for 72 hours)
8.	Transmitter Electronics:	Remote mounted with cable to sensor
9.	Flow range:	700 - 2,000 gpm
10.	Flow Indicators:	Digital flow indicator (gpm) and totalizer (gallons).

B. FEB Effluent/DAF Influent Pump Station Flow Meter:

1.	Quantity:	One (1)
2.	Size:	10 inch
3.	Liner Material:	Neoprene
4.	Process Connection:	Flange ANSI Class 150
5.	Flange Material:	Carbon Steel
6.	Electrode Material:	AISI 316 Ti (316 SS)
7.	Enclosure:	NEMA 6 (10 feet of water for 72 hours)
8.	Transmitter Electronics:	Remote mounted with cable to sensor
9.	Flow range:	700 - 2,000 gpm
10.	Flow Indicators:	Digital flow indicator (gpm) and totalizer (gallons).

C. RAS Pump Station Flow Meter:

1.	Quantity:	Two (2)
2.	Size:	8 inch
3.	Liner Material:	Neoprene
4.	Process Connection:	Flange ANSI Class 150
5.	Flange Material:	Carbon Steel
6.	Electrode Material:	AISI 316 Ti (316 SS)
7.	Enclosure:	NEMA 6 (10 feet of water for 72 hours)
8.	Transmitter Electronics:	Remote mounted with cable to sensor
9.	Flow range:	500 - 2800 gpm

10.	Flow Indicators:	Digital flow indicator (gpm) and totalizer (gallons).

D. FEB/Anoxic Reactor Effluent Pump Station Flow Meter:

1.	Quantity:	Two (2)
2.	Size:	14 inch
3.	Liner Material:	Neoprene
4.	Process Connection:	Flange ANSI Class 150
5.	Flange Material:	Carbon Steel
6.	Electrode Material:	AISI 316 Ti (316 SS)
7.	Enclosure:	NEMA 6 (10 feet of water for 72 hours)
8.	Transmitter Electronics:	Remote mounted with cable to sensor
9.	Flow range:	1,500 - 6,000 gpm
10.	Flow Indicators:	Digital flow indicator (gpm) and totalizer (gallons).

E. WAS Pump Station Flow Meter:

1.	Quantity:	One (1)
2.	Size:	4 inch
3.	Liner Material:	Neoprene
4.	Process Connection:	Flange ANSI Class 150
5.	Flange Material:	Carbon Steel
6.	Electrode Material:	AISI 316 Ti (316 SS)
7.	Enclosure:	NEMA 6 (10 feet of water for 72 hours)
8.	Transmitter Electronics:	Remote mounted with cable to sensor
9.	Flow range:	1,500 - 6,000 gpm
10.	Flow Indicators:	Digital flow indicator (gpm) and totalizer (gallons).

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit product data, including Manufacturer's data, for specified products. Include the following:
   1. Manufacturer's outline and mounting dimensions for all flow meters.
   2. Manufacturer's wiring diagrams, including field connections.
   3. Mounting Details.
   4. All equipment to be furnished under this Section must be approved prior to being released for manufacturing unless otherwise noted by the Engineer.

1.06 QUALITY ASSURANCE

A. The flow meters covered by this Section are intended to be standard equipment, as modified by this Section, of proven ability, as manufactured by a single manufacturer, having long experience in the production of such flow meters. The flow meters furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and specified herein.

B. In the event that equipment which differs from this Section be offered and determined to be equal to that specified, such equipment shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate such a substitution shall be made at no cost to the Owner and be as approved by the Engineer.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Rosemont

B. ABB

C. Sparling Instrument Co., Inc.

D. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GENERAL

A. The magnetic flowmeter shall utilize characterized electromagnetic induction to produce a voltage linearly proportional to the average flow rate. The metering system shall consist of a sensor with field coils, transmitter and interconnecting cables to make a complete operating flow metering system. The meter shall be of the bi-polar pulsed dc type with continuous automatic zeroing.

2.03 CONSTRUCTION

A. The sensor shall be a flanged tube with non-conductive liner. The tube shall be constructed of Type 304 stainless steel with carbon steel flanges AWWA Class D if the coils are external to the tube. If the coils are encapsulated inside the tube, the tube and flanges may be of carbon steel. Sensor rating shall be NEMA-4 and capable of withstanding accidental submergence in water. The power supply shall be 120-volt AC, 60 HZ. Power consumption shall not exceed 42 watts regardless of size. Accuracy of the flowmeter system shall be 0.5 percent of rate from 10 to 100 percent of scale. Below 1 full percentage scale [fps] it shall be 0.1 percent of full scale. Repeatability shall be 0.1 percent of rate. Liner material shall be neoprene or teflon. External surfaces shall be factory-finished with a corrosion resistant coating. The specific conductivity of the liquid shall not preclude meter operation.

2.04 COMPONENTS

A. Output: 4-20 mA DC into 800 ohms, isolated, standard

B. Adjustments: Calibration, Sensitivity, Damping, mA zero and span.

C. Linearity: plus or minus 0.5% full span

D. Repeatability: plus or minus 0.1% full span

E. Accuracy: Within plus or minus 2.0% full span

F. Signal Strength Meter: Analog type standard

G. Transducer: Single twin-crystal transducer with 20 feet amored flexible cable.

H. Standard Transducer Temperature Range: -300 degrees F to 320 degrees F.

I. Transmitter Temperature Range: -10 degrees F to 140 degrees F.

J. Power Requirements: 120 Volts, 60 Hz.

K. Transmitter Housing: NEMA 4X thermoplastic standard.

L. Flow Rate Indicator: Mounted integrally in transmitter housing. Graduations linear in gpm. Shatterproof window.

M. Internal Frequency Standard: Calibration assured by on-board frequency reference.

N. Grounding: Grounding rings or electrodes of the same material as the sensing electrodes shall be furnished mounted in each end of all meters one inch and larger in size. Provide grounding strap between adjacent pipe, grounding rings and flow tube, unless adjacent pipe is either non-conductive or lined with non-conductive materials, in which case provide grounding string between the rings and tube only. If grounding electrodes are provided, grounding rings shall also be provided for liner protection.

O. Transmitter: The transmitter shall be either meter and/or remote mounted as indicated on the Drawings and as specified in paragraph 1.04 Design Requirements. If the transmitter is remote mounted, the interconnecting cable shall be furnished by the manufacturer of the metering system. Remote transmitters shall be housed in NEMA-4X enclosures suitable for wall mounting. The transmitter shall produce a 4-20 mA dc output signal into a minimum load of 800 ohms linear to flow, and a scaled pulse when called for above for totalization.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and recommendations in the locations shown on the Drawings and as specified herein.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01400.

B. Each flow meter shall be tested prior to shipment and the documentation of the test shall be submitted with O & M Manual for the flow meters.

C. The services of a factory trained representative shall be provided for a total of two (2) days of testing and calibration of the flow meters.

END OF SECTION

SECTION 40 91 30
ULTRASONIC LEVEL SENSOR

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to install and test, complete and ready for operation, five (5) Ultrasonic Level Sensor and Transmitter as shown on the Drawings and as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Division 26 - Electrical

1.03 SYSTEM DESCRIPTION

A. The process fluid to be measured will be treated sanitary wastewater treatment system effluent.

B. Fluid temperature will range from 5 degrees C to 35 degrees C

1.04 DESIGN REQUIREMENTS

A. Raw Wastewater Pump Station:
   1. Quantity: One (1)
   2. Designed for measuring the liquid level in the Raw Wastewater Pump Station wet well as shown on the drawings.
   3. Level range:
      a. Top of Tank Wall: 7.33 feet Above Bottom
      b. High Water Level 6 feet Above bottom
      c. Equipment Supplier shall verify that there is sufficient distance from the mounting position of the Ultra Sonic Level Sensor to the High Water Level
   4. Indicators: Digital level indicator (feet).
   5. Pump Control Function:
      a. Low-Low Water Level: All Pumps Off/Alarm
      b. Lead Pump Off Level: Lead Pump Off
      c. Lag Pump Off Level: Lag Pump Off
      d. Operating Range: Adjust pump speed to maintain set liquid level in wet well
      e. Lead Pump On Level: Lead Pump On
      f. Lag Pump On Level: Lag Pump On
      g. High Water Level: High Water Level Alarm

B. DAF FEB Tank:
   1. Quantity: One (1)
   2. Designed for measuring the liquid level in the DAF FEB Tank as shown on the drawings.
   3. Level range:
      a. Top of Tank Wall: 26 feet Above Bottom
      b. High Water Level: 24 feet Above bottom
      c. Low Water Level: 5 feet Above Bottom
      d. Equipment Supplier shall verify that there is sufficient distance from the mounting position of the Ultra Sonic Level Sensor to the High Water Level
   4. Indicators: Digital level indicator (feet).
   5. Pump Control Function:
      a. Low-Low Water Level: All Pumps Off/Alarm
      b. High Water Level: High Water Level Alarm/Pump On Full Speed

C. DAF Effluent Pump Station:
   1. Quantity: One (1)
   2. Designed for measuring the liquid level in the DAF Effluent Pump Station as shown on the drawings.
   3. Level range:
      a. Top of Wet Well: 11.6 feet Above Bottom
      b. High Water Level: 10 feet Above bottom
      c. Equipment Supplier shall verify that there is sufficient distance from the mounting position of the Ultra Sonic Level Sensor to the High Water Level
   4. Indicators: Digital level indicator (feet).
   5. Pump Control Function:
      a. Low-Low Water Level: All Pumps Off/Alarm
      b. Lead Pump Off Level: Lead Pump Off
      c. Lag Pump 1 Off Level: Lag Pump 1 Off
      d. Lag Pump 2 Off Level: Lag Pump 2 Off
      e. Operating Range: Adjust pump speed to maintain set liquid level in wet well
      f. Lead Pump On Level: Lead Pump On
      g. Lag Pump 1 On Level: Lag Pump 1 On
      h. Lag Pump 2 On Level: Lag Pump 2 On
      i. High Water Level: High Water Level Alarm/Pump On Full Speed

D. FEB/Anoxic Reactor #1A:
   1. Quantity: One (1)
   2. Designed for measuring the liquid level in the Anoxic Reactor #1A as shown on the drawings.
   3. Level range:
      a. Top of berm: 13.67 feet Above Bottom
      b. High Water Level: 12 feet Above bottom
      c. Low Water Level: 5.5 feet Above Bottom
      d. Equipment Supplier shall verify that there is sufficient distance from the mounting position of the Ultra Sonic Level Sensor to the High Water Level. The mounting height may be different from top of berm height.
   4. Indicators: Digital level indicator (feet).
   5. Pump Control Function:
      a. Low Low Water Level: All Pumps Off/Alarm
      b. High Water Level: High Water Level Alarm/Pump On Full Speed

E. FEB/Anoxic Reactor #1B:
   1. Quantity: One (1)
   2. Designed for measuring the liquid level in the Anoxic Reactor #1A as shown on the drawings.
   3. Level range:
      a. Top of berm: 13.67 feet Above Bottom
      b. High Water Level: 12 feet Above bottom
      c. Low Water Level: 5.5 feet Above Bottom
      d. Equipment Supplier shall verify that there is sufficient distance from the mounting position of the Ultra Sonic Level Sensor to the High Water Level. The mounting height may be different from top of berm height.
   4. Indicators: Digital level indicator (feet).
   5. Pump Control Function:
      a. Low-Low Water Level: All Pumps Off/Alarm
      b. High Water Level: High Water Level Alarm/Pump On Full Speed

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit product data, including Manufacturer's data, for specified products. Include the following:
   1. Manufacturer's outline and mounting dimensions for all sensors.
   2. Manufacturer's wiring diagrams, including field connections.
   3. Mounting Details.
   4. All equipment to be furnished under this Section must be approved prior to being released for manufacturing unless otherwise noted by the Engineer.

1.06 QUALITY ASSURANCE

A. The level sensors covered by this Section are intended to be standard equipment, as modified by this Section, of proven ability, as manufactured by a single manufacturer, having long experience in the production of such sensors. The sensors furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and specified herein.

B. In the event that equipment which differs from this Section be offered and determined to be equal to that specified, such equipment shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate such a substitution shall be made at no cost to the Owner and be as approved by the Engineer.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01600.

1.08 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hach

B. Magnetrol

C. Siemens

D. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Sensor:
   1. Type:
      a. The transducer shall generate an ultrasonic signal and receive an echo from the liquid surface.
   2. Operation/Function:
      a. The sensor shall be potted/encapsulated in a chemical and corrosion resistant PVC or CPVC housing. Sensors shall be capable of being completely submerged without damage.
      b. Temperature Limits: - 5 degrees F to + 120 degrees F.
      c. Relative Humidity: 0 to 100%.
      d. The sensor shall be provided with automatic air temperature and density compensation.
   3. Physical:
      a. Sensors located in areas where freezing condensation may occur shall be provided with special heaters or other type of transducer protection designed to prevent sensor icing.
      b. Sensors shall be suitable for surface, pipe, or flange mounting as indicated on the Drawings.

c. The supplier shall be responsible for coordinating all sensor mounting requirements and shall furnish dimensional and elevational drawings to ensure proper and satisfactory installation.

B. Transmitter:
1. Type:
a. Microprocessor based device which converts the sensor output signal to a flow output in feet.
2. Function/Performance:
a. Temperature Limits: -5 degrees F to +120 degrees F.
b. Accuracy: Shall be plus or minus 0.25 percent for the transducer and converter.
c. Transmitter shall ignore momentary loss-of-echo signals.
d. Output: Isolated 4-20 mA linear set to feet.
e. Output: 3 discrete outputs that are set by the operator.
f. Power Requirements: 120 Volt/60 Hz
g. Display: 4 digit 18 mm LCD, scaled to read in feet.
h. All required device programming interface equipment is to be provided.
3. Physical:
a. Provide NEMA 4X enclosure.
b. Provide sensor interconnecting cable between sensor and transmitter.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and recommendations in the locations shown on the Drawings and as specified herein.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01400.

B. Each flow meter shall be tested prior to shipment and the documentation of the test shall be submitted with O & M Manual for the flow meters.

C. The services of a factory trained representative shall be provided for a total of one (1) day of testing and calibration of the flow meters.

END OF SECTION

SECTION 43 11 33
ROTARY LOBE POSITIVE DISPLACEMENT BLOWERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to install and test, complete and ready for operation, two (2) positive displacement blowers with sound and weather enclosures as shown on the Drawings and as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Division 26 - Electrical

B. Section 26 29 23 - Variable Frequency Drives

1.03 SYSTEM DESCRIPTION

A. The positive displacement blowers described in this section shall be supplied by a single manufacturer.

B. The blowers shall be positive displacement, rotary lobe type, designed for air service, suitable for variable frequency drive operation, and belt driven via electric motor.

C. Each blower package unit shall be complete with rotary lobe positive displacement blower, drive unit, V-Belt drive, weather and sound enclosure, Flexible expansion joints, drive guard, common steel base discharge silencer, inlet filter silencer, pressure relief valve, check valve, discharge isolation valve, pressure gauge (inlet and discharge), temperature Gauge (inlet and discharge), temperature switch (discharge), pressure switch (discharge), vibration isolation pads, and appurtenances. One manufacturer shall furnish all components.

1.04 DESIGN REQUIREMENTS

A. The manufacturer shall supply identical positive displacement blowers as follows for the DAF FEB Tank:

1.	Quantity:	Two (2)
2.	Site Elevation:	35 ft. Above Sea Level
3.	Installation Location:	Outdoors
4.	Ambient Pressure:	14.7 psia
5.	Ambient Temperature:	100 degrees F
6.	Relative Humidity:	90%
7.	Discharge Volume:	1,500 scfm
8.	Inlet Pressure:	14.7 psia
9.	Inlet Temperature:	100 degrees F
10.	Discharge Pressure:	26.7 psia
11.	Differential Pressure:	12 psig
12.	Relief Valve Set Pressure:	13 psig
13.	Supply Voltage:	480 Volts, three (3) phase, 60 Hz
14.	Gas:	Air
15.	Motor Horsepower:	150_HP
16.	Rotors:	Tri-Lobe Design

17. Blowers shall be capable of being operated on a variable frequency drive for automatic speed control to maintain a constant dissolved oxygen concentration in DAF FEB Tank.

