Contract Drawings For

Wastewater Treatment Plant Upgrade - Egg Shaped Anaerobic Digester - ESAD

2017 City of Fremont

Civil/Structural/Architectural/Process/Mechanical/Electrical

Project No. 10045587
Fremont, Nebraska

Date: July 23, 2018

ISSUED FOR BID
GENERAL NOTES:
1. BACKGROUND IS A COMBINATION OF SITE SURVEY PROVIDED BY JEO CONSULTING GROUP, INC. ON 01/25/17 AND SITE PIPING INFORMATION PROVIDED BY THE OWNER.
2. THE LOCATION OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE APPROXIMATE OR MAY NOT BE INDICATED IN THESE PLANS. THE CONTRACTOR IS TO FIELD VERIFY LOCATIONS OF ALL ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR REMOVAL THROUGHOUT CONSTRUCTION. ALL REPAIRED OR REPLACED ITEMS ARE AT THE EXPENSE OF THE CONTRACTOR. REPAIR OR REPLACE ITEMS TO EQUAL OR BETTER CONDITION THAN EXISTING. SEE SHEET 65D101 FOR ADDITIONAL SITE PIPING BACKGROUND.
3. CALL NEBRASKA ONE CALL CENTER AT 811 PRIOR TO BEGINNING ANY EXCAVATION.
4. HAUL ALL DEBRIS AND UNSUITABLE MATERIALS RESULTING FROM EXCAVATION AND CONSTRUCTION ACTIVITIES OFF-SITE AND DISPOSE OF LEGALLY.
5. MAINTAIN ACCESS TO ESAD AREAS OF THE PLANT THROUGHOUT CONSTRUCTION AND DO NOT CAUSE DISRUPTION TO FACILITY OPERATIONS UNLESS APPROVED BY THE OWNER.

PROJECT MANAGER: RONALD J. SOVA
PROJECT NUMBER: 10045587
2017 City of Fremont
Wastewater Treatment Plant Upgrade - Egg Shaped Anaerobic Digester - ESAD

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CIVIL SITE GRADING PLAN

PIPING AND UTILITY PLAN

**CIVIL SITE GRADING PLAN**

1. **TOP OF PAVING**
   - Approximate length of run: 200 ft.
   - Construction of new concrete roadway/pavement.
   - Special grade limits of new ESAD.
   - Connect to existing ESAD No. 1.
   - Connect to ESAD No. 2.
   - Connect to existing PG.
   - Connect to existing PS.
   - Connect to existing SG.
   - Connect to existing DG.
   - Connect to existing ES.
   - Connect to existing SD.
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GENERAL NOTES:
1. PIPING AT EXISTING ESAD NO. 1 NOT SHOWN.
2. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS.
3. BRIDGE ALTERNATIVE FOR TOP ACCESS TO ESAD NO. 2. SEE SPECIFICATION SECTION 01 30 05.

KEYNOTES
1. BRIDGE ALTERNATIVE FOR TOP ACCESS TO ESAD NO. 2. SEE SPECIFICATION SECTION 01 30 05.

UPPER LEVEL PROCESS PLAN
Wastewater Treatment Plant Upgrade - Egg Shaped Anaerobic Digester - ESAD
2017 City of Fremont

NOTE: THIS DOCUMENT WAS ORIGINALLY ISSUED AND IS NOW SEALED BY ERIC G. BERGGREN, E-10200 ON 07/23/2018. THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT.
**ESAD No. 1 Sludge/Gas Storage Vessel**

**ESAD No. 2 Sludge/Gas Storage Vessel**

**Transfer Pump**

**Combination Pressure/Vacuum Relief Valve and Flame Arrestors**

**Handrail**

**Control Room**

**Overflow**

**Bridge Bid Alternative No. 1**

**New Plug Valve Type**

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**Keynotes:**

1. Some existing ESAD No. 1 piping not shown for clarity.
2. Provide new tank nozzles for DS and DG pipe connections at elevations set by contractor. DS connection not shown in section.
3. Install permanent bio-gas bypass in the existing sludge/gas holding tank.
4. Support bio-gas bypass pipe from sludge/gas storage tank.
5. For continuation see Sheet 65C102.

---

**Project Manager:** Ronald J. Sova

**Issue Date:** 07/23/18

**Sheet:** 65D301

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**Wastewater Treatment Plant Upgrade - Egg Shaped Anaerobic Digester - ESAD 2017 City of Fremont**
Wastewater Treatment Plant Upgrade - Egg Shaped Anaerobic Digester - ESAD

2017 City of Fremont

General Notes:
1. Small diameter piping is not shown. Refer to heating water schematic for information on hot water and glycol piping and valve requirements.
2. Strainer typical.
4. Dismantling joint typical.
5. Check valve typical.
6. Ball valve typical.

Keynotes:
- # Strainer Typical
- 2 Butterfly Valve Typical
- 3 Dismantling Joint Typical
- 4 Check Valve Typical
- 5 Ball Valve Typical

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### Notes

1. **POWERED FROM ASSOCIATED CONDENSING UNIT.**

### 65ESAD-MAU01

- **Area:** MAU01
- **Location:** CONTROL ROOM
- **Size:** 9x10
- **Pressure:** 0.2
- **Energy:** MCA 460
- **Voltage:** 220 V
- **Rating:** 20 HP
- **Use:** EXPLOSION PROOF UNIT
- **Power:** 4200 W
- **Remains:** 42%

### 65ESAD-LVR01

- **Area:** LVR01
- **Location:** EQUIP. GALLERY
- **Size:** 6x3
- **Pressure:** 0.2
- **Energy:** MCA 460
- **Voltage:** 220 V
- **Rating:** 20 HP
- **Use:** EXPLOSION PROOF UNIT
- **Power:** 4200 W
- **Remains:** 42%

### 65ESAD-LVR02

- **Area:** LVR02
- **Location:** EQUIP. GALLERY
- **Size:** 6x3
- **Pressure:** 0.2
- **Energy:** MCA 460
- **Voltage:** 220 V
- **Rating:** 20 HP
- **Use:** EXPLOSION PROOF UNIT
- **Power:** 4200 W
- **Remains:** 42%

### 65ESAD-LVR03

- **Area:** LVR03
- **Location:** EQUIP. GALLERY
- **Size:** 6x3
- **Pressure:** 0.2
- **Energy:** MCA 460
- **Voltage:** 220 V
- **Rating:** 20 HP
- **Use:** EXPLOSION PROOF UNIT
- **Power:** 4200 W
- **Remains:** 42%

### 65ESAD-FLT01

- **Area:** FLT01
- **Location:** MAU01
- **Size:** 9x10
- **Pressure:** 0.2
- **Energy:** MCA 460
- **Voltage:** 220 V
- **Rating:** 20 HP
- **Use:** EXPLOSION PROOF UNIT
- **Power:** 4200 W
- **Remains:** 42%

### 65ESAD-FLT02

- **Area:** FLT02
- **Location:** MAU01
- **Size:** 9x10
- **Pressure:** 0.2
- **Energy:** MCA 460
- **Voltage:** 220 V
- **Rating:** 20 HP
- **Use:** EXPLOSION PROOF UNIT
- **Power:** 4200 W
- **Remains:** 42%

### 65ESAD-FLT03

- **Area:** FLT03
- **Location:** MAU01
- **Size:** 9x10
- **Pressure:** 0.2
- **Energy:** MCA 460
- **Voltage:** 220 V
- **Rating:** 20 HP
- **Use:** EXPLOSION PROOF UNIT
- **Power:** 4200 W
- **Remains:** 42%
GENERAL NOTE

1. CONDUIT STUBBED TO 10' OUTSIDE OF STRUCTURE BY WWTP PLANT CONTRACTOR. CONNECT TO CONDUIT AND PROVIDE CONDUCTORS AND TERMINATIONS TO HEADWORK BUILDING.

2. 2" CONDUIT FOR FIBER OPTIC PROVIDED BY WWTP PLANT CONTRACTOR.

3. 4" CONDUIT FOR POWER FEEDER PROVIDED BY WWTP PLANT CONTRACTOR.