1.05 SUBMITTALS

A. See Section 0 130 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit product data, including Manufacturer's data, for specified products.

C. Product Description: Include product description including the following:
   1. Manufacturer's data, order sheet, or equivalent for the blowers being supplied.
   2. Manufacturer's outline and mounting dimensions for all field mounted devices, including, but not limited to, drives, motors, and enclosures.
   3. Manufacturer's wiring diagrams for control system, including necessary field connections (if required).
   4. Manufacturer's dimensions and field fabrication details for all mechanical equipment.
   5. The manufacturer shall clearly identify any exception to the specification or drawings. Failure to do this shall be grounds for rejection of the submittal.
   6. All equipment to be furnished under this Section must be approved prior to being released for manufacturing unless otherwise noted by the Engineer.

D. Shop Drawings: Show layout of all equipment; including layout and erection details for all blowers; include mounting details.

E. Certification: Show characteristics curves for blowers; including pressure and brake horsepower plotted against CFM capacity for full blower range. Clearly identify the design point specified.

F. Operating and Maintenance Manuals (O&M Manuals): Submit two (2) sets and one (1) electronic copy in pdf format of operating and equipment maintenance instructions and detailed drawings.

G. The manufacturer shall clearly identify any exception to this Section, related sections, or the Drawings. Failure to do this shall be grounds for rejection of the submittal.

H. Certification: The Manufacturer shall provide a certification stating that they have reviewed the Drawings and Specification for this project and have verified that the applicability of the specified equipment to be provided by the Manufacturer for the intended use per the Drawings and Specifications.
   1. The Manufacturer shall provide to the Engineer, as part of the certification, in writing any recommended revisions to the design based upon the Manufacturers review of the Specifications and Drawings.

I. Certification: The Manufacturer shall provide a certification stating that they have reviewed the Drawings and Specifications to verify that all appropriate appurtenances are to be installed to the Rotary Lobe Positive Displacement Blowers and associated air piping to prevent damage to the supplied equipment as a result of thermal expansion or vibration.
   1. The Manufacturer shall provide to the Engineer, as part of the certification, in writing any recommended revisions to the design based upon the Manufacturers review of the Specifications and Drawings.

1.06 QUALITY ASSURANCE

A. The blowers and equipment covered by this specification are intended to be standard blower equipment, of proven ability, as manufactured by a reputable CE certified manufacturer having at least ten (10) years' experience in the production of such blowers; and, at least 25 successful systems of the type specified in operation of such blowers.

B. The blowers furnished shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed.

C. The positive displacement blowers furnished under this specification shall be new, unused, and shall be the standard product of a single manufacturer having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of two (2) years.

1.07 FACTORY TESTING

A. All critical dimensions of the blower components actually provided by the manufacturer shall be verified and documented prior to assembly.

B. The rotating parts of each blower actually provided by the Manufacturer shall be statically and dynamically balanced before final assembly. The blower alone shall operate without excessive vibration.

C. Each blower actually provided by the Manufacturer shall be slip tested. The Slip RPM shall be documented. A document certifying that the supplied blowers conform to the design specifications shall be provided.

D. On completion of final assembly of the packaged blower and prior to shipment, each packaged blower shall be mechanically run for a minimum of fifteen (15) minutes.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00.

B. The blower packages shall be factory assembled and tested before shipment.

C. The blower packages shall be stored on-site with a protective covering and elevated off the ground.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. The Manufacturer and Contractor shall warrant the blowers, motors and all other package components being supplied to the Owner against all defects in workmanship and materials for a period of twenty-four (24) months from date of Substantial Completion.

C. The Manufacturer's warranty shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed. The Contractor shall be responsible for proper storage of the equipment so as to remain in "as shipped" condition. If the equipment remains in storage at the job site for longer than six (6) months before installation, the Contractor shall provide factory service personnel for a complete inspection of the equipment. Any work necessary to restore the equipment to "as shipped" condition shall be the responsibility of the Contractor.

1.10 EXTRA MATERIALS

A. See Section 01 60 00 - Product Requirements, for additional provisions.

B. Supply one (1) set of belts for each blower supplied.

C. Supply enough oil for two (2) oil changes for each blower supplied.

D. Supply one (1) set of blower bearing for each blower supplied.

E. Supply one (1) set of blower gaskets and seals for each blower supplied.

F. Supply two (2) intake filter elements for each blower supplied.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Robuschi USA Inc.

B. Kaeser Compressors, Inc.

C. Aerzen

D. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DESIGN CRITERIA

A. Blower shall be positive displacement rotary type with top inlet and bottom outlet.

B. Blower shall be V-belt driven by an electric motor.

C. All bearings shall be anti-friction type rated by AFBMA standards to have a minimum B10 life of 100,000 hours at design speed and maximum radial and thrust load conditions.

D. All piping shall be so installed that no weight or strain will be imposed on the blower.

E. Design point noise levels for each blower furnished shall not exceed the dbA limits specified herein. The required room level dbA limits are expressed as measurements taken at a distance of three feet in any direction from the blower system or from the acoustical enclosure if it is provided. With its submittals, the contractor shall provide the engineer with the manufacturer's certification of the design point dbA level for each blower system furnished.

2.03 BLOWER COMPONENTS

A. Casing:
   1. The casing shall be made of high strength, close grained, cast iron, and shall be adequately ribbed to resist deflection and facilitate cooling.
   2. The casing shall be precision machined to allow for minimum clearances.
   3. The casing design shall incorporate two cast in machined ports to minimize pulsation.
   4. Casing has flanged inlet and discharge connections. Screwed connections will not be acceptable.

B. Rotor Assemblies:
   1. The rotor assemblies shall be one piece and precision machined from high strength, close grain, spheroidal graphite ductile iron allowing smooth, efficient operation at all rated speeds and pressures.
   2. The rotors shall be of the straight, three-lobe involute type and shall operate without rubbing, liquid seals or lubrication. Two lobe rotors will not be acceptable.
   3. The integral shafts shall be designed to carry higher loads than calculated for the maximum design load and shall incorporate replaceable seal ring wear sleeves.
   4. The rotor assemblies shall be statically and dynamically balanced. Rotor cavities shall be plugged to prevent imbalance due to contaminants.
   5. The rotors shall be a tri-lobe design in order to minimize pulsation and noise.

C. End Plates:
   1. The gear-end plate shall be cast iron.
   2. The drive-end plate shall be integral to the blower casing ensuring heavy-duty construction, long life, and maximum machine noise attenuation in all applications.
   3. Bearing fits shall be precision machined to ensure accurate positioning of the rotors in the casing.
   4. Replaceable seal wear inserts shall be provided on the drive-end and gear-end plates.
   5. The end plates shall be heavy-duty cast iron with a precision machined sealing face.

D. Timing Gears:
   1. Both rotors shall be positively timed by a pair of accurately machined, heat treated ground alloy steel, helical tooth timing gears. To increase gear life and reduce noise, the use of spur gears is not acceptable. The timing gears shall be mounted on tapered shafts to provide positive locking of gears and shaft.
   2. Connections shall be provided for a hydraulic pump for expansion to adjust and/or remove gears.
   3. The rotor timing gears shall be precision machined from case hardened and ground alloy steel.
   4. Each timing gear shall be straight cut and beveled to eliminate axial bearing loads and ensure long life as well as quiet operation.
   5. Gears shall be finish ground on a precision grinder to ensure concentricity.
   6. The timing gear set shall be taper-mounted on the rotors for improved rebuild ability and accurate timing.

E. Bearings:
   1. All four shaft support locations shall incorporate large, heavy-duty cylindrical roller or ball bearings designed to handle extreme radial loads without sacrificing product integrity and reliability.
   2. The minimum acceptable B10 design life at the blower's maximum rated speed and maximum rated differential pressure shall be no less than 100,000 hours.

3. Drive shaft bearing is sized for an overhung V-belt drive maximum continuous operating load.
4. The bearing housing shall have a retainer providing positive containment of the bearings. Ground gear spacers shall maintain permanent rotor clearances within the blower casing.

F. Lubrication:
1. The blower shall incorporate two (2) separate oil chambers each with adequately sized sight glasses, and ample reservoir capacity.
2. Both the gear-end and the drive-end of the blowers shall be oil splash lubricated for minimal maintenance and long service life.
3. Grease lubricated bearings are not acceptable.
4. The lubrication design shall ensure adequate lubrication of the timing gears and bearings.

G. Seals:
1. There shall be four (4) piston ring type labyrinth seals at each end of each rotor to minimize leakage and maintenance costs.
2. The cavity between the air-side and oil-side seals shall be vented through threaded ports to allow external purging or containment of any lubricating oil or process gas that may have migrated past the seals.
3. Enough ports shall be incorporated in the design to ensure that the cavity is vented from the bottom no matter what blower drive-to-driven shaft orientation is utilized.
4. A vent cavity shall be provided on all four (4) sets of piston ring type labyrinth seals. The two (2) vent holes located on the bottom side of the blower shall be left open. The vent holes at the other locations shall be closed off with threaded metal plugs.
5. The input drive shaft seal shall be a high temperature radial lip type seal with Viton elastomers. The seal design shall incorporate a replaceable wear sleeve on the input drive shaft.

2.04 DRIVE MOTORS:

A. Drive motors shall be designed, manufactured, and tested in accordance with the latest revised editions of NEMA MG-1, IEC, IEEE, ANSI, and AFBMMA standards as applicable and shall be capable of continuous operation.

B. The motor nameplate horsepower rating shall not be exceeded at the design speed.

C. The motor shall be sized to accept load at pressure relief valve pop pressure without exceeding rated FLA.

D. The temperature rise of the motor windings shall not exceed IEC and NEMA standards when the motor is operated continuously at the rated horsepower, rated voltage, and rated frequency in ambient conditions of 40 degrees C.

E. The motors shall conform to the following:
1. Mounting: Horizontal.
2. Type: Squirrel Cage Induction.
3. Enclosure: Totally Enclosed - Fan Cooled.
4. Service Factor: 1.15.
5. Duty Cycle: Continuous.
6. Ambient Temperature Rating: 40 degrees C
7. Starting Current: Six (6) times full load current maximum.
8. Winding Insulation: Class F.
9. Temperature Rise: Class B.
10. Voltage/Frequency/Phase: 460/60/3
11. Bearing Lifte:60,000 hours rating life as defined by AFBMA standards
12. Bearing Lubrication: Oil, Oil Mist, or Grease (with grease addition fittings and grease relief fittings).
13. Maximum Speed: 3,600 rpm.
14. Speeds: Capable of being operating with a variable frequency drive
15. Accessories: Winding Temperature Detector

2.05 BLOWER PACKAGES:

A. The packaged blowers are to be standard engineered designs of a CE certified manufacturer regularly engaged in the production of packaged blowers to ensure single source accountability and shall include the following listed standard features:
   1. The packages shall be driven through V-belts and sheaves. The drive assembly shall be of the high capacity type, oil and heat resistant, with a minimum service factor of 1.4.
   2. Automatic tensioning of the V-belts by use of a pivoting, swing frame motor base with adjustable spring assistance and visual indication of V-belt tension shall be provided to ensure the V-belts remain properly tensioned with minimal maintenance and to extend V-belt, sheave, and bearing life. Adjustment of the tensioning device shall be accomplished without removal of the guard or loosening of the motor mounting bolts.
   3. The drive guard shall be the manufacturer's standard sheet metal with provision for ventilation. The installed guard shall be fully enclosed, easily removable, and designed to meet current OSHA recommendations and CE standards.
   4. The base shall be an elevated, rigid, fabricated steel design with a solid sub-base. The absorptive type discharge silencer shall be integral to the frame in order to minimize space requirements. The blower shall be mounted horizontally for a compact frame.
   5. To prevent transmission of vibration and noise, as well as secure the package to the foundation, the base shall include vibration isolators made of rubber in a steel footing equipped with mounting holes for anchoring purposes.
   6. Oil drains from the blower drive-end and gear-end lubricating oil sumps shall be piped to the front of the base for ease of maintenance. The drain valves shall be a ball valve with a fully retained and gasketed threaded cap.
   7. The inlet filter shall be integral to the inlet silencer and shall include a washable and reusable polyester element for minimal pressure drop.
   8. The inlet silencer shall be of the absorptive type, directly connected to the inlet port of the blower, and shall be mounted horizontally.
   9. The discharge silencer shall be of the absorptive type with an integral pulsation dampener and directly connected to the outlet port of the blower. The discharge silencer shall be mounted horizontally and shall be integral to the base frame.
   10. The relief valve shall be spring loaded and factory installed after the discharge silencer in a location to protect the blower from excessive differential pressures. The relief valve exhaust shall be piped out of the enclosure.
   11. A discharge check valve shall be provided constructed of a cast iron body, double disc-type check valve for mounting on the blower discharge piping. Valve shall have aluminum bronze internals and EPDM seat material.
   12. An elastomeric compensator/flex connector shall be provided for connection of the packaged blower to the system piping to reduce transmission of structure borne noise as well as prevent unacceptable loading of the silencer connection and blower casing.
   13. A sound enclosure shall be provided. The sound enclosure shall be sheet steel construction with powder coat finish. It shall have acoustic foam insulation and shall provide sound attenuation of up to 20 dba. The enclosure shall also provide sound attenuation such that the maximum average noise level is 75 dbA measured at six locations at a distance of 3 feet from the enclosure. Noise level shall be measured in a "free-field". The enclosure shall have a hinged panel on top and a removable panel on the front of the package to allow maintenance access. Panels shall incorporate locking closures.
   14. An installed, integral ventilation fan, sized to provide adequate cooling of the package, shall be provided. The fan shall be provided with a dedicated motor. Powering the fan from the blower drive motor is not acceptable.
   15. A discharge pressure gauge shall be provided, pre-piped and panel mounted, on the sound enclosure.
   16. A discharge temperature gauge, with adjustable switching point and contact, shall be provided pre-piped and panel mounted on the sound enclosure.

17. An inlet filter differential pressure gauge shall be provided pre-piped and panel mounted on the sound enclosure.
18. A discharge pressure high temperature switch shall be provided. The high temperature switch shall be Ashcroft or equal with an operating range of 150° to 260°F. The maximum temperature capability shall be 400°F. Sensor is to be capillary type with remote 3-3/4" brass bulb. Contractor to provide 1/2" FPT in discharge piping near blower for thermostat well. Piping under 4 inches will require a tee with bushings to mount the well. Piping 4 inches and over may be drilled and tapped.
19. A high pressure shut-down switch shall be provided. The high pressure switch be Ashcroft type 400, B4 series or equal with an operating range of 1 psig to 15 psig. Actuator seal must be Viton.
20. The blower package shall be designed to allow all preventive maintenance to be performed from the front of the package. All utility connections and process connections shall be at the rear of the package.
21. The blower packages must fit in the space provided as indicated on the Drawings. The Manufacturer is responsible for assuring that the equipment provided is serviceable and that all clearances for maintenance are provided as necessary to ensure safe and trouble-free maintenance for the blower packages.

2.06 BLOWER CONTROLS

A. When in Auto mode all blowers will be controlled by the PLC Panel as indicated on the Drawings. Refer to Electrical Drawings for additional information.

B. Blower controls shall be located in the motor control center (MCC) as indicated on the Drawings and specified herein.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions to provide a complete installation.

B. All piping shall be supported to prevent exerting undue forces and moments on the blower flanges. Single arch expansion joints shall be furnished to isolate the blower package from the piping system.

C. Each blower unit will be installed on a flat and level concrete pad, suitable for supporting the dead weight of the unit. Vibration isolation pads must always be placed between concrete pad and common base legs.