4. ELECTRICAL POWER FOR NEW OR RELOCATED EQUIPMENT IN ESAD NO 1 SHALL BE PROVIDED BY ELECTRICIAN ON-SITE.

5. CONTROL AND INSTRUMENTATION FOR NEW OR RELOCATED EQUIPMENT IN ESAD NO 1 SHALL BE PROVIDED BY ELECTRICIAN ON-SITE IN ROOM 65ESAD-PLC2 IN ESAD NO 2 CONTROL ROOM.

PROJECT MANAGER

B. HINDLEY

P. A. GINZBURG

J. RICKERT

E. BERGGREN

S. HOWELL

L. WORTH

J. MILLER

SCALE 1" = 3'-0"

ELECTRICAL PLAN

Wastewater Treatment Plant Upgrade - Egg Shaped Anaerobic Digester - ESAD
2017 City of Fremont

65E101
NON-POTABLE WATER SYSTEM

GENERAL NOTES:
1. THE PROCESSES SHOWN ON THIS DRAWING ARE THE MINIMUM TO BE PROVIDED. CONTRACTOR (SYSTEM DESIGNER) TO PROVIDE ADDITIONAL FUNCTIONS, COMPONENTS AND INSTRUMENTATION AS REQUIRED TO PROVIDE A COMPLETE AND FUNCTIONAL SYSTEM.

SPECIFICATIONS:
- NON-POTABLE WATER TANK
- FLOAT OPERATED VALVE
- HOSE BIBB
- EXTERIOR WALL HYDRANT
- FROM NPW SYSTEM TO BOILERS FOR MAKE UP WATER
- TO RECIRCULATION PUMP
- PI CORPORATION STOP

KEY NOTES:
1. SIGNAL TO ESAD NO. 2 PLC.

NOTES:
- 1. "THE PROCESS FUNCTIONS, PIPING AND INSTRUMENTATION SHOWN ON THIS DRAWING ARE THE MINIMUM TO BE PROVIDED. CONTRACTOR (SYSTEM DESIGNER) TO PROVIDE ADDITIONAL FUNCTIONS, COMPONENTS AND INSTRUMENTATION AS REQUIRED TO PROVIDE A COMPLETE AND FUNCTIONAL SYSTEM."
THE PROCESS FOR RECIRCULATING PUMPS AND HEAT EXCHANGER SYSTEM IS SHOWN ON THIS DRAWING AND MUST BE PROVIDED. CONTRACTOR (SYSTEM DESIGNER) TO PROVIDE ADDITIONAL FUNCTIONS, COMPONENTS AND INSTRUMENTATION AS REQUIRED TO PROVIDE A COMPLETE AND FUNCTIONAL SYSTEM.

1. SIGNAL TO ESAD NO. 2 PLC.

GENERAL NOTES:
1. THE PROCESS FOR RECIRCULATING PUMPS AND HEAT EXCHANGER SYSTEM IS SHOWN ON THIS DRAWING AND MUST BE PROVIDED. CONTRACTOR (SYSTEM DESIGNER) TO PROVIDE ADDITIONAL FUNCTIONS, COMPONENTS AND INSTRUMENTATION AS REQUIRED TO PROVIDE A COMPLETE AND FUNCTIONAL SYSTEM.

KEY NOTES:
1. SIGNAL TO ESAD NO. 2 PLC.

NOTE:
1. SIGNAL TO ESAD NO. 2 PLC.

NOTE:
1. SIGNAL TO ESAD NO. 2 PLC.

NOTE:
1. SIGNAL TO ESAD NO. 2 PLC.
FROM ESAD NO. 2
SLUDGE TRANSFER PUMP
M
OVERFLOW
M
TO EXISTING SLUDGE/GAS HOLDING VESSEL
M
TO EXISTING DIGESTED SLUDGE HOLDING TANK
PIT
PSH
ANNULAR SEAL
65Y601
65ESAD-CV10
65ESAD-TP02
65ESAD-CV09

KEY NOTES
1. SIGNAL TO ESAD NO. 2 PLC.

GENERAL NOTES
1. THE PROCESS DRAWINGS, PIPING AND INSTRUMENTATION DIAGRAMS ARE DRAWN ON THE ASSUMPTION THAT THE MEASUREMENTS AND THE MACHINES TO BE PROVIDED ARE CONSTRUCTION SYSTEM SPECIFICATIONS, WHICH IS SUBJECT TO CHANGE. CONTRACTOR (SYSTEM DESIGNER) TO PROVIDE ADDITIONAL FUNCTIONS, COMPONENTS AND INSTRUMENTATION AS REQUIRED TO PROVIDE A COMPLETE AND FUNCTIONAL SYSTEM.

DRAWING
65Y605
City of Fremont, Nebraska
Egg-Shaped Anaerobic Digester - ESAD

Construction Documents
Project Manual

Issued for Bid

July 23, 2018

HDR Project # 10045587
### SECTION 00 01 07

SEALS AND SIGNATURES

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<td>Eric G. Berggren, E-10200</td>
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<td>Shawn A. Howell, E-11820</td>
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<td>My license renewal date is December 31, 2018</td>
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<td>Lance R Worth, E-14950</td>
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SEALS AND SIGNATURES

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PROCUREMENT AND CONTRACTING REQUIREMENTS
SECTION 00 11 13
ADVERTISEMENT FOR BIDS
City of Fremont Nebraska
2017 EGG SHAPED ANAEROBIC DIGESTER

ADVERTISEMENT FOR BIDS

Sealed Bids for the construction of the Fremont 2017 Egg Shaped Anaerobic Digester will be received by The City of Fremont, at the office of the City Clerk for the City of Fremont, 400 E. Military Avenue, Fremont NE, 68025, until 2:00 P.M. local time on September 6, 2018, at which time the Bids received will be “publicly” opened and read. The Project consists of finalizing design and constructing a second Egg Shaped Anaerobic Digester at the City’s existing Wastewater Treatment Plant on Morningside Road Southeast of Fremont.

Bids will be received for a single prime Contract. Bids shall be on a lump sum basis as indicated in the Bid Form.

The Issuing Office for the Bidding Documents is: HDR Engineering, 8404 Indian Hills Drive, Omaha NE 68114; Omaha Contact: Mr. Scott Anderson, phone: 402-399-1486, email: scott.anderson@hdrinc.com. Prospective Bidders may examine the Bidding Documents at the Issuing Office on Mondays through Fridays between the hours of 9:00 A.M. and 4:00 P.M. Central Time, and may obtain copies of the Bidding Documents from the Issuing Office as described below.

Bidding Documents also may be examined at:

- Omaha Builders Exchange www.omahaplanroom.com
- Lincoln Builders Bureau www.buildersbureau.com
- Dodge Data and Analysis www.construction.com

And at the office of:

- The City of Fremont, Engineering Office
  400 E. Military Avenue
  Third Floor
  Fremont, NE 68025
  402-727-2636.

Mondays through Fridays between the hours of 8:00 A.M. and 4:30 P.M.
Complete digital project documents are available at www.questcdn.com. Digital documents may be downloaded for $10.00 by inputting Quest project #5890010 on the website’s Project Search page. Please contact QuestCDN.com at 952-233-1632 or info@questcdn.com for assistance in free membership registration, downloading, and working with this digital project information.

Alternatively, printed Bidding Documents may be obtained from the Issuing Office either via in-person pick-up or via U.S. Mail, upon Issuing Office’s receipt of payment for the Bidding Documents. The non-refundable cost of printed Bidding Documents is $150.00 for half size sets and $250.00 for full size sets, payable to “HDR Engineering, Inc.”. Upon Issuing Office’s receipt of payment, printed Bidding Documents will be sent. The date that the Bidding Documents are transmitted by the Issuing Office will be considered the prospective Bidder’s date of receipt of the Bidding Documents. Partial sets of Bidding Documents will not be available from the Issuing Office. Neither Owner nor Engineer will be responsible for full or partial sets of Bidding Documents, including Addenda if any, obtained from sources other than the Issuing Office.

In addition to Bidding Documents, all prospective Bidders will receive a compact disk containing PDF Drawings of portions of the existing Wastewater Treatment Plant identified to be demolished and available reports identified in the Supplementary Conditions.

A pre-bid conference will be held at 10:00 AM local time on August 23, 2018 at the City of Fremont, 400 E. Military Avenue, Fremont NE. Attendance at the pre-bid conference is highly encouraged but is not mandatory.