D. All piping and fittings to mount the specified instruments must be provided by the blower system manufacturer.

E. If required all blower oil drains must be piped away from the blower to easily drain oil.

F. The blower manufacturer will furnish the services of a factory-based engineer to check the installation of the blower system and make any field adjustments necessary to insure proper mechanical operation. The blower system manufacturer will submit, to the contractor, a written report certifying that the equipment has been satisfactorily installed and lubricated.

3.02 FIELD QUALITY CONTROL

A. Provide manufacturer's field representative for one (1) day of eight (8) hours to prepare and start equipment.

END OF SECTION

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SECTION 43 21 22
SELF-PRIMING CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to install and test, complete and ready for operation six (6) new self-priming centrifugal pumps and modify five (5) existing self-priming centrifugal pumps as shown on the Drawings and as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Division 26 - Electrical

1.03 SYSTEM DESCRIPTION

A. The pumps shall be designed with an open impeller to be used for pumping liquids containing solid particles and abrasives.

B. The pumps shall have an unobstructive flow into the suction and a large smooth flow channel to the casing and impeller which shall prevent clogging.

C. The pumps shall be designed for continuous duty under severe operating conditions.

D. Each pumping unit shall be complete with pump, baseplate and coupling guard, overhead v-belt drive, belts and sheaves, motor, and appurtenances. One manufacturer shall furnish all components.

1.04 DESIGN REQUIREMENTS

A. Raw Wastewater Pump Station:

1.	Number of Pumps:	Two (2)
2.	Configuration:	Parallel
3.	Design Point #1:	2800 gpm at 40 ft TDH
4.	Design Point #2:	1667 gpm at 30 ft TDH
5.	Pump Speed at Design Capacity:	1050 rpm
6.	Maximum Solids Size:	3 inches
7.	Motor Horsepower:	40 HP
8.	Motor Type:	TEFC Severe Duty
9.	Motor Configuration:	Overhead V-Belt Drive
10.	Pump Influent Size:	10-inch
11.	Pump Effluent Size:	10-inch

12. The pump shall be capable of operating on a variable speed drive for automatic control of the pump speed to maintain a set liquid level in the pump station wet well.

B. FEB Effluent/DAF Influent Pump Station:

1.	Number of Pumps:	Two (2)
2.	Configuration:	Parallel
3.	Design Point #1:	1400 gpm at 45 ft TDH
4.	Design Point #2:	1100 gpm at 35 ft TDH
5.	Pump Speed at Design Capacity:	1050 rpm
6.	Maximum Solids Size:	3 inches
7.	Motor Horsepower:	30 HP
8.	Motor Type:	TEFC Severe Duty
9.	Motor Configuration:	Overhead V-Belt Drive
10.	Pump Influent Size:	8-inch
11.	Pump Effluent Size:	8-inch

12. The pump shall be capable of operating on a variable speed drive for manual control of pump speed and flow pump rate.

C. Existing DAF Effluent Pump Station:
1. The Existing DAF Effluent Pump Station pumps shall be modified with new motors, impellers, belts and sheaves, as necessary, to be fully operational for the stated conditions:
   a. It shall be the Contractor's responsibility to coordinate the necessary improvements for the existing pumps based on their existing condition with the pump manufacturer.
2. Number of Pumps: Three (3)
3. Configuration: Parallel
4. Design Point #1: 1400 gpm at 60 ft TDH
5. Design Point #2: 1100 gpm at 25 ft TDH
6. Pump Speed at Design Capacity: 1150 rpm
7. Maximum Solids Size: 3 inches
8. Motor Horsepower: 50 HP
9. Motor Type: TEFC Severe Duty
10. Motor Configuration: Overhead V-Belt Drive
11. Pump Influent Size: 8-inch
12. Pump Effluent Size: 8-inch
13. The pump shall be capable of operating on a variable speed drive for automatic control of the pump speed to maintain a set liquid level in the pump station wet well.

D. Existing RAS Pump Station:
1. The Existing RAS Pump Station pumps shall be modified with new motors, impellers, belts and sheaves, as necessary, to be fully operational for the stated conditions:
   a. It shall be the Contractor's responsibility to coordinate the necessary improvements for the existing pumps based on their existing condition with the pump manufacturer.
2. Number of Pumps: Two (2)
3. Configuration: Parallel
4. Design Point #1: 1400 gpm at 47 ft TDH
5. Design Point #2: 700 gpm at 15 ft TDH
6. Pump Speed at Design Capacity: 1550 rpm
7. Maximum Solids Size: 3 inches
8. Motor Horsepower: 40 HP
9. Motor Type: TEFC Severe Duty
10. Motor Configuration: Overhead V-Belt Drive
11. Pump Influent Size: 6-inch
12. Pump Effluent Size: 6-inch
13. The pump shall be capable of operating on a variable speed drive for manual control of pump speed and flow pump rate.

E. FEB/Anoxic Reactor #1 Pump Station:
1. Number of Pumps: Two (2)
2. Configuration: Parallel
3. Design Point #1: 2500 gpm at 126 ft TDH
4. Pump Speed at Design Capacity: 1250 rpm
5. Maximum Solids Size: 3 inches
6. Motor Horsepower: 125 HP
7. Motor Type: TEFC Severe Duty
8. Motor Configuration: Overhead V-Belt Drive
9. Pump Influent Size: 12-inch
10. Pump Effluent Size: 12-inch
11. The pump shall be capable of operating on a variable speed drive for manual control of pump speed and flow pump rate.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data shall include at least the following:
   1. Certified shop and erection drawings showing all important details of construction and dimensions.
   2. Descriptive literature, bulletins, and/or catalogs of the equipment.
   3. Data on the characteristics and performance of the pumps. Data shall include certified performance curves, based on actual shop tests of duplicate units, which show that they meet the specified requirements for head, capacity, efficiency, allowable NPSH, allowable suction lift and horsepower. Curves shall be submitted on 8-1/2 inch x 11-inch sheets.
   4. The total weight of the equipment including weight of the single largest item.
   5. A complete total bill of materials for all equipment.
   6. A list of manufacturer's recommended spare parts.
   7. Complete data on motors.
   8. Manufacturer's wiring diagrams for instrumentation and control system, including necessary field connections (if required).

C. The manufacturer shall clearly identify any exception to this Section, related sections, or the Drawings. Failure to do this shall be grounds for rejection of the submittal.

1.06 QUALITY ASSURANCE

A. The pumps covered by this Section are intended to be standard pumping equipment, as modified by this Section, of proven ability, as manufactured by a single manufacturer, having long experience in the production of such pumps. The pumps furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and specified herein.

B. In the event that equipment which differs from this Section be offered and determined to be equal to that specified, such equipment shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate such a substitution shall be made at no cost to the Owner and be as approved by the Engineer.

C. The rated horsepower of the drive unit shall be such that the unit will not be overloaded nor the service factor reduced when the pump is operated at any point on the pump's capacity curve. If, due to the slope of the pump's performance curve, a drive unit of greater horsepower than specified is required to meet this condition, the pump will be considered for approval only if any and all changes in electrical work, etc. required by such a change will be provided at no additional cost to the Owner and be to the satisfaction of the Engineer.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Gorman Rupp

B. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PUMP DESIGN

A. 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 1.04 - Design Requirements of this section.

2.03 MATERIALS AND CONSTRUCTION FEATURES

A. Pump casing:
   1. Casing shall be cast iron Class 30 with integral volute scroll.
   2. Casing shall incorporate the following features:
      a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
      b. Fill port coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads 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.
      c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.

B. Coverplate:
   1. Coverplate shall be cast iron Class 30.
   2. Design must incorporate the following maintenance features:
      a. Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service of the impeller, seal, wear plate or check valve without removing suction or discharge piping.
      b. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.
      c. In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 PSI.
      d. O-ring of Buna-N material shall seal coverplate to pump casing.

C. Rotating Assembly:
   1. A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearing, seal plate and bearing housing must be removable as a single unit without disturbing the pump casing or piping.
   2. Design shall incorporate the following features:
      a. Seal plate and bearing housing shall be stainless steel. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by liquid pumped and lip seals will prevent leakage of oil. The bearing cavity to have an oil level sight gauge and fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
      b. Impeller shall be stainless steel CD4MCu, 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 lockscrew and conical washer.
      c. Shaft shall be stainless steel 17-4.
      d. Adjustable wear plate shall be stainless steel with self-cleaning cutting edges.
      e. Bearings shall be anti-friction ball or tapered roller 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.
      f. Shaft seal shall be 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 band 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 AISI 316 stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings.

g. Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means. Stainless steel adjusting shims shall be used to move the entire rotating assembly as a unit when adjusting the working clearances. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

h. 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 coverplate opening, 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.

i. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1 1/4" NPT and on 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

2.04 MOTORS

A. Motors shall be squirrel cage induction type meeting as a minimum NEMA design B speed torque class. Breakdown torque shall be 200% or more of the maximum torque load placed on the motor shaft.

B. Motors shall have ball bearings and shall have an AFBMA B-10 bearing life of 100,000 hours minimum. Bearings shall be regreaseable.

C. All insulated windings shall have Class F non-hygroscopic insulation systems rated for temperature rise and ambient temperature in accordance with NEMA MG-1 Standards for the insulation class specified, except the motors shall be designed for Class B temperature rise.

D. Motor shall be high efficiency type. Motor shall be wound with copper wire.

E. Motors shall be horizontal solid shaft, 480 volts, 3 phase, 60 Hertz. Each motor shall have a minimum 1.15 service factor. Where a 1.15 service factor is required on an inverter duty motor, provide next largest size motor and a 1.0 service factor.

F. Motors shall be rated for use with a variable frequency drive (VFD). Coordinate with VFD supplier to match drive and motor.

G. Motors shall be TEFC and shall have cast iron frames, end bells, bearing brackets, oversized terminal box, and guards. Motors shall have a stainless steel breathers/drains. Motor shall be server duty rated for an indoor environment.

2.05 SERVICEABILITY

A. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs by incorporating the following features.

B. No special tools shall be required for replacement of any components within the pump.

2.06 ACCESSORIES

A. A Standard Suction and Discharge Gauge Panel Kit shall be provided for each pump.

B. A 1-inch x 1-inch Automatic Air Release Valve shall be provided for each pump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off-loading, contractor shall inspect complete pump and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all pump serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

A. Install, level, align, and lubricate pump(s) as required. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

C. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

3.03 MANUFACTURER'S FIELD SERVICES

A. A factory-authorized service representative shall perform the following:
   1. Eight (8) labor hours, on-site time for functional and performance testing and training.

B. Operational Test
   1. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.
   2. After construction debris and foreign material has been removed from the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

END OF SECTION

SECTION 43 21 35
ROTARY LOBE PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to install and test, complete and ready for operation, one (1) positive displacement rotary convoluted lobe pumps as shown on the Drawings and as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Division 26 - Electrical

1.03 SYSTEM DESCRIPTION

A. The pump(s) shall be designed for continuous duty under severe operating conditions.

B. Each pumping unit shall be complete with rotary convoluted lobe pump, gear reducer, baseplate and coupling guard, overhead v-belt drive, belts and sheaves, and appurtenances. One manufacturer shall furnish all components of the pumping units.

1.04 DESIGN REQUIREMENTS

A. Waste Activated Sludge Pump Station:

1.	Number of Pumps:	One (1)
2.	Design Point #1:	
	a. Flow Rate:	100 gpm
	b. Friction Head:	13 ft
	c. Static Head:	2 ft
	d. TDH:	15 ft
3.	Design Point #2	
	a. Flow Rate:	30 gpm
	b. Friction Head:	2 ft
	c. Static Head:	-9.5 ft
	d. TDH:	-7.5 ft
4.	Maximum Solids Size:	0.5 inches
5.	Motor Horsepower:	5 HP
6.	Motor Type:	TEFC Severe Duty
7.	Motor Configuration:	Overhead V-Belt Drive
8.	Pump Influent Size:	4-inch
9.	Pump Effluent Size:	4-inch

10. The pump shall be capable of operation with a variable speed drive for automatic speed and flow rate adjustment to maintain a manually selected flow rate.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data shall include at least the following:
   1. Certified shop and erection drawings showing all important details of construction and dimensions.
   2. Descriptive literature, bulletins, and/or catalogs of the equipment.
   3. Data on the characteristics and performance of the pumps. Data shall include certified performance curves, based on actual shop tests of duplicate units, which show that they meet the specified requirements for head, capacity, efficiency, allowable NPSH, allowable suction lift and horsepower. Curves shall be submitted on 8-1/2 inch x 11-inch sheets.

4. The total weight of the equipment including weight of the single largest item.
5. A complete total bill of materials for all equipment.
6. A list of manufacturer's recommended spare parts.
7. Complete data on motors.
8. Manufacturer's wiring diagrams for instrumentation and control system, including necessary field connections (if required).

C. The manufacturer shall clearly identify any exception to this Section, related sections, or the Drawings. Failure to do this shall be grounds for rejection of the submittal.

1.06 QUALITY ASSURANCE

A. The pumps covered by this Section are intended to be standard pumping equipment, as modified by this Section, of proven ability, as manufactured by a single manufacturer, having long experience in the production of such pumps. The pumps furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and specified herein.

B. In the event that equipment which differs from this Section be offered and determined to be equal to that specified, such equipment shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate such a substitution shall be made at no cost to the Owner and be as approved by the Engineer.

C. The rated horsepower of the drive unit shall be such that the unit will not be overloaded nor the service factor reduced when the pump is operated at any point on the pump's capacity curve. If, due to the slope of the pump's performance curve, a drive unit of greater horsepower than specified is required to meet this condition, the pump will be considered for approval only if any and all changes in electrical work, etc. required by such a change will be provided at no additional cost to the Owner and be to the satisfaction of the Engineer.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide two year 100% parts and labor manufacturer warranty, including wear and tear to the pump. The warranty shall include, but not be limited to, mechanical seals, wear plates, housing segments, and lobes.

1.09 EXTRA MATERIALS

A. See Section 01 60 00 - Product Requirements, for additional provisions.

B. Supply two sets of belts for Owner's use in maintenance of equipment.

C. Supply any of the manufacturer's special tools for proper operation and maintenance of the pumps.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Vogelsang USA - Twinsburg, Ohio

B. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ROTARY LOBE POSITIVE DISPLACEMENT PUMP

A. Each pump shall be of heavy duty, positive displacement rotary lobe design with gray cast iron casing and smooth end cover, of 230 - 260 Brinell hardness.

B. The pump shall utilize two tri-lobe rotors, which are driven through positive timing gears running in oil. Solid gray cast iron cores shall be covered with a layer of Buna-N Durometer hardness 65-72. The geometry of the rotor core shall be the same as that of the finished rotor. Rotor vane geometry shall be convoluted to provide pressure-pulse free operation. The convoluted rotor shall be specifically designed for pumping secondary sludge containing organic solids, small inorganic particles and grit. Rotors shall be positioned to the shaft by replaceable hardened key ways, and secured to the shaft by internal/external expansion clamp sleeves and flush discs requiring no recesses in the end cover.

C. The front cover shall be constructed of gray cast iron, with a minimum Brinell hardness of 230-260, and permit removal of the rotors without disturbing piping, bearings, and mechanical seals. It shall also be machined to accept a reversible wear plate, constructed of Hardox 500 material or equal, with a minimum brinell hardness of 550, and a finished hardened reversible surface of 700 brinell. Each pump shall be of heavy duty, positive displacement rotary lube design with ductile iron ASTM A536 casting and end cover, of 140 to 190 Brinnell hardness.

D. The shafts shall be of carbon steel ASTM A293 fitting with replaceable ceramic coated stainless steel sleeves where passing through the seal area. They shall be timed in their rotation by straight cut timing gears running in a separate oil chamber which also contains the ball and roller bearings for each shaft.

E. Split mechanical seals shall be provided for each positive displacement pump. A blocking chamber located behind the mechanical seal, and in front of the bearing housing lipseal shall be molded into the casting of the pump. This chamber shall be suitable for fill, from the side of the pump, through nipples, and have an external sight glass to review the status of the mechanical seals operation, mounted on the opposite side of the pump, located in easy view of the operator.