Bid security shall be furnished in accordance with the Instructions to Bidders.

Owner: City of Fremont, Nebraska

By: Tyler Ficken

Title: City Clerk

+ + END OF ADVERTISEMENT FOR BIDS + +
# SECTION 00 21 13
INSTRUCTIONS TO BIDDERS

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ARTICLE 1 – DEFINED TERMS

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

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

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

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

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

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

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidder’s qualifications to perform the Work, after submitting its Bid and within five (5) days of Owner’s request, Bidder shall submit (a) written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and (b) the following additional information:

A. Evidence of Bidder’s authority to do business in the state where the Project is located.

B. Bidder’s state or other contractor license number, if applicable.

C. Subcontractor and Supplier qualification information; coordinate with provisions of Article 12 of these Instructions, “Subcontractors, Suppliers, and Others.”

D. Other required information regarding qualifications.

E. Evidence Bidder has successfully completed, with startup responsibility, of at least two (2) similar or greater size Egg Shaped Anaerobic Digesters in the past six (6) years.

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

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

3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder’s representations and certifications.
ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER’S SAFETY PROGRAM; OTHER WORK AT THE SITE

4.01 Site and Other Areas

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

4.02 Existing Site Conditions

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions:

1. The Supplementary Conditions identify:
   a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
   b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
   c. Technical Data contained in such reports and drawings.

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

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

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

4.03 Site Visit and Testing by Bidders

A. A site visit is scheduled on the same day as the Pre-Bid Conference. Additional site visits may be arranged by contacting:

   Keith Kontor
   Wastewater Plant Superintendent
   402-727-2670
   Keith.Kontor@fremontne.gov

B. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.

C. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner’s authority regarding the Site.

D. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.

E. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 Owner’s Safety Program

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

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

ARTICLE 5 – BIDDER’S REPRESENTATIONS

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

A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;

B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;

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

E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder’s safety precautions and programs;

F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;

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

H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and

J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

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

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

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

HDR Engineering, Inc.
8404 Indian Hills Drive
Omaha, NE 68114
ATTN: Mr. Eric Berggren
402-926-7167
eric.berggren@hdrinc.com

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

ARTICLE 8 – BID SECURITY

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

8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of
8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

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

ARTICLE 9 – CONTRACT TIMES

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

ARTICLE 10 – LIQUIDATED DAMAGES

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

ARTICLE 11 – SUBSTITUTE AND “OR-EQUAL” ITEMS

11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or “or-equal” items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or “or-equal” item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.

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

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

12.01 A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.

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

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

12.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.06 of the General Conditions.

ARTICLE 13 – PREPARATION OF BID

13.01 The Bid Form is included with the Bidding Documents.
A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.
B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words “No Bid” or “Not Applicable.”

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

13.03 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.

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

13.05 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.

13.06 All names shall be printed in ink below the signatures.

13.07 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.

13.08 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
13.09 The Bid shall contain evidence of Bidder’s authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder’s state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID

14.01 Base Bid
A. Bidders shall submit a Bid on a lump sum basis for the base Bid

ARTICLE 15 – SUBMITTAL OF BID

15.01 The Bidder will provide one separate unbound copy of the Bid Form, which is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 7 of the Bid Form.

15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement for bids and shall be enclosed in a plainly marked package with the Project title, the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation “BID ENCLOSED.” A mailed Bid shall be addressed to:

City of Fremont
ATTN: Tyler Ficken, City Clerk
400 E. Military Avenue
Fremont, NE  68025

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

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.

16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.

16.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.
ARTICLE 17 – OPENING OF BIDS

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

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

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

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work. Discrepancies between words and figures will be resolved in favor of the words.

19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid whose evaluation by Owner indicates to the Owner that the Award will be in the best interest of the Project.

19.03 Evaluation of Bids

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

19.04 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 20 – BONDS AND INSURANCE

20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner’s requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.
ARTICLE 21 – SIGNING OF AGREEMENT

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

ARTICLE 22 – SALES AND USE TAXES

22.01 Owner is exempt from Nebraska State sales and use taxes on materials and equipment to be incorporated in the Work. The City of Fremont will furnish the successful Contractor with the appropriate forms indicating Sales Tax Exemption. Said taxes shall not be included in the Bid. Refer to Paragraph SC-7.09 of the Supplementary Conditions for additional information.