F. Port connections shall be ANSI Class 150 flanges; size specified on Drawings. They shall be hot dipped galvanized, for long life, and abrasion resistance.

G. The removable end cover shall be flush with no recesses or dead pockets where solids can accumulate. The cover shall be sealed with Buna "N" O-ring and provide complete access to the pump chamber without disconnecting pipe work glands or bearings. The removable front cover is to be mounted to the pump with 4 individual bolts, to provide unhindered access to the rotors to facilitate ease of maintenance and operator safety.

H. The manufacturer of the pumps shall measure all critical clearances upon reassemble of the coated parts and reaffirm all warranties on the pumps.

I. The pump, gear reducer and motor shall be mounted on a steel baseplate complete with necessary couplings, guards, and mounting hardware. Mounting of the pump shall be such that the oil drain on the bottom of the gear casing shall be easily accessible to allow

J. Miscellaneous: Nameplates and other data plates shall be stainless steel, suitably secured to the pump.
   1. Parts shall be completely identified with a numerical system to facilitate parts inventory control. Each part shall be properly identified by a separate number, and those parts which are identical shall have the same number to effect minimum spare parts inventory.

K. Appurtenances: All bolts, nuts, washers, and gaskets necessary for field installation shall be furnished by the manufacturer.

L. Vibration: Pumps and motors shall operate at any point within their operating range without undue noise and vibration. Vibration at any point in the operating range shall not exceed the limits allowed by the Hydraulic Institute.

M. The top and bottom housing segments of the pump shall be constructed of gray cast iron, hardened to a minimum of 700 brinell hardness, and be adjustable based on wear. The adjustment shall be accomplished by simply moving stainless steel shims from one hole to the next in the pump housing, allowing for the closing of tolerance around the rotors. This adjustment must be available a minimum of two times from factory tolerance.

2.03 MOTORS

A. Motors shall be squirrel cage induction type meeting as a minimum NEMA design B speed torque class. Breakdown torque shall be 200% or more of the maximum torque load placed on the motor shaft.

B. Motors shall have ball bearings and shall have an AFBMA B-10 bearing life of 100,000 hours minimum. Bearings shall be regreaseable.

C. All insulated windings shall have Class F non-hygroscopic insulation systems rated for temperature rise and ambient temperature in accordance with NEMA MG-1 Standards for the insulation class specified, except the motors shall be designed for Class B temperature rise.

D. Motor shall be high efficiency type. Motor shall be wound with copper wire.

E. Motors shall be horizontal solid shaft, 480 volts, 3 phase, 60 Hertz. Each motor shall have a minimum 1.15 service factor. Where a 1.15 service factor is required on an inverter duty motor, provide next largest size motor and a 1.0 service factor.

F. Motors shall be rated for use with a variable frequency drive (VFD). Coordinate with VFD supplier to match drive and motor.

G. Motors shall be TEFC and shall have cast iron frames, end bells, bearing brackets, oversized terminal box, and guards. Motors shall have a stainless steel breathers/drains. Motor shall be server duty rated for an indoor environment.

H. Each motor shall be furnished with three hermetically sealed thermal switches imbedded in the windings. The thermal switches shall be connected in series and shall be wired to the motor starter. Each switch shall open when an excessive heat rise occurs in the motor.

2.04 CLEANING AND PACKING

A. Thoroughly clean all equipment, components, and subassemblies of all water, sand, grit, weld splatter, grease, oil, and other foreign materials before preparation for shipment. Protect all machined surfaces against physical damage and exposure during shipment. Handling, storage, and installation.

B. Pack pump to provide ample protection from damage during shipment, handling, and storage. Cap and seal all openings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's recommendations.

3.02 CLEANING

A. Clean grease, oil, or any other debris from the exterior surfaces of the pumps and motors.

3.03 FIELD QUALITY CONTROL

A. Controls shall be factory tested and documentation of the test shall be submitted to the Engineer and shall be included in the O&M manual.

B. After the pumps have been completely installed, conduct such tests as are necessary to indicate that pump efficiency and discharge conform to the Specifications. Field tests shall be performed on all pumps furnished under this Section. Supply all electric power, labor and water or wastewater and auxiliary equipment required to complete the field tests.

C. If the pump performance does not meet the Specifications, corrective measures shall be taken, or pumps shall be removed and replaced with pumps which satisfy the conditions specified. A twelve (12) hour operating period of the pumps will be required before acceptance.

D. Any component parts which are damaged as a result of testing or which fail to meet the requirements of these Specifications shall be replaced, reinstalled and retested at the Contractor's expense.

END OF SECTION

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SECTION 46 43 21
CLARIFIER MECHANISM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The equipment described in this Section shall be provided as an Owner Supplied Product for Contractor installation.

B. Furnish all labor, materials, equipment, and incidentals to install and test, complete and ready for operation one (1) Clarifier Mechanism as shown on the Drawings and as specified herein.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 SYSTEM DESCRIPTION

A. One (1) suction type sludge collector mechanism shall be furnished each being suitable for installation in one (1) tank with a nominal diameter of 80'-0" diameter x 12' side water depth. The tank floor will pitch at a constant slope of 1/16" in 12".

B. Final Effluent Trough shall be 24" wide x 18" deep with scum baffle 8" from Final Effluent Trough.

C. The clarifier mechanism shall be designed for installation in an above grade stainless steel tank.

D. The clarifier mechanism shall be designed for the attachment of algae sweeps to the skimmer arm to clean the trough, baffle, and weir surfaces when engaged.

E. The new Clarifier No. 2 will work in parallel with the existing 81 feet diameter Clarifier No. 1.

1.03 DESIGN REQUIREMENTS

A. The new Clarifier No. 2 mechanism shall be designed for the following hydraulic flow conditions:

1. Influent Mixed Liquor Flow:

	Flow To Clarifier No. 2 with 1 Clarifier in Service	Flow To Clarifier No. 2 with 2 Clarifiers in Service
Minimum:	2.60 MGD	1.30 MGD
Average:	3.20 MGD	1.60 MGD
Maximum:	5.00 MGD	2.50 MGD

2. Effluent Flow:

	Flow From Clarifier No. 2 with 1 Clarifier in Service	Flow From Clarifier No. 2 with 2 Clarifiers in Service
Minimum:	1.30 MGD	0.65 MGD
Average:	1.60 MGD	0.80 MGD
Maximum:	2.00 MGD	1.00 MGD

3. Return Sludge Flow:

	Flow From Clarifier No. 2 with 1 Clarifier in Service	Flow From Clarifier No. 2 with 2 Clarifiers in Service
Minimum:	1.30 MGD	0.65 MGD
Average:	1.60 MGD	0.80 MGD
Maximum:	3.00 MGD	1.50 MGD

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit product data, including Manufacturer's data, for specified products.
   1. System Description: Include the following:
      a. Manufacturer's data, order sheet, or equivalent for each major piece of equipment, component, instrument or device being supplied.
      b. Manufacturer's outline and mounting dimensions for all field mounted components, including, but not limited to, drives, motors, pumps, liquid jet headers, air headers, instrumentation and controls.
      c. Manufacturer's wiring diagrams for instrumentation and control system, including necessary field connections (if required).
      d. Manufacturer's Dimensions and Field Fabrication Details for all mechanical equipment.
      e. Mounting Details.
      f. The Manufacturer shall clearly identify any exception to the specification or drawings. Failure to do this shall be grounds for rejection of the submittal.
      g. All equipment to be furnished under this Section must be approved prior to being released for manufacturing unless otherwise noted by the Engineer.
      h. Instrument and control panel layout to scale and dimensioned, with overall size, mounting and field entries dimensioned.

C. Certification of compliance with the American Steel and Iron provision of the State Revolving Loan Fund.

1.05 QUALITY ASSURANCE

A. The clarifier mechanisms covered by this Section are intended to be standard equipment, as modified by this Section, of proven ability, as manufactured by a single manufacturer, having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and specified herein.

B. In the event that equipment which differs from this Section be offered and determined to be equal that specified, such equipment shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate such a substitution shall be made at no cost to the Owner and be as approved by the Engineer.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00.

B. The equipment will be shipped as follows:
   1. Unless otherwise approved by the Engineer, the bridge will be shipped in one (1) section with bolted field splices.
   2. The handrail will be piece marked for field assembly.
   3. The influent well will be shipped in four (4) sections.
   4. The center cage will be shipped in one (1) section.
   5. The center column will be shipped as one (1) assembly.

6. The truss arms will be shipped in one (1) section.
7. Skimmers will be shipped loose for field assembly.
8. The header will be shipped in two (2) sections for bolted field assembly.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Evoqua/Envirex

B. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Collector Mechanism:
   1. Each clarifier mechanism shall include the following components:
      a. Drive mechanism complete with reducer, motor and overload device
      b. Unitube sludge removal header and manifold Influent feedwell and supports.
      c. Center pier and center cage.
      d. Half bridge and walkway with aluminum handrails and toe plates.
      e. Center platform with aluminum handrail and toe plates.
      f. Two surface skimmers.
      g. One scum trough with a flushing device.
   2. Each sludge collector mechanism will utilize a center drive mounted on a stationary center support pier. A welded structural steel cage attached to the drive will support and rotate the unitube sludge collector header and manifold. The header will be located parallel to the tank bottom and will have a series of inlet orifices so that in a single revolution the entire tank bottom is swept clean. The header will continuously remove the required proportional settled sludge volume to effect a uniform withdrawal over the entire radius of the tank. The header will be hydraulically designed to remove larger volumes of sludge at greater distances from the tank center. The slowly revolving mechanism will collect the sludge from the tank bottom and carry it through the header to the center outlet, the removal being accomplished by pumping.
   3. Each mechanism will be designed so there is no field welding required.

B. Drive Mechanism:
   1. Internal Gear Pitch Diameter: 38 inches
   2. Ball Race Diameter: 42 inches
   3. Motor Horsepower: 0.75 HP
   4. AGMA Rated Torque: 31,300 foot-pounds
   5. Speed: 0.04 RPM
   6. The drive mechanism will be completely factory assembled and will consist of a primary gear reduction unit, an intermediate reduction unit, plus a final reduction unit consisting of a pinion and internal gear enclosed in a turntable base. All gearing will be enclosed in gray cast iron ASTM A-48 Class 40B housing.
   7. The primary reduction unit will be helical gear reducer. All bearings will be anti-friction type running in oil in a cast iron housing.
   8. The motor will be totally enclosed, ball bearing type, of ample power for starting and continuously operating the mechanism without overloading. The motor will conform to NEMA standards and be nameplated for operation on 230/460 volt, 60 Hz current, three (3) phase.
   9. The primary reduction gear reducer will drive the intermediate reduction unit through a chain and sprocket arrangement. The drive chain will be 80 L self-lubricated roller chain and be covered with an OSHA approved removable guard constructed of fiberglass

of 150# per lineal foot, with a deflection not exceeding 1/360 of the span. A 3' wide walkway covered with 2" high fiberglass, non-skid Chemgrate Safety Grating will extend over the entire bridge length. The grating style and color shall match the adjacent structure grating.

2. Structural members of the structural steel access bridge shall be galvanized steel in accordance with Section 05120 - Structural Steel.
3. The bridge handrail members will be 21" and 42" above the walkway.
4. A double handrail, consisting of not less than 1-1/2" diameter, aluminum pipe for the rails and vertical posts, and a 3/16" thick x 4" high aluminum toe plate, will be furnished for both sides of walkway and around the center tower.

I. Surface Skimmer, Scum Trough, and Skimmer Blade Ramp:
1. Two (2) full surface skimmers will be furnished consisting of a scum blade supported from the influent well and structural A frames mounted on top of the truss arms. A hinged wiper assembly will be mounted on the outer end of the scum blade to form a pocket for trapping the scum.
2. The hinged arrangement will insure continual contact and proper alignment between wiper blade, scum baffle and beach as the blade travels up the beach. The wiper blade will have a wearing strip on its outer end which contacts the scum baffle and a neoprene strip on its lower and inner edge. The scum will be trapped as the wiper blade meets the skimmer blade ramp and is raised up the beach to be dumped into the scum troughs.
3. One (1) scum trough shall be furnished each fabricated of 1/4" thick steel plate, adequately supported from the tank wall. The scum troughs will be 4'-0" wide, with a length of 4'-9" along the tank wall. A 6" standard pipe flange will be provided for connection to the scum discharge piping.

J. Effluent Weirs and Scum Baffles:
1. The effluent weirs and scum baffles will be supplied by the Tank Manufacturer as indicated on the Drawings.

K. Effluent Collection Trough:
1. The effluent collection trough will be supplied by the Tank Manufacturer and will be 24" wide and 18" deep fastened to the interior of the tank wall.

L. Drain Plug:
1. The unit will allow the tank to be drained through the header to the level of the orifices. The Contractor will provide a final drain fitting in the sludge line for complete tank drainage as indicated on the Drawings. A special plug for this drain will be furnished by the Manufacturer.

M. Anchor Bolts:
1. All equipment anchor bolts shall be furnished by the Manufacturer and shall be zinc plated steel, and of ample size and strength for the purpose intended. All anchor bolts will be set by the Contractor in accordance with the Manufacturer's instructions.

N. Sludge Judge:
1. Manufacturer shall provide a sludge judge of at least 18 ft. in length.

2.03 PAINTING AND SURFACE PREPARATION

A. Chain - One coat of slush oil.

B. Shafting and exposed machined surfaces - solvent wiping followed by one coat of Mobil-Arma 633, or equal.

C. Wood, nonferrous materials and galvanized surfaces - unpainted.

D. Drive units and controls - Manufacturer's Standard

E. Submerged and non-submerged castings, steel plates and shapes - Surfaces will be prepared by blast cleaning, then followed by one shop coat of Tnemec 37-77, or equal.

F. Touch-up shall be furnished and applied by Contractor.

G. Contractor shall apply two (2) coats of coal tar epoxy on all submerged components. Refer to section 09900 - Paints and Coatings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in strict accordance with manufacturer's instructions.

B. Contractor shall supply and install 2" grout layer in bottom of clarifier utilizing the clarifier mechanism to screed the grout in accordance with the manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. After the clarifier mechanism has been completely installed, conduct such tests as are necessary to verify that operation is in conformance with the Specifications. Supply all electric power, labor, and auxiliary equipment required to complete the field tests.

B. If the clarifier mechanism does not meet the Specifications, corrective measures shall be taken, or the mechanism removed and replaced with a mechanism which satisfies the conditions specified.

C. Any component parts which are damaged as a result of testing or which fail to meet the requirements of these Specifications shall be replaced, reinstalled and retested at the Contractor's expense.

3.03 MANUFACTURER'S FIELD SERVICES

A. The services of a factory trained representative of the Manufacturer shall be provided to inspect the installation of the equipment, make any necessary adjustments (before initial start-up), and place it in initial trouble-free operation. The factory trained representative must be provided for two (2) trips for a total of four (4) days on-site.

END OF SECTION

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SECTION 46 43 25
AUTOMATED CLARIFIER BRUSH CLEANING DEVICE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to install and test, complete and ready for operation one (1) set of automated clarifier brush cleaning device as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Section 46 43 21 - Clarifier Mechanism

1.03 SYSTEM DESCRIPTION

A. Provide an apparatus for cleaning algae and debris from the baffle, weir, spillway and effluent flow launder of a circular clarifier. The system consists of an attachment sleeve mounted to existing clarifier equipment as directed by clarifier manufacturer, a mainframe member, several telescopic brush arms, numerous brushes of various sizes, and an assortment of springs in different configurations to provide the biasing forces. A series of brushes are mounted to the frame member and biased into engagement with the baffle, weir, spillway and walls of the effluent flow channel. Furthermore, a bridging device is positioned over the effluent discharge hole to support the launder brush assembly as it passes. All metallic parts of the automated brush system shall be constructed of Type 316 stainless steel or greater with exception of Mainframe and Attachment Assembly which will be 304 stainless steel.