ARTICLE 23 – BID FORM DESCRIPTION OF MEASUREMENT AND PAYMENT

23.01 Total Lump Sum Bid Price:

A. Under this item, the CONTRACTOR shall be paid in accordance with Article 6 of the Agreement, the Total Lump Sum Bid Price on the Bid Form as full compensation for all Work associated with the City of Fremont 2017 Egg Shaped Anaerobic Digester.
SECTION 00 41 13
BID FORM
City of Fremont, Nebraska 2017 Egg Shaped Anaerobic Digester

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ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

City of Fremont, Nebraska
400 E. Military Avenue
Fremont, NE  68025

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

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of Section 00 21 13 - Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

2.02 BIDDER will sign and deliver the required number of counterparts of the AGREEMENT with the Bonds and other documents required by the Bidding Requirements within 15 days after the date of OWNER’s Notice of Award.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

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

<table>
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<tr>
<th>Addendum No.</th>
<th>Addendum, Date</th>
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</table>

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

C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder’s safety precautions and programs.

F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

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

H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.

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

J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER’S CERTIFICATION

4.01 Bidder certifies that:

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

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

C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

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

1. “corrupt practice” means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;
2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

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

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

ARTICLE 5 – BASIS OF BID

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

Total Lump Sum Bid Price: ____________________________

(use words)

($____________________)

(use figures)

ARTICLE 6 – SUBCONTRACTORS

6.01 The following Subcontractors for the Work are listed below:

Mechanical (HVAC/Plumbing) Subcontractor:

_________________________________________________

Electrical Subcontractor:

_________________________________________________

Concrete Subcontractor:

_________________________________________________

Mechanical (Piping and Equipment) Subcontractor:

_________________________________________________

ARTICLE 7 – TIME OF COMPLETION

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

7.02 Bidder accepts the provisions of the Agreement as to liquidated damages.
ARTICLE 8 – ATTACHMENTS TO THIS BID

8.01 The following documents are submitted with and made a condition of this Bid:

A. Required Bid security;
B. Evidence of authority to do business in the State of Nebraska; or a written covenant to obtain such license within the time for acceptance of Bids;

ARTICLE 9 – DEFINED TERMS

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

ARTICLE 10 – BID SUBMITTAL

BIDDER: [Indicate correct name of bidding entity]

By: [Signature] [Printed name]
(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: [Signature] [Printed name]

Title: __________________________

Submittal Date: ______________________

Address for giving notices: __________________________

Telephone Number: __________________________

Fax Number: __________________________

Contact Name and e-mail address: __________________________
SECTION 00 43 13
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:
The City of Fremont
400 E. Military Avenue
Fremont, NE 68025

BID
Bid Due Date:
Description:
Fremont 2017 Egg Shaped Anaerobic Digester – Fremont, Nebraska

BOND
Bond Number:
Date:
Penal sum ___________________________ $ ___________________________

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

BIDDER

Surety

Bidder’s Name and Corporate Seal

Surety’s Name and Corporate Seal

By: By:
Signature

Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest:

Attest:
Signature

Signature

Title

Title

Note: Addresses are to be used for giving any required notice.
Provide execution by any additional parties, such as joint venturers, if necessary.
1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder’s and Surety’s liability. Recovery of such penal sum under the terms of this Bond shall be Owner’s sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:
   
   3.1 Owner accepts Bidder’s Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

   3.2 All Bids are rejected by Owner, or

   3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety’s written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term “Bid” as used herein includes a Bid, offer, or proposal as applicable.
SECTION 00 52 13
AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

THIS AGREEMENT is by and between City of Fremont, NE (“Owner”) and ______________________ (“Contractor”).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as: Egg Shaped Anaerobic Digester at the City’s existing Wastewater Treatment Plant on Morningside Road Southeast of Fremont.

ARTICLE 2 – THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Fremont 2017 Egg Shaped Anaerobic Digester, Fremont, Nebraska.

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by HDR Engineering, Inc. 8404 Indian Hills Drive, Omaha, NE 68114.