B. The Automated Brush System shall be custom designed, constructed, for the removal of algae and debris and installed on a circular clarifier. Because of custom designed application of the automated brush units, manufacturer is required to have a factory service technician on site for a minimum of up to three working days per unit to observe and advise the installation of Automated Brush System on one scheduled mobilization to site. This is particularly important for fine-tuning / brush adjustment segment of installation.

C. The Automated Brush System shall be designed to work off the power of the existing clarifier drive motor. The system shall be constructed to avoid any noticeable torque increases. The unit shall be capable of encountering an indefinite stall without incurring damage.

D. The unit shall be designed with an engaged position for cleaning, and a dis engaged position allowing the system to ride idle around the tank.

1.04 DESIGN REQUIREMENTS

A. New Final Clarifier No. 2
   1. Provide an automated brush cleaning system for the New Final Clarifier No. 2.
   2. The Automated Brush System for algae and debris control shall be designed for a Brush to make contact with each of the following surfaces (exact dimensions shall be field verified):
      a. Inner Baffle
      b. Outer Baffle
      c. Inner Weir
      d. Outer Weir
      e. Inner Launder Wall
      f. Launder Bottom
      g. Outer Launder Wall

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data shall include at least the following:
   1. Certified shop and erection drawings showing all important details of construction and dimensions.
   2. Descriptive literature, bulletins, and/or catalogs of the equipment.
   3. The total weight of the equipment including weight of the single largest item.
   4. A complete total bill of materials for all equipment.
   5. A list of manufacturer's recommended spare parts.

C. The manufacturer shall clearly identify any exception to this Section, related sections, or the Drawings. Failure to do this shall be grounds for rejection of the submittal.

D. Certification of compliance with the American Steel and Iron provision of the State Revolving Loan Fund.

1.06 QUALITY ASSURANCE

A. Qualifications of manufacturer: The Manufacturer of Automated Cleaning Brush systems shall regularly engage in the manufacture of Weir Cleaning systems with have a minimum of five (5) years' experience in the manufacture of Automated Weir Cleaning systems. Additionally, Manufacturer of Automated Cleaning Brush System shall and a minimum of seventy-five (75) UNITS of their own units in operation. A history of successful installations (with contact names and phone numbers) must be available and included, if required.

B. Qualifications of manufacturer: Products used in the work specified shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of successful production.

C. Use of factory trained workmen, who are completely familiar with the specified requirements of automated brush cleaning devices and the methods needed for proper performance of equipment will be required. One (1) Factory trained and employed technician will be on site for up to 3 days per clarifier to observe and advise the installation and "sign off" on the custom designed, field built Automated Weir Cleaning system with the contractor performing installation. Factory advisement includes calculating bridge clearances, strengthening uprights, placement of ramps over effluent discharge/ scum box areas and adapting brush system for radial variances of the clarifier walls and weir surfaces. It will be the responsibility of the Manufacturer of the Automated Brush system to ensure the brush system is cleaning all effluent surfaces included in the specifications.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00

1.08 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Automated Brush system will include a 5 year parts warranty and 1 year labor warranty provided by the Manufacturer of the Automated Brush system to the Owner. The Manufacturer of the Automated Weir Cleaning Brush system is the sole responsible party for the installation and performance of the Automated Brush system after the system has been "signed off" or accepted.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Ford Hall Company (Weir Wolf)

B. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ATTACHMENT ASSEMBLY

A. The Attachment Assembly shall provide a means of attaching the Automated Brush System to the skimmer arm and or rake truss so as not to interfere with any other operations of the skimmer arm (such as the effective skimming of floatable solids or the operation of the skimmer blade assembly at the scum box).

B. The Attachment Assembly shall be custom designed for each specific clarifier. It shall be constructed of 304 stainless steel.

2.03 MAINFRAME

A. The Automated Brush System Mainframe shall be constructed of Type 304 stainless steel and designed to slip easily into the Attachment Assembly and be tightened in position with the use of set screws.

B. The Mainframe shall be designed so that the Brush Arms can be positioned at any point on the Mainframe.

2.04 BRUSH ARMS

A. Brush Arms shall be of Type 316 stainless steel and custom designed and installed for individual applications. Factory service technician will be on site to observe and advise the installation of the Brush Arms to allow for cleaning all aforementioned surfaces and allow for the following:
   1. Flexibility to clean effluent surfaces within a plus or minus 4-inch radial variance (specifically: Clarifier walls, both sides of weirs & baffle).
   2. To have opposite the Mainframe end, a Brush Holder component allowing for the insertion of a brush.
   3. To allow Brush Holder to be adjusted telescopically so that a maximum number of Brush Arm adjustments are possible.
   4. To have a means of biasing the arm to the Mainframe so as to provide sufficient force to remove algae and debris.
   5. Include a component that allows for each brush arm to be "locked out" or disengaged. This will allow operators to customize cleaning schedule and extend life of the brushes

2.05 SPRINGS ASSEMBLIES

A. Each Brush Arm requires spring tension to bias the Brush Arm with the Brush Holder and Brushes into tight engagement with the appropriate effluent surface to be cleaned. The Spring Assemblies require the following.
   1. A minimum of one Spring Assembly of 316 stainless steel is required for each Brush Arm.
   2. Spring Assemblies consist of two stainless steel springs & one stainless steel guide.
   3. Each spring will be composed of 316 stainless steel wire with a minimum diameter of 0.95 inch and a minimum of 260 active coils per spring length.
   4. Spring coils will have a mean diameter of 0.655 inches. A minimum inner coil diameter of.56 inch & an outer diameter of.75 inch are required of each stainless steel spring.
   5. Springs to have a minimum initial spring tension of 6.68 lbf and a maximum of 10.02 lbf with a minimum load tolerance of 18.44 lbf.

2.06 BRUSH HOLDER

A. At the end of each Brush Arm, there will be a 316 stainless steel Brush Holder to allow the insertion of a Cleaning Brush.

B. A Brush Holder shall be aligned with each of the following surfaces: both sides of the baffle, both sides of the weir and each of the effluent launder surfaces. Each Brush Holder will:
   1. Consist of a "bolted clamp design" to allow for the easy insertion and removal of Brushes.
   2. Include a factory-supplied brush suitable for prolonged exposure to wastewater environment.
   3. Contain a Shear Safety Component.

2.07 SHEAR SAFETY COMPONENT

A. Each Brush holder will contain a Shear Safety Component having a frangible point designed to break when subjected to a force exceeding an optimum predetermined stress value.

B. The stress value on each Shear Safety Component will be low enough to release the Brush Holder to forgo any damage to Brush Cleaning unit and/or Skimmer equipment but be high enough to allow standard operation of Brush cleaning system.

2.08 BRUSHES

A. Each Brush Holder shall contain one (1) Cleaning Brush. Brushes shall be provided that slip easily into the Brush Holder and provide the cleaning means necessary to remove algae and debris from their respective surfaces. A brush shall be aligned to make contact with both sides of the baffle, both sides of the weir and all the effluent launder surfaces.

B. Brush construction shall be as follows:
   1. Brush backing shall be of durable plastic able to with stand continuous exposure to sunlight, seasonal temperature changes and the corrosive elements found in wastewater.
   2. Brush bristles shall be polypropylene with adequate trim length, density, and stiffness for extended continuous use.
   3. Brushes shall be cut and shaped appropriately so as to clean their respective surfaces without binding.

C. Replacement Brushes shall be stocked by the manufacturer to the exact dimensions and will be available for purchase. Average Brush life is approximately one (1) year.

2.09 LOCK IN / LOCK OUT DESIGN

A. Each Automated Brush System shall be designed with an engaged or locked in position for cleaning and a disengaged or locked out position for riding idle around the tank.

B. Each Brush Arm will have permanently mounted to the Brush Arm a Lock Out Hook that corresponds to a Lock Out Ring, which allows disengagement of the individual Brushes. The Lock Out Ring is mounted to a Lock Out Boss that is attached parallel to the Mainframe.

C. Each Automated Brush System shall be designed so that the entire Brush system can be disengaged or individual Brush Arms can be disengaged allowing for customized cleaning of weir and effluent surfaces.

2.10 BRUSH BRIDGE

A. Provides the automated brush system Launder Brush Assembly a "Bridge" over the effluent hole on which to travel.

B. The Brush Bridge shall be constructed entirely out of Type 304 Stainless Steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with Manufacturer's instructions and recommendations.

B. Basis of acceptance: The manufacturer's recommended installation procedures, when approved by the Engineer, will become the basis for inspecting and accepting or rejecting actual installation procedures used on this work.

3.02 FIELD QUALITY CONTROL

A. Provide one (1) Factory trained and employed technician will be on site for up to 3 days per clarifier to observe and advise the installation and "sign off" on the custom designed, field built Automated Weir Cleaning system with the contractor performing installation.

B. If any part of the automatic brush cleaning system does not meet the specifications, corrective measures shall be taken, or components removed and replaced with components which satisfy the conditions specified.

C. Any component parts which are damaged as a result of testing or which fail to meet the requirements of these Specifications shall be replaced, reinstalled and retested at the Contractor's expense.

END OF SECTION

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SECTION 46 43 63
DISSOLVED AIR FLOTATION SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The equipment described in this Section shall be supplied as an Owner Supplied Product.

B. The scope of supply from the manufacturer shall include all necessary components for the installation of two (2) Recycle Air Dissolving Pumps (one installed and one shelved standby), one (1) Air Dissolving Tube and one (1) pneumatic control panel.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Division 26 - Electrical.

1.03 SYSTEM DESCRIPTION

A. The following components shall be supplied by the Contractor for Contractor installation:
   1. Two (2) 30 HP White Water Recycle Air Dissolving Pumps
   2. One (1) Pneumatic Control Panel
   3. One (1) Air Dissolving Tube

1.04 DESIGN REQUIREMENTS

A. The Existing DAF system for which the new components are to be installed is designed for the following application:

1. Design Flow Rate:	1500 gpm
2. TSS:	3000 mg/L

B. New DAF Components

1. White Water Recycle Air Dissolving Pumps	
a. No. of Pump(s):	two (2) (1 installed, 1 shelved standby)
b. Type:	End Suction Centrifugal (ANSI)
c. Recycle Flow:	302 gpm at 205 ft
d. Power:	30 HP
2. White Water Air Dissolving Tube	
a. Quantity:	one (1)
b. Diameter:	12 inch
c. Length:	9 ft 10 inches
d. Material:	304 Stainless Steel
3. Pneumatic Control Panel	
a. Quantity:	one (1)

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit product data, including Manufacturer's data, for specified products.
   1. Product Description: Include product description including the following:
      a. Manufacturer's data, order sheet, or equivalent for the blowers being supplied.
      b. Manufacturer's outline and mounting dimensions for all field mounted devices, including, but not limited to, drives, motors, and enclosures.
      c. Manufacturer's wiring diagrams for control system, including necessary field connections (if required).
      d. Manufacturer's dimensions and field fabrication details for all mechanical equipment.

e. The manufacturer shall clearly identify any exception to the specification or drawings. Failure to do this shall be grounds for rejection of the submittal.
f. All equipment to be furnished under this Section must be approved prior to being released for manufacturing unless otherwise noted by the Engineer.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Contractor shall be responsible for receiving, off loading equipment, and storing equipment in accordance with Section 01 60 00 - Product Requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. FRC Systems International
B. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. DAF Recirculation Pumps:
   1. Manufacturers:
      a. Flowserve
      b. Or Approved Equal
         1) Substitutions: See Section 01 60 00 - Product Requirements.
   2. Two (2) Recirculation Pumps shall be supplied.
   3. The recirculation pumps shall be supplied complete with motor, coupling, guard, and mounting frame. The motor enclosures shall be rated: TEFC. The motors shall be 30 HP, rated for 480 V, 3 Phase, 60Hz. The recirculation pumps supplied are ANSI standard centrifugal pumps.
   4. Impellers and shaft are 316 Stainless Steel.
   5. Flow rate is 302 gpm at 205 ft

B. DAF Pneumatic Control Panel
   1. These panels shall be provided in the system with the following control functions:
      a. Regulate, monitor, and control metered quantities of compressed air to the "selected" DAF recirculation pump.
      b. Monitor proper discharge pressure of recirculation pump
      c. Control the pneumatically actuated "sand" and "settled solids" drain valves
      d. Provide for an alarm signal in case of loss of recirculation pressure or air supply
   2. The control panels shall consist of the following components:
      a. 0-160 psi "oil-filled" pressure gauge
      b. Adjustable differential pressure switches
      c. Compressed air regulator w/ gauge
      d. Adjustable airflow "rotometers" rated at 50 liters/minute
      e. Two N.C. 120 VAC 60HZ 56ma solenoid valves for recirculation pump selection-air injection
      f. Two N.C. 120 VAC 60HZ 56ma solenoid valves for "sand" & "settled solids" drain valve operation
      g. Pre-wired terminal strips for electrical connections.
   3. All components shall be assembled and mounted in clear, polycarbonate enclosures. Contractor is responsible for mounting of the control panels and the 120volt/1ph/60Hz control wiring and conduit from the supplied Pneumatic Control Panel to the Electrical Control Panel.
   4. DAF Pneumatic Panel requires a minimum of 1.0 cfm of 100 psi pressure air. This air must be filtered for particulate removal and either "desiccant" or "refrigerant" dried for moisture removal. Excessive particulate and moisture will cause damage to the air panel components and/or pneumatic valves actuators.

5. The manually operated "air-purge" DAF plate cleaning system air is not required to be free of moisture or filtered. A minimum of 30 cfm of 90-120 psi pressure air for short duration's during the shutdown and cleanup mode of the DAF unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that all components are delivered and are in acceptable condition upon delivery to the site.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.03 MANUFACTURER'S FIELD SERVICES

A. Provide services of a factory representative for (1) day to verify the proper installation of the equipment.

B. Provide services of a factory representative for (1) day to instruct owner's personnel on operation and maintenance.

END OF SECTION

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SECTION 46 51 18
SLOT INJECTOR AERATION AND MIXING SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The equipment described in this Section shall be provided as an Owner Supplied Product.

B. Furnish and provide all labor, materials, equipment, and incidentals to install and test, complete and ready for operation, the Slot Injector System as shown on the Drawings and as specified herein.

C. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Division 26 - Electrical

1.03 SYSTEM DESCRIPTION

A. The Slot Injector System shall be supplied by a single manufacturer for all equipment described in this Section and installed by the Contractor in accordance with the manufacturer's instructions.

B. For each basin, the Slot Injector System shall be designed to transfer sufficient oxygen to meet the specified actual oxygen transfer rate (AOTR), as well as, provide sufficient mixing energy in each basin to provide completely mixed conditions with no air supply blowers in operation.

C. The Slot Injector System shall consist of a liquid jet manifold and air manifold suitable for wet installation (Drop In) inside the existing tank complete with necessary supports and hardware, jet recirculation pump, and positive displacement, rotary lobe type blowers as shown on the Drawings and specified herein.

D. The Drop In jet mixing and aeration system shall suitable for installation inside the existing reactor tank without tanking the tank out of service. The new Drop In jet aeration and mixing system shall supplement the existing single manifold jet aeration and mixing system installed in the reactor tank.

1.04 DESIGN REQUIREMENTS

A. Existing Nitrification Reactor #2A:

1. Nominal Basin Diameter: 100 feet
2. High Water Level: 29 feet
3. Site Altitude: < 35 feet Above Sea Level
4. Installation: Refer to Drawings for Installation Location
5. Design Conditions:
   a. Maintain completely mixed conditions with no air supply blowers in operation.
   b. MLSS Concentration: 4,000 - 6,000 mg/L
   c. AOTR @ 28 ft. SWD and D.O. = 2.0 mg/L 800 pounds/hour, to be supplied by the combined use of the New Drop In and Existing jet mixing and aeration systems.
6. New Drop In Jet Aeration and Mixing System
   a. No. of New Jet Pumps: One (1)
   b. New Jet Pump Type: Self-Priming Suction Lift
   c. New Jet Pump Capacity: 3000, gpm at 48 ft TDH
   d. New Jet Pump Power: 60 HP
   e. New Jet Header: Single Drop In Header
   f. Nozzle Type: Slot
   g. No. of New Blowers: One (1)
   h. New Blower Capacity: 1244 scfm at 12 psig

i. New Blower Type: Positive Displacement
j. New Blower Power: 125 HP
k. Air Sparging Capacity: 350#O2/hr (AOTR) at 1244 scfm

7. Existing Jet Aeration and Mixing System
   a. No. of Ex. Jet Pumps: One (1)
   b. Ex. Jet Pump Type: End Suction
   c. Ex. Jet Pump Capacity: 8000, gpm at 25 ft TDH
   d. Ex. Jet Pump Power: 75 HP
   e. Existing Jet Header: Single Header
   f. No. of Ex. Header Nozzles: 22
   g. No. of Ex. Blowers: Two (2)
   h. Ex. Blower Capacity: 3000 scfm at 11.5 psig
   i. Ex. Blower Type: Centrifugal
   j. Air Sparging Capacity: 500#O2/hr (AOTR) at 2475 scfm

B. The manufacturer shall supply one (1) positive displacement blower with weather sound attenuating enclosures for outdoor installation as follows:
   1. Site Elevation: 35 ft. A.S.L.
   2. Ambient Pressure: 14.7 psia
   3. Ambient Temperature: 100 F
   4. Relative Humidity: 90%
   5. Discharge Volume: 1244 scfm
   6. Inlet Pressure: 14.7 psia
   7. Inlet Temperature: 100 F
   8. Discharge Pressure: 26.7 psia
   9. Differential Pressure: 12 psig
   10. Relief Valve Set Pressure: 13 psig
   11. Supply Voltage: 460 Volts, three (3) phase, 60 Hz
   12. Motor Horsepower: 125 HP
   13. Gas: Air

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit product data, including Manufacturer's data, for specified products.
   1. System Description: Include the following:
      a. Manufacturer's data, order sheet, or equivalent for each major piece of equipment, component, instrument or device being supplied.
      b. Manufacturer's outline and mounting dimensions for all field mounted components, including, but not limited to, drives, motors, pumps, liquid jet headers, air headers, instrumentation and controls.
      c. Manufacturer's wiring diagrams for instrumentation and control system, including necessary field connections (if required).
      d. Manufacturer's Dimensions and Field Fabrication Details for all mechanical equipment.
      e. Mounting Details.
      f. The Manufacturer shall clearly identify any exception to the specification or drawings. Failure to do this shall be grounds for rejection of the submittal.
      g. All equipment to be furnished under this Section must be approved prior to being released for manufacturing unless otherwise noted by the Engineer.

1.06 QUALITY ASSURANCE

A. The equipment covered by this Section is intended to be standard equipment, as modified by this Section, of proven ability, as supplied by a single manufacturer, having long experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and as specified herein.

B. In the event that equipment which differs from this Section be offered and determined to be equal to that specified, such equipment shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate such a substitution shall be made at no cost to the Owner and be as approved by the Engineer.

C. The rated horsepower of the drive units shall be such that the units will not be overloaded nor the service factor reduced when the unit is operated at any point on the curve. If, due to the slope of the performance curve, a drive unit of greater horsepower than specified is required to meet this condition, the drive unit will be considered for approval only if any and all changes in electrical work, etc. required by such a change will be provided at no additional cost to the Owner and be to the satisfaction of the Engineer.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00.

1.08 FACTORY TESTING OF BLOWERS

A. All critical dimensions of the blower components actually provided by the manufacturer shall be verified and documented prior to assembly.

B. The rotating parts of each blower actually provided by the Manufacturer shall be statically and dynamically balanced before final assembly. The blower alone shall operate without excessive vibration.

C. Each blower actually provided by the Manufacturer shall be slip tested. The Slip RPM shall be documented. A document certifying that the supplied blowers conform to the design specifications shall be provided.

D. On completion of final assembly of the packaged blower and prior to shipment, each packaged blower shall be mechanically run for a minimum of fifteen (15) minutes.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. KLa Systems, Inc. - Assonet, MA

B. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS FOR JET RECIRCULATION PUMP(S)

A. Jet Recirculation Pump Manufacturers:
   1. Gorman Rupp
   2. Or Approved Equal
      a. Substitutions: See Section 01 60 00 - Product Requirements

B. Jet Recirculation Pump Design Conditions:

1.	Pump Type:	Self-Priming End Suction Centrifugal
2.	Inlet Size:	10 inches
3.	Discharge Size:	10 inches
4.	Capacity:	3000 gpm at 48 feet TDH
5.	Power:	60 HP

6. The Jet Recirculation Pump shall be capable of operating with a variable speed drive so that the pump speed and flow rate may be adjusted.

C. Liquid recirculation shall be furnished with the following accessories:
1. Ductile Iron volute
2. Austempered ductile iron impeller open type impeller capable of handling 3" solids
3. CD4MCu wear plate and seal plate
4. Cast Iron bearing frame, suction head and seal housing
5. Fabricated steel Horizontal belt drive base
6. 60 HP 1800 rpm TEFC motor (460 V, 3 ph, 60 Hz)
7. Single Mechanical Seal
8. Belt Drive and guard
9. Manufacturer's Standard Coating system

2.03 MATERIALS FOR BLOWERS

A. Blower Manufacturers:
1. Kaeser Compressors, Inc.
2. Aerzen
3. Or Approved Equal
   a. Substitutions: See Section 01 60 00 - Product Requirements.

B. Casing:
1. The casing shall be made of high strength, close grained, cast iron, and shall be adequately ribbed to resist deflection and facilitate cooling.
2. The casing shall be precision machined to allow for minimum clearances.
3. The casing design shall incorporate channels at the discharge port to minimize pulsation.

C. Rotor Assemblies:
1. The rotor assemblies shall be one piece and precision machined from high strength, close grain, spheroidal graphite ductile iron allowing smooth, efficient operation at all rated speeds and pressures.
2. Rotors shall be closed-end using a threaded plug.
3. The integral shafts shall be designed to carry higher loads than calculated for the maximum design load and shall incorporate replaceable seal ring wear sleeves.
4. The rotor assemblies shall be statically and dynamically balanced.
5. The rotors shall be a tri-lobe design in order to minimize pulsation and noise.

D. End Plates:
1. The gear-end plate shall be cast iron.
2. The drive-end plate shall be integral to the blower casing ensuring heavy-duty construction, long life, and maximum machine noise attenuation in all applications.
3. Bearing fits shall be precision machined to ensure accurate positioning of the rotors in the casing.
4. Replaceable seal wear inserts shall be provided on the drive-end and gear-end plates.
5. The end plates shall be heavy-duty cast iron with a precision machined sealing face.

E. Timing Gears:
1. The rotor timing gears shall be precision machined from case hardened and ground alloy steel.
2. Each timing gear shall be straight cut and beveled to eliminate axial bearing loads and ensure long life as well as quiet operation.
3. Gears shall be finish ground on a precision grinder to ensure concentricity.
4. The timing gear set shall be taper-mounted on the rotors for improved rebuild ability and accurate timing.

F. Bearings:
   1. All four shaft support locations shall incorporate large, heavy-duty cylindrical roller bearings designed to handle extreme radial loads without sacrificing product integrity and reliability.
   2. The minimum acceptable L10 design life at the blower's maximum rated speed and maximum rated differential pressure shall be no less than 70,000 hours.

G. Lubrication:
   1. Both the gear-end and the drive-end of the blowers shall be oil splash lubricated for minimal maintenance and long service life.
   2. Grease lubricated bearings are not acceptable.
   3. The lubrication design shall ensure adequate lubrication of the timing gears and bearings.

H. Seals:
   1. There shall be four (4) piston ring type labyrinth seals at each end of each rotor to minimize leakage and maintenance costs.
   2. The cavity between the air-side and oil-side seals shall be vented through threaded ports to allow external purging or containment of any lubricating oil or process gas that may have migrated past the seals.
   3. Enough ports shall be incorporated in the design to ensure that the cavity is vented from the bottom no matter what blower drive-to-driven shaft orientation is utilized.
   4. A vent cavity shall be provided on all four (4) sets of piston ring type labyrinth seals. The two (2) vent holes located on the bottom side of the blower shall be left open. The vent holes at the other locations shall be closed off with threaded metal plugs.
   5. The input drive shaft seal shall be a high temperature radial lip type seal with Viton elastomers. The seal design shall incorporate a replaceable wear sleeve on the input drive shaft.

I. Drive Motors:
   1. Drive motors shall be designed, manufactured, and tested in accordance with the latest revised editions of NEMA MG-1, IEC, IEEE, ANSI, and AFBMMA standards as applicable and shall be capable of continuous operation.
   2. The motor nameplate horsepower rating shall not be exceeded at the design speed.
   3. The temperature rise of the motor windings shall not exceed IEC and NEMA standards when the motor is operated continuously at the rated horsepower, rated voltage, and rated frequency in ambient conditions of 40 degrees C.
   4. The motors shall conform to the following:

a.	Mounting:	Horizontal.
b.	Type:	Squirrel Cage Induction.
c.	Enclosure:	Totally Enclosed - Fan Cooled.
d.	Service Factor:	1.15.
e.	Duty Cycle:	Continuous.
f.	Ambient Temperature Rating:	40 degrees C
g.	Starting Current:	Six (6) times full load current maximum.
h.	Winding Insulation:	Class F.
i.	Temperature Rise:	Class B.
j.	Voltage/Frequency/Phase:	460/60/3.
k.	Bearing Lubrication:	Oil, Oil Mist, or Grease (with grease addition fittings and grease relief fittings).
l.	Maximum Speed:	1800 rpm.
m.	Speeds:	Capable of being operated with a variable frequency drive.

J. Blower Packages:
   1. The packaged blowers are to be standard engineered designs of a CE certified manufacturer regularly engaged in the production of packaged blowers to ensure single source accountability and shall include the following listed standard features:

a. The packages shall be driven through V-belts and sheaves. The drive assembly shall be of the high capacity type, oil and heat resistant, with a minimum service factor of 1.5.
b. Automatic tensioning of the V-belts by use of a pivoting, swing frame motor base with adjustable spring assistance and visual indication of V-belt tension shall be provided to ensure the V-belts remain properly tensioned with minimal maintenance and to extend V-belt, sheave, and bearing life. Adjustment of the tensioning device shall be accomplished without removal of the guard or loosening of the motor mounting bolts.
c. The drive guard shall be the manufacturer's standard sheet metal with provision for ventilation. The installed guard shall be fully enclosed, easily removable, and designed to meet current OSHA recommendations and CE standards.
d. The base shall be an elevated, rigid, fabricated steel design with a solid sub-base. The absorptive type discharge silencer shall be integral to the frame in order to minimize space requirements. The blower shall be mounted horizontally for a compact frame.
e. To prevent transmission of vibration and noise, as well as secure the package to the foundation, the base shall include vibration isolators made of rubber in a steel footing equipped with mounting holes for anchoring purposes.
f. Oil drains from the blower drive-end and gear-end lubricating oil sumps shall be piped to the front of the base for ease of maintenance. The drain valves shall be a ball valve with a fully retained and gasketed threaded cap.
g. The inlet filter shall be integral to the inlet silencer and shall include a washable and reusable polyester element for minimal pressure drop.
h. The inlet silencer shall be of the absorptive type, directly connected to the inlet port of the blower, and shall be mounted horizontally.
i. The discharge silencer shall be of the absorptive type with an integral pulsation dampener and directly connected to the outlet port of the blower. The discharge silencer shall be mounted horizontally and shall be integral to the base frame.
j. The relief valve shall be spring loaded and factory installed in a location to protect the blower from excessive differential pressures. The relief valve exhaust shall be piped out of the enclosure.
k. An unloaded start valve shall be provided and factory installed to allow the motor to accelerate prior to system pressurization and eliminate pneumatic shock.
l. An elastomeric compensator/flex connector shall be provided for connection of the packaged blower to the system piping to reduce transmission of structure borne noise as well as prevent unacceptable loading of the silencer connection and blower casing.
m. A sound enclosure shall be provided. The sound enclosure shall be sheet steel construction with powder coat finish. It shall have acoustic foam insulation and shall provide sound attenuation of up to 20 dB(A). The enclosure shall have a hinged panel on top and a removable panel on the front of the package to allow maintenance access. Panels shall incorporate locking closures. An installed, integral ventilation fan, sized to provide adequate cooling of the package, shall be provided.
n. The enclosure shall be suitable for outdoor installation.
o. A pressure gauge shall be provided, pre-piped and panel mounted, on the sound enclosure.
p. A temperature gauge, with adjustable switching point and contact, shall be provided pre-piped and panel mounted on the sound enclosure.
q. A filter differential pressure gauge shall be provided pre-piped and panel mounted on the sound enclosure.
r. The blower package shall be designed to allow all preventive maintenance to be performed from the front of the package. All utility connections and process connections shall be at the rear of the package.

2.04 COMPONENTS

A. Nitrification Reactor #2A
   1. Aeration Manifold
      a. The aerator shall be a monolithic fabrication with slot injectors arranged as bi-directional (injectors mounted on both sides of the liquid header) aeration manifolds. Slot injectors shall be spaced along the length of the header with an injector spacing not greater than 2.0-ft. c-c. Aeration manifold liquid header shall be 14-in. diameter pipe and air header shall be 8-in. diameter air pipe. The aeration manifolds shall provide uniform distribution of the liquid and air to each slot injector. The slot injectors shall be aligned on a common plane approximately 30-in. above the tank floor and angled down 20° in order to maximize gas dispersion. The liquid header shall be a cylindrical member, internally smooth and free from protrusions, which might create additional head loss or collect stringy material. The air header shall also be a cylindrical member located above and parallel to the liquid header. The air header shall be attached to and supported above the liquid header by an air duct at each injector location. Individual air ducts shall ensure uniform air distribution to each injector. Additional supports shall be provided as necessary. Each Slot Injector aeration manifold shall be shipped in one prefabricated sections
   2. Slot Injectors
      a. Each slot injector shall consist of an inner propulsion nozzle, outer mixing chamber and an air duct. The slot injectors shall be fabricated from injection molded reinforced polypropylene and air ducts shall be fabricated from contact-molded reinforced thermosetting laminates in accordance with ASTM C 582-95 and NBS PS 15-69 using vinyl ester resin formulated for ultra-violet protection. In order to retain more of the jet's kinetic energy, the cross section of the mixing chamber shall transition from a circle to a slot without a reduction in flow area. The shape of the propulsion nozzle shall also taper from a circle to a slot in order to assure even distribution of energy across the mixing chamber. The injectors shall be molded and assembled to be concentric with the propulsion nozzle and mixing chamber in axisymmetric alignment. The propulsion liquid and compressed air shall combine in the outer mixing chamber, discharging as a high energy, fine bubble, flat ribbon shaped cloud in the lower regions of the basin.
   3. Liquid and Air Piping
      a. All air and liquid header piping for fabricating the slot injector system and connection piping within the basin shall be provided as part of the jet system. Air down-comer shall be 8-in. diameter and connect to the customer-supplied out-of-basin pipe located 1.0-ft. above the maximum liquid level. Liquid supply pipe shall be 14-in. diameter and connect to the customer's pump recirculation piping approximately 1.0-ft. above the maximum liquid level. Standard, 150-lb. drilling flange(s) shall be furnished for supplier/customer interface. The fiberglass reinforced polyester (FRP) pipe used for the slot injector systems shall be fabricated from premium grade vinyl ester resin with a pressure rating of not less than 75 psi. The pipe shall incorporate a resin-rich liner on both the inside and outside that consists of a "C" glass veil and resin, to a 10-20 mil nominal thickness, with a minimum amount of wax in the surface resin to allow the pipe to cure. The total pipe wall thickness shall be per the following table with a structural wall of continuous glass fibers wound at a 54.75o helical angle in a matrix of vinyl ester resin. Pipe shall be fabricated in conformance with ASTM D-2996-01, type 1, grade 2, class E. The resin shall be formulated for ultra-violet protection. The resin shall remain natural in color (No Pigment Allowed). Unless otherwise noted the wall thickness of the piping is to be as follows:

Diameter	Wall Thickness
14"	0.21
8"	0.15

b. Pipe, fittings, and air feeds shall be fabricated using vinyl ester resin. FRP flanges shall be fabricated in accordance with NBS PS 15-69.