3.02 The Owner has retained HDR Engineering, Inc. 8404 Indian Hills Drive, Omaha, NE 68114 (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 Time of the Essence

A. 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 Contract Times: Dates

A. The Work shall be completed and ready to initiate the Demonstration Period (as described in Section 01 75 00) on or before December 31, 2019. The Work will be substantially completed upon successful completion of the Demonstration Period (as described in section 01 75 00) or before March 31, 2020 and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 30 days after substantial completion.
B. Parts of the Work shall be substantially completed on or before the following Milestones:

1. Milestone 1: Preliminary Submittal Requirements: Process and Instrumentation Drawings (P&ID) Submittal:
   a. Specification Section 01 30 05 includes an overview description of the work for the project including Preliminary Submittal Requirements. Milestone 1 includes submission of the Process and Instrumentation Drawings. Milestone 1 must be completed within the timeframe described in section 01 30 05.

2. Milestone 2: Preliminary Submittal Requirements: Layout Drawings and Preliminary Equipment Selection:
   a. Specification Section 01 30 05 includes an overview description of the work for the project including Preliminary Submittal Requirements. Milestone 2 includes submission of the Layout Drawings and Preliminary Equipment Selection. Milestone 2 must be completed within the timeframe described in Section 01 30 05.

3. Milestone 3: Final Design Documents:
   a. Specification Section 01 30 05 includes an overview description of the work for the Project including Preliminary Submittal Requirements. Milestone 3 includes submission of the Final Design Documents. Milestone 3 must be completed within the timeframe described in Section 01 30 05.

4.03 Liquidated Damages

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion: Contractor shall pay Owner $2,000 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.

2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner $750 for each day that expires after such time until the Work is completed and ready for final payment.

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

4. Milestones: Contractor shall pay Owner $1,000 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for achievement of Milestone 1, until Milestone 1 is achieved; Milestone 2, until Milestone 2 is achieved; and Milestone 3 until Milestone 3 is achieved. These liquidated damages will be in
addition to those defined in 4.3.a. 1 and 2 for Project substantial and final completions.

**ARTICLE 5 – CONTRACT PRICE**

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

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

**ARTICLE 6 – PAYMENT PROCEDURES**

6.01 **Submittal and Processing of Payments**

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

6.02 **Progress Payments; Retainage**

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor’s Applications for Payment each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.

   a. Ninety (90) 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, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and

   b. Ninety (90) percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage) that is delivered suitably stored and accompanied by documentation satisfactory to the Owner as provided in Paragraph 15.01 of the General Conditions.

B. 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 set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 125 percent of Engineer’s estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 **Final Payment**

A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.
ARTICLE 7 – CONTRACTOR’S REPRESENTATIONS

7.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.

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

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

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

E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor’s safety precautions and programs.

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

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 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.

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

J. Contractor’s entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.
ARTICLE 8 – CONTRACT DOCUMENTS

8.01 Contents

A. The Contract Documents consist of the following:
   1. This Agreement (pages 1 to 7, inclusive).
   2. Performance bond (pages 1 to 3, inclusive).
   3. Payment bond (pages 1 to 3 inclusive).
   4. Other bonds.
      a. {___} (pages {___} to {___}, inclusive).
   5. General Conditions (pages 1 to 65, inclusive).
   6. Supplementary Conditions (pages 1 to 11, inclusive).
   7. Specifications as listed in the table of contents of the Project Manual.
   8. Drawings (not attached but incorporated by reference) consisting of 20 sheets with each sheet bearing the following general title: Egg Shaped Anaerobic Digester – ESAD, 2017 City of Fremont.
   9. Addenda (numbers {___} to {___}, inclusive).
   10. Exhibits to this Agreement (enumerated as follows):
      a. Contractor’s Bid (pages {___} to {___}, inclusive).
   11. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
      a. Notice to Proceed.
      b. Work Change Directives.
      c. Change Orders.
      d. Field Orders.

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

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

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

ARTICLE 9 – MISCELLANEOUS

9.01 Terms

A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.
9.02 Assignment of Contract

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

9.03 Successors and Assigns

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

9.04 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.