4. Fabrication
   a. The slot injectors, air ducts, flanges, elbows and other fittings shall be attached to the air and liquid headers and connection piping (as required) using hand lay up fabrication methods in accordance with NBS PS 15-69 and ASTM C 582-95. All sharp edges, cuts and burrs are to be sanded and resin coated to seal exposed edges. All flange connections are to straddle the vertical and horizontal centerlines of the equipment in the installed position. Whenever possible flange and fitting-to-pipe joints are to be hand-layed-up and resin coated internally so there are no internal seams. All external areas of the fiberglass equipment are to be resin coated after completion of all assembly and hand-lay-up procedures.
5. Support Skid
   a. The manifold assembly shall be provided as a two complete, assembled units to be connected in the field. The first unit consists of the slot injector manifold mounted on a support frame. The second shall consist of the liquid supply pipe and the air supply pipe mounted on a support frame. Each support frame shall consist of a structural steel skid specifically designed to support the weight of the aerator, piping, and ballast. In addition, the frame must be designed to withstand all the forces that may be encountered in transportation, installation, and operation. Each support frame shall be fabricated from structural carbon steel and shall be hot dip galvanized. The support skid for the slot injector manifold shall require concrete ballast to be supplied and installed at site by the Contractor.
   b. The manifold assembly shall be connected in the field by the Contractor to the liquid and air supply assembly. The liquid suction piping shall be supplied and installed by others. Each complete manifold/piping assembly shall be retrievable and replaceable in the basin without the need to drain or have maintenance personnel enter the basin. A retrieval system consisting of Type 304 Stainless Steel lifting cables, thimbles, shackles, wire rope clips and HDPE foam filled float(s) shall be provided with each assembly. The retrieval system shall be assembled in the field by others. The crane and lifting beam assembly required to install the complete manifold piping assembly shall be the responsibility of the Contractor.
6. Back-Flush System
   a. Each slot injector manifold system shall be provided with one back-flush system (supplied by the installing Contractor in the out-of-basin piping), which can clear any fouling debris without requiring maintenance personnel to enter the basin. The system shall be an air-lift type, activated by turning off the recirculation pump while keeping the blower operating and opening the back-flush valve. The air-lift shall draw air and liquid in a reverse direction through the inner liquid nozzle, into the manifold piping, and then exiting the system up the riser pipe, and discharging back into the basin. Back-flush system shall include 8-in. butterfly valve with hand wheel operator, discharge pipe and Type 304L SS supports.
7.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's instructions and recommendations.

3.02 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 01400.

B. After Contractor and Engineer have mutually agreed that the equipment installation is complete and ready for continuous operation, Contractor and a qualified field service representative of the manufacturer shall conduct an operating test of the equipment and the controls in the presence of Engineer to demonstrate that the Slot Injector System and controls will function correctly to the satisfaction of the Owner and Engineer.

3.03 MANUFACTURER'S FIELD SERVICES

A. The services of a factory trained representative of the manufacturer shall be provided to inspect the installation of the equipment, make any necessary adjustments (before initial start-up), place it in initial trouble-free operation, and instruct the operating personnel in its operation and maintenance.

B. The factory trained representative shall be provided for three (3) trips and a total of six (6) days on-site for:
   1. Installation inspection of jet headers, pumps and blowers.
   2. Start-up and operating instructions for the in-basin equipment.
   3. Start-up of pumps and blowers.
   4. Operations and Maintenance Training for Owner's Personnel.

END OF SECTION

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SECTION 46 51 21
FIXED AERATION HEADER DIFFUSER SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to install and test complete and ready for operation the coarse bubble diffuser system in the DAF FEB Tank including piping and appurtenances as shown on the Drawings and as specified herein.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Section 43 11 33 - Rotary Lobe Positive Displacement Blowers

1.03 DESIGN REQUIREMENTS

A. Air shall be conveyed from the blowers to the diffuser equipment through an air distribution piping network comprising the aeration and mixing system.

B. The diffused aeration equipment shall diffuse the air uniformly into the tank or basin in which it is installed.

C. DAF FEB Tank:
1. Nominal Basin Diameter: 65 feet
2. Maximum Side Water Depth: 24.5 feet
3. Minimum Side Water Depth: 8.25 feet
4. Site Altitude: 35 feet Above Sea Level
5. Design Conditions:
   a. Maintain completely mixed conditions at with the specified TSS at all liquid depths between the specified minimum and maximum side water depths.
   b. TSS Concentration: < or = 3,000 mg/L
   c. Dissolved Oxygen Concentration: 2.0 mg/L
   d. AOTR Design Conditions

Design Condition	AOR (lbs/hr)	Air Flow (scfm)	Liquid Depth (feet)	DO (mg/l)
Design Condition #1	233	2,700	16	2.0

   e. Minimum Airflow: 1,000 scfm
   f. Maximum Airflow: 5,300 scfm
   g. Alpha: 0.75
   h. Beta: 0.95
   i. Water Temperature: 20 degrees C
6. Diffuser Length: 24 inches
7. Minimum Number of Diffusers: 88
8. Minimum Drop Leg Size: 10"

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Submittal drawings showing plan, elevation and cross sections of the equipment.

C. Component details of the aeration equipment showing diffusers, diffuser connectors, supports, expansion joints and flanges

D. Materials and manufacturing specifications.

E. Equipment booklet to include:
   1. Equipment data sheets
   2. Performance data including oxygen transfer calculations.
   3. Head loss calculation and pressure requirements.
   4. Descriptive literature and bulletins.
   5. Customer contact list with telephone numbers (minimum of 10 contacts from similar size facilities).

F. Operation and maintenance manual with installation instructions. Submit after approval of equipment and prior to shipment.

G. Detailed list of any or exceptions taken to these specifications. Include specification reference and proposed alternative with reason stated for exception.

1.05 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00.

1.06 WARRANTY

A. Provide a manufacturer's written one-year full warranty from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aquarius Technologies, Inc.

B. Sanitaire Division of ITT Industries

C. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DROP-LEGS AND AIR DISTRIBUTION HEADER SYSTEM

A. Drop-leg shall start at flange connection on air supply header and extend down to two to four feet above air distribution header system.

B. Air distribution header system shall convey air from drop-leg to coarse bubble diffuser inlet connections.

C. Air distribution pipe shall be fabricated in sections up to 30 feet in length. Air distribution pipe sections shall be joined with fixed joints, expansion joints, or combination of fixed joints and expansion joints.

D. Air distribution header sections shall be shop fabricated with provisions for mounting diffusers.

E. Bottom elevation of air distribution header shall be same throughout each air distribution header system. Provide eccentric reducers at changes in diameter, for both runs and branches. Orient eccentric reducers so that flow line elevation does not change and crown of pipe elevation changes.

F. Provide removable cap, plug, or flange at dead end of each air distribution header.

G. Clean all welded stainless steel surfaces and welds after fabrication to remove weld splatter and finish clean all interior and exterior welds by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.

2.03 DROP LEG AND AIR DISTRIBUTION SYSTEM MATERIALS

A. Drop-legs and air distribution system shall be fabricated of stainless steel pipe, fittings and flanges and shall meet the following requirements:
   1. Stainless Steel Pipe, 4" through 36"
      a. Material for Stainless Steel Pipe, 4" through 36": AISI 304L Stainless steel.

b. Pipe Standards for Stainless Steel Pipe, 4" through 36": ASTM A312 or ASTM A778.
c. Dimension Standard for Stainless Steel Pipe, 4" through 36": ANSI/ASME B36.19M, 12 gage thickness.

2. Stainless Steel Pipe, 3" or smaller
   a. Material for Stainless Steel Pipe, 3" and smaller: AISI 316L stainless steel.
   b. Pipe Standard for Stainless Steel Pipe, 3" and smaller: ASTM A312.
   c. Dimension Standard for Stainless Steel Pipe, 3" and smaller: ANSI/ASME B36.19M, Schedule 40S.
3. Stainless Steel Fittings 4" through 36"
   a. Material for Stainless Steel Fittings, 4" through 36": AISI 304L stainless steel.
   b. Material Standard for Steel Fittings, 4" through 36"
      1) Fittings for ASTM A312 Pipe: ASTM A403
      2) Fittings for ASTM A778 Pipe: ASTM A774
   c. Dimension Standards for Stainless Steel Fittings, 4" through 36"
      1) Fitting Wall Thickness: ANSI/ASME B36.19M, 5 gage.
      2) Fitting Dimensions: ANSI B16.9
4. Stainless Steel Fittings, 3" and smaller
   a. Material for Stainless Steel Fittings, 3" and smaller: ASTM 316L stainless steel.
   b. Fitting Standard for Stainless Steel Fittings, 3" and smaller
      1) Forged/Wrought Stainless Steel Fittings: ASTM A182, Grade 316L
      2) Cast Stainless Steel Fittings: ASTM A351, Grade CF 8M.
   c. Dimension Standard for Stainless Steel Fittings, 3" and smaller: ANSI B316.3, Class 150
   d. Stainless Steel Pipe and Fitting Joints
   e. Stainless Steel Pipe and Fittings, 4" through 36": Flange, welded, or clamp type coupling.
   f. Stainless Steel Pipe and Fittings, 3" and smaller: Threaded or Flange.
5. Flanges for Stainless Steel Pipe and Fittings
   a. Stainless Steel Flange Material
      1) Flanges for 4" through 36" Stainless Steel Pipe and fittings: AISI 304L stainless steel.
      2) Flanges for 3" and smaller Stainless Steel Pipe and Fittings: AISI 316L stainless steel.
   b. Stainless Steel Flange Standard: ASTM A182.
   c. Stainless Steel Flange Dimension Standard: ANSI B16.5, Class 150.
   d. Stainless Steel Flange Type
      1) Flanges for Stainless Steel Pipe, 4" through 36": Welding neck, lap joint, or slip-on.
      2) Flanges for Stainless Steel Fittings, 4" through 36": Welding Neck.
      3) Flanges for Stainless Steel Pipe and fittings, 3" and smaller: Threaded.
   e. Flange Face Type: 1/16" raised face.
6. Stainless Steel Flange Joint Accessories
   a. Stainless Steel Flange Joint Gaskets
      1) Gasket Type: ring.
      2) Gasket Thickness: 1/8"
      3) Gasket Material: Ethylene-Propylene diene terpolymer (EPDM) rubber.
   b. Bolts, Studs, and Nuts for Stainless Steel Flange Joints
      1) Bolt, Stud, and Nut Material: AISI Type 316 or Type 316N stainless steel.
      2) Bolt and Stud Standard: ASTM A193, Grade B8M, B8MN, or B8MLN.
      3) Nut Standard: ASTM A194, Grade 8M, B8MN, or M8MLN.
      4) Bolt, Stud and Nut Threads: UNC threads.
      5) Stud Length: Studs shall extend through nuts a minimum of ¼".

B. Provide expansion couplings in air distribution header systems between fixed supports. Expansion couplings shall allow air distribution header system pipe to move longitudinally so that pipe and support system are not stressed or deflected. Expansion coupling shall allow free movement of pipe end over temperature range of 125°F. Expansion couplings shall be AISI Type 304L Stainless Steel will EPDM gaskets.

C. Each unused diffuser tap shall be plugged with hex head stainless steel threaded plug.

D. Fabrication of stainless steel drop-legs and air distribution header system shall be as specified in this Section.

2.04 DIFFUSER CONNECTIONS

A. Each diffuser connection shall be special cast tee. Each diffuser connection shall be designed to connect two diffusers to air distribution header pipe.

B. Diffuser connections shall be stainless steel casting and shall meet the following requirements:
   1. Stainless Steel Diffuser Connection Material: AISI 316L stainless steel.
   2. Standard for Stainless Steel Diffuser Connections
      a. ASTM A 182, Grade 316L;
      b. Or ASTM A743, Grade CF3

C. Diffuser connection tee branch shall be factory welded to bottom centerline of air distribution header pipe. All diffuser connections in each air diffusion system shall be on common horizontal plane. Diffuser connection tee branch shall be of sufficient length that air exits diffusers below flow line of air diffusion header pipe.

D. Diffuser connection, including cast tee and connection to air diffusion header, shall withstand a moment of 1,000 inch-pounds applied at diffuser connection without any permanent deformation of diffuser connection or air diffusion header. Diffuser connection shall be reinforced with, gussets, plates, or a combination of gussets or plates as required to meet the requirements specified in this Section.

E. Each diffuser connection shall have air passage from air diffusion header pipe to diffusers. Air shall pass from air diffusion header pipe into diffuser connection through neat, clean hole in bottom of all diffusion header pipe. Hole in bottom of air diffusion header pipe shall be centered over axis of diffuser connection tee branch. Diameter of hole in bottom of air diffusion header pipe shall be same inside diameter connection inlet.

F. Diffusers shall connection to diffuser connection tee run ends. Run ends of diffuser connection tee shall have ¾" NPT female threads.

2.05 COARSE BUBBLE DIFFUSERS

A. Diffusers shall be non-clogging coarse bubble diffusers with no flexing or moving parts. Each diffuser shall consist of inlet connection, inlet air control device, inverted air reservoir, and graduated air exit ports.

B. Diffuser body shall be formed to provide air reservoir in top of diffuser body for full length of diffuser body. Graduated air exit ports shall be distributed along sided of diffuser body for full length of diffuser body. Free air discharge slots, or opening, shall be provided in lower part, or bottom, of diffuser body for full length of diffuser body. Lower part of diffuser body shall be designed to direct liquid being aerated along exterior of diffuser body walls. Air existing diffuser shall through air exit ports be sheared into relatively small bubbles and distributed into liquid being aerated. Diffuser body shall be formed of AISI Type 304L Stainless Steel plate, 20 gauge minimum. Nominal length of diffuser body shall be 12" or 24".

C. Diffuser ends shall be Stainless Steel castings.
   1. Diffuser end castings shall meet the following requirements:
      a. Stainless Steel Diffuser Connection Material: AISI 304L Stainless Steel.
      b. Standard for Stainless Steel Diffuser Connections: ASTM A743, Grade CF3.
   2. Diffuser inlet end cap shall have diffuser inlet connection and air control device. Diffuser cap opposite diffuser inlet shall be plane with no openings.

3. Diffuser end caps shall support ends of diffuser body. Diffuser end caps shall be welded to diffuser body.
4. Diffuser inlet end cap shall have ¾" nipple with NPT mail threads. Diffuser end cap nipple dimensions shall meet the requirements of ANSI/ASME B36.19M, Schedule 80S. Diffuser inlet shall screw into diffuser connection tee. Diffuser inlet end connection shall have integral square or hexagon nut for installation and removal of diffuser.
5. Provide air inlet control device in each diffuser inlet end cap. Air control device shall be orifice or nozzle. Air inlet control orifice, or nozzle, shall limit air flow to diffusers so that uniformity of air flow to diffusers is between 0.95 and 1.05.

2.06 AIR DISTRIBUTION HEADER SYSTEM AND DIFFUSER SUPPORT SYSTEM

A. General
1. Air distribution header system and diffuser support systems shall support air distribution header system and diffusers when tanks are empty and when air distribution header system and diffusers are submerged at any depth to maximum depth of water in tanks. Air distribution header system and diffuser support systems shall prevent air distribution header system and diffusers form floating when air distribution header system and diffusers are submerged at any depth to maximum depth of water in the tank. Air distribution header system and diffuser support systems shall not loosen when air diffusion system is operated continuously or intermittently for minimum of three years.
2. Air distribution header system and diffuser supports shall be fabricated from AISI Type 304L stainless steel.
3. Submit calculations that show support system meets the requirements of this Section. Calculations shall be certified by an Engineer registered in the State of the State in which the Project is located.

B. Air Distribution Header Supports
1. Each air distribution header pipe shall be supported by a minimum of two supports. Spacing between manifold supports shall not exceed 12 feet.
2. Air distribution header supports shall resist thrust generated by expansion and contraction of air distribution pipe.
3. Air manifold supports shall resist bending moment of 550 inch-pounds without exceeding 22,500 psi design stress.
4. Inside surface of air manifold support elements that directly contact air distribution header pipe shall be contoured to match exterior surface of air distribution header pipe. Width of bearing surface contacting air distribution header pipe shall not be less than 2".
5. Air distribution header system support system shall include mechanism that provides ± 2" vertical adjustment and ± ½" rizontal adjustment for field alignment of air distribution header pipes. Adjusting and aligning mechanism shall be infinitely adjustable within specified vertical and horizontal adjustment limits.

C. Air Distribution Header System and Diffuser Support System Anchors
1. Supports shall be anchored to tank, or channel, floors, or concrete support bases, with stainless steel epoxy adhesive anchor bolts designed for embedment in existing reinforced concrete.
2. Coordinate anchor bolt locations and attachment requirements with structural Drawings.
3. Anchor bolt material shall be AISI Type 316, Type 316D, Type 316L or Type 316N stainless steel.
4. Support System shall be designed so that, under full buoyancy anchor withdrawal force shall not exceed 450 pounds.

2.07 STAINLESS STEEL FABRICATION

A. Welding of Stainless Steel Fabrications
1. Welded stainless steel fabrications shall be shop welded. Field welding of stainless steel components will not be accepted.
2. Shop welding shall use shielded arc, inert gas, MIG, or TIG method.

3. Filler wire shall be added to welds and shall provide cross sections and weld metal thickness equal to or greater than parent metal.
4. Butt welds shall fully penetrate to interior surfaces. Gas shielding shall be provided to interior and exterior of joint.
5. Interior weld beads shall be smooth and evenly distributed with interior projection not exceeding 1/16".

B. Pack equipment to provide ample protection from damage during shipment, handling, and storage. Cap and seal openings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Follow equipment manufacturer's recommendations for sequencing of equipment installation.

B. Layout and install support anchors in accordance with equipment manufacturer's recommendations and anchor setting plan.

C. Level aeration system such that all diffusers connected to a header are within plus or minus 3/8 inch of a common horizontal plane.

3.02 TESTING

A. Following installation, adjustment, elimination of leaks, and replacement of defective diffusers, test air diffusion system.

B. Place water in tank to minimum allowable operating depth of diffusers. Turn on air flow to diffusers at minimum rate required to observe operation of diffused air system.

C. Slowly fill tank. Observe operation of air control valve, diffusers, air distribution and mixing of tank contents during filling of tank.

D. Record air flow rate during filling of tank.

E. If any part of air diffusion system fails, or is damaged during testing, correct defects by adjustment, repair, modification or replacement. Re-test equipment following correction of defects. Re-test equipment at no additional cost to Owner.

F. If air diffusion system does not, in the opinion of the Engineer, meet requirements of this Section through observation of system operation or measurements of dissolved oxygen concentration, field performance testing shall be conducted under provisions of the General Conditions.

3.03 CLEANING

A. Clean grease, oil, or any other debris from the exterior surfaced of air diffusion system piping and diffusers.

B. Remove debris from diffusers.

3.04 MANUFACTURER'S FIELD SERVICES

A. Provide services of a factory representative for (1) day to verify the proper installation of the equipment.

B. Provide services of a factory representative for (1) day to instruct owner's personnel on operation and maintenance.

END OF SECTION

SECTION 46 66 53
OPEN CHANNEL ULTRA-VIOLET DISINFECTION SYSTEM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and appurtenances required to provide an open channel, gravity flow, low pressure high intensity ultraviolet lamp (UV) disinfection system. The UV system to be complete and operational with all control equipment and accessories as shown and specified herein. This system will be capable of disinfecting effluent to meet the water quality standards listed in this section.

B. The material specified herein shall comply with the American Iron and Steel provision of the Clean Water Act as it applies to the State Revolving Loan Funds and as administered by the State of Delaware. It is the Contractor's responsibility to determine if the Approved Manufacturers comply with the requirements of the provision.

1.02 RELATED SECTIONS

A. Division 26 - Electrical

1.03 SYSTEM DESCRIPTION

A. System configuration:
   1. The UV system must fit within the Concrete UV channel(s) as shown on the Drawings.
   2. The UV system configuration will be as follows:
      a. Number of Channels: 1
      b. Number of Banks per Channel: 2 (1 duty and 1 standby)
      c. Number of UV Modules per Bank: 3
      d. Number of Lamps per UV Module: 6
      e. Total Number of Lamps in the UV System: 36
      f. Number of Power Distribution Centers: 2
      g. Number of System Control Centers: 1
   3. Number of Level Controllers: 1
      a. Type of level controller: Serpentine Weir
   4. UV Module Lifting Equipment:
      a. Davit Crane and UV Module Lifting Sling
   5. Lamp array configuration:
      a. The lamp array configuration shall be evenly spaced in both horizontal and vertical rows with all lamps parallel to each other and to the effluent flow.
      b. The total number of lamps is based upon a power current of 510mA per lamp, a production of 44.9 watts of UV light per lamps, and a guaranteed lamp output of at least EIGHTY-EIGHT (88) percent at the end of lamp life (12,000 Hrs. MINIMUM).

1.04 DESIGN REQUIREMENTS

A. Provide equipment that will disinfect effluent with the following characteristics:
   1. Average Flow: 1.5 MGD
   2. Maximum Flow: 2.0 MGD
   3. Total Suspended Solids: 5.0 mg/L, 30 day average of grab samples
   4. Effluent Temperature Range: 33 to 85 F
   5. Ultraviolet Transmittance @ 253.7 nm: 60 %, minimum
   6. Maximum Mean Particle Size: 30 microns
   7. Effluent standards to be achieved:
      a. 63 col enterococci/100 mL based on a 30 day geometric mean of daily samples for the effluent standard as specified in 1. through 6. Effluent standards will be guaranteed regardless of influent count to UV system.

b. 200 MPN/100 mL fecal coliform based on a 30 day geometric mean of daily samples for the effluent standard as specified in 1. through 6. Effluent standards will be guaranteed regardless of influent count to UV system.

1.05 PERFORMANCE REQUIREMENTS

A. The UV dose produced by the system shall not be less than 61,034 u-Watt-secs/cm2 after one year (8760 hours) of lamp operation, based upon a theoretical retention time of 5.04 seconds at the peak flow rate. Dosage shall be measured in an effluent with a 65% UV transmission at 253.7 nm. The dispersion coefficient "E" shall be less than 100 sq. cm./second, and the dispersion number "d" shall be less than 0.1. Lamp output to be at 89% of its initial level, after one year of operation, and there shall be no fouling on the lamp sleeves. The average Intensity (I) within the bank shall not be less than 13,620 uWatt/cm2 at a transmission rate of 65% after 12,000 hours of operation. Intensity shall be calculated based upon a lamp power consumption of 510 mA at a temperature of 10 degrees C. The UV Density of the banks shall not be less than 5.65 Watts/Liter. Dosage calculation based upon the "UV-Dis" method will NOT be allowed.

B. The system will be able to continue providing disinfection while replacing UV lamps, quartz sleeves, ballasts and while cleaning the UV lamp sleeves.

C. The system will be designed for complete outdoor installation.

1.06 PERFORMANCE GUARANTEE

A. The manufacturer shall guarantee that the UV disinfection system will meet The required e-Coli limits as stated in Part 1.04. These limits must be met irregardless of the influent e-Coli concentration, as long as the design parameters for peak flow, suspended solids and UVT as listed in Part 1.04 are not exceeded. Manufacturers of equipment whose guarantee is limited to a maximum influent fecal coliform concentration will not be allowed.

1.07 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Submit for review, shop drawings showing the following:
1. Complete description in sufficient detail to permit an item comparison with the specification.
2. Dimensions and installation requirements.
3. Descriptive information including catalogue cuts and manufacturers' specifications for major components.
4. Electrical schematics and layouts.
5. Written verification from an independent, third-party laboratory certifying that the lamp output complies with Design Requirements.
6. Submit the manufacturer's written guarantee that the lamp warranty complies with Design Requirements.
7. Independent bioassay report and dosage calculations demonstrating compliance with the specified dose requirements.
8. Disinfection performance guarantee.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Provide equipment which is a standard product of the manufacturer.
2. To be qualified, the UV manufacturer must provide documentation on at least THIRTY (30) of its wastewater disinfection systems which have been in satisfactory operation in the State of Virginia for a minimum of ten (10) years. The lamps are to be parallel to the flow, in a uniform array, and in an open channel, as shall be furnished on this project.

B. Prequalification Requirements:
   1. Demonstrate that the dose required in the performance specification is being met or exceeded in an effluent at 40 degrees Fahrenheit. The UV equipment manufacturer will provide both an EPA and a bioassay calculation. The bioassay calculation, as the name implies, shall be based on an independently produced bioassay report on the proposed UV equipment. The bioassay calculation shall be conducted at the full scale system's per lamp flow. Both the EPA and bioassay calculations shall demonstrate that the proposed UV system design will deliver the intended dose.
   2. In order to verify the lamp output assumption made in the EPA calculation, the UV equipment manufacturer shall provide a UV Lamp Output Graph. This UV output graph shall be verified by an independent agency. The proposed electronic ballast for the full scale system shall have a minimum operating current of 500 mA. The curve shall show the output of the identical lamp individually being driven by both ballasts, while immersed in a liquid over the operating temperature range of 40 to 100 degrees Fahrenheit. The most recent radiometer calibration documentation, as used in the test procedure, and a complete procedural description shall be supplied with the calculations.
   3. The Engineer shall reserve the right to require that the test be modified and repeated if the protocol used is not satisfactory.

1.09 DELIVERY, STORAGE, AND PROTECTION

A. In accordance with Section 01 60 00.

1.10 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Equipment:
   1. The equipment furnished under this section will be free of defects in material and workmanship, including damages that may be incurred during shipping for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.

C. UV Lamps:
   1. The UV lamps to be warranted for a minimum of 12,000 hours when operated in automatic mode, prorated after 9,000 hours.

D. Ballasts to be warranted for 5 years, prorated after 1 year.

1.11 EXTRA MATERIALS

A. The following spare parts and safety equipment to be supplied.
   1. 4 UV Lamps
   2. 4 Quartz Sleeves
   3. 4 Lamp Holder Seals
   4. 1 Operators kit including face shield, gloves and cleaning solution.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Trojan Technologies, Inc. - London, Ontario, Canada

B. Or Approved Equal
   1. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GENERAL REQUIREMENTS

A. Provide a UV disinfection system complete with UV lamp modules and channels with level control, and transition boxes, as shown on the Contract Drawings and as herein specified.

B. The installation contractor shall be responsible for supplying electrical power to each module and providing sufficient electrical outdoor receptacles. The receptacles to be rated for continuous operation of the UV lamp modules. The contractor is also to provide Ground fault interrupter protection from the power source.

K. Power Distribution Center (PDC):
1. Power distribution will be through bus bars to environmentally sealed receptacles to allow for local connection of UV modules.
2. Data concentration will be through integrated circuit boards located inside the Power Distribution Center.
3. Fusing and Ground detection circuits will be located inside the Power Distribution Center.
4. Enclosure material will be Type 304 stainless steel.
5. All internal components will be sealed from the environment.
6. All Power Distribution Centers located outdoors will be equipped with a Type 304 stainless steel sunshade complete with stainless steel stand-offs to minimize heat gain.
7. All Power Distribution Centers to be CSA approved or equivalent with a rating of Type 4X.
8. One (1) separate sealed Power Distribution Center will be provided per bank of lamps.
9. To be considered as an alternative, systems that have ballasts mounted in cabinets, the UV manufacturer will provide one (1) complete cabinet for each bank of lamps, to ensure that each bank is electrically isolated for safety during maintenance and to provide redundancy under average flow conditions.

L. Control and Instrumentation:
1. System Control Center (SCC):
2. The operation of the UV System is managed at the SCC by a Microprocessor based controller which continuously monitors and controls the system functions.
   a. The operator interface, display screen, and message keypad will be menu driven with automatic fault message windows appearing upon alarm conditions.
   b. Keypad will have a sealed membrane overlay covering all function keys and numerical keys.
   c. Alarms will be provided to indicate to plant operators that maintenance attention is required or to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. The alarms will include:
      1) Lamp Failure: Each alarm will identify the affected lamps by an address system. The address will specify the bank, module and lamp (i.e., Bank #1A, Module #3, Lamp #2).
      2) Low UV Intensity: Pre-set at 80% of the intensity after 100 hours burn-in of the lamp
      3) Multiple Lamp Failure
      4) Module Communication Alarm
   d. The 70 most recent alarms will be recorded in an alarm history register and displayed when prompted.
   e. Bank status will be capable of being placed either in Manual, Off or Auto mode.
   f. Banks will be cycled for equal wear and timed off to minimize bank cycling.
   g. Elapsed time of each bank will be recorded and displayed on the display screen when prompted.
   h. Panel will be CSA approved or equivalent, rated Type 4X and be will be located not more than 500 feet from the channel.
   i. Digital I/O modules rated for 3 amps will be provided to remotely indicate status and alarms such as:
      1) Common Major Alarm Condition
      2) Bank Status (one for each UV bank supplied)
   j. Trojan On-Line RMI SystemTM:
   k. System Control Center includes capabilities for remote diagnostics (by manufacturer's service technicians) through a modem connection. Data transfer to the manufacturer's remote computer to be available through a dedicated telephone line terminated in the System Control Center. The modem can be enabled / disabled at the System Control Center by plant personnel.

M. UV Detection System:
   1. A submersible UV sensor will continuously monitor the UV intensity produced in each bank of UV lamps.
   2. The sensor will measure only the germicidal portion of the light emitted by the UV lamps. The detection system will be factory calibrated. Detection systems that can be field calibrated will not be permitted.

N. Dose-Pacing:
   1. A dose-pacing system will be supplied to modulate the lamp UV output in relationship to a 4-20 mA DC signal from an effluent flow meter (by Others), in conjunction with entered UV transmittance values. Dose pacing using the UV Detection System will not be allowed.
   2. The system to be dose-paced such that as the flow and effluent quality change, the UV dose delivered is optimized while conserving power.
   3. The dose-pacing system will allow the operator to vary the design dose setting. Logic and time delays will be provided to regulate the UV bank ON/OFF cycle.

O. Hydraulic Systems Center (HSC):
   1. One (1) HSC will be supplied to house all components required to operate the automatic cleaning system.
   2. Enclosure material of construction will be Type 304 stainless steel.
   3. The HSC will contain a hydraulic pump complete with integral 4-way valve and fluid reservoir housed inside the HSC.

P. Cleaning System:
   1. Cleaning system will have mechanical and chemical cleaning abilities, complete with an automatically initiated and controlled cleaning cycle.
      a. The cleaning system, including both mechanical and chemical components, will be fully operational without requiring either lamps or modules be placed out of service.
      b. Cleaning cycle intervals to be field adjustable within the range of once every 24 hours to once every 500 hours. Remote Manual and Remote Auto cleaning control to be available through the operator interface.
      c. The system will be provided with the required cleaning solutions necessary for initial equipment testing and for equipment start-up.
   2. To be considered as an alternate, systems that use only mechanical wiping must have the ability to periodically be cleaned out of channel using a chemical bath. Out of channel cleaning will include lifting slings, removable banks, cleaning tanks, agitation system and air compressors, as required. The UV manufacturer will be responsible for supplying all equipment including any equipment not specifically listed required to perform out of channel chemical cleaning. Contactor will be responsible for installation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with Contract Documents, Shop Drawings, and manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. As required for complete and proper installation and start-up the equipment, and Training of the plant's operating personnel.

B. Operator Training: One (1) full day on site.

C. Warranty Service: As required during the warranty period.

END OF SECTION

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