9.05 Contractor’s Certifications

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:

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

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

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

4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.
IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

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

OWNER:  

By:  
Title:  
Address for giving notices:  
License No.:  

CONTRACTOR:  

By:  
Title:  
Address for giving notices:  

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

Attest:  
Title:  
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 this Agreement.)
SECTION 00 61 13
PERFORMANCE BOND

CONTRACTOR (name and address): 

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

OWNER:
The City of Fremont
400 E. Military Avenue
Fremont, NE 68025

CONSTRUCTION CONTRACT
Effective Date of the Agreement:
Amount:
Description: Fremont 2017 Egg Shaped Anaerobic Digester, Fremont, Nebraska

BOND
Bond Number:
Date (not earlier than the Effective Date of the Agreement of the Construction Contract):
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

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

CONTRACTOR AS PRINCIPAL
(attach power of attorney)

SURETY

Contractor’s Name and Corporate Seal

Surety’s Name and Corporate Seal

By: ____________________________
    Signature

By: ____________________________
    Signature (attach power of attorney)

Print Name

Print Name

Title

Title

Attest: ____________________________
    Signature

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

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety’s obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor’s performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner’s notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety’s receipt of the Owner’s notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner’s right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety’s obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

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

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

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

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

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

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

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor’s Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety’s liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

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

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

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

14. Definitions

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

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

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

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

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

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

16. Modifications to this Bond are as follows:
SECTION 00 61 14
PAYMENT BOND

CONTRACTOR (name and address):

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

OWNER:
The City of Fremont
400 E. Military Avenue
Fremont, NE 68025

CONSTRUCTION CONTRACT
Effective Date of the Agreement:
Amount:
Description: Fremont 2017 Egg Shaped Anaerobic Digester, Fremont, Nebraska

BOND
Bond Number:
Date (not earlier than the Effective Date of the Agreement of the Construction Contract):
Amount:
Modifications to this Bond Form: [ ] None [ ] See Paragraph 18

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

CONTRACTOR AS PRINCIPAL
Contractor's Name and Corporate Seal
By: ________________________________
    Signature (attach power of attorney)

SURETY
Surety's Name and Corporate Seal
By: ________________________________
    Signature (attach power of attorney)

Print Name
Title
Attest: ________________________________
    Signature

Print Name
Title
Attest: ________________________________
    Signature

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

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

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

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

   7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

   7.2 Pay or arrange for payment of any undisputed amounts.

5. The Surety’s obligations to a Claimant under this Bond shall arise after the following:

   5.1 Claimants who do not have a direct contract with the Contractor,

       5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

       5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).

   5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety’s expense take the following actions:

   7.3 The Surety’s failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety’s total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

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

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

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

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

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

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

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

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

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

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

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

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

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

18. Modifications to this Bond are as follows:
CERTIFICATE OF LIABILITY INSURANCE

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFER NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER

CONTACT NAME: 
PHONE [AC, No, Ext]: 
FAX [AC, No]: 
E-MAIL ADDRESS: 

INSURER(S) AFFORDING COVERAGE NA/C #

INSURER A: 
INSURER B: 
INSURER C: 
INSURER D: 
INSURER E: 
INSURER F: 

COVERAGES

CERTIFICATE NUMBER: 

REVISION NUMBER: 

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

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<td>if you, describe under DESCRIPTION OF OPERATIONS below</td>
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DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

CERTIFICATE HOLDER

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

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# STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term’s singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

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

2. Agreement—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

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

4. Bid—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. Bidder—An individual or entity that submits a Bid to Owner.

6. Bidding Documents—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. Bidding Requirements—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. Change Order—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. Change Proposal—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. Claim—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer’s decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer’s decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer
has declined to address. A demand for money or services by a third party is not a Claim.

11. Constituent of Concern—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. Contract—The entire and integrated written contract between the Owner and Contractor concerning the Work.

13. Contract Documents—Those items so designated in the Agreement, and which together comprise the Contract.

14. Contract Price—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

15. Contract Times—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. Contractor—The individual or entity with which Owner has contracted for performance of the Work.

17. Cost of the Work—See Paragraph 13.01 for definition.

18. Drawings—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. Effective Date of the Contract—The date, indicated in the Agreement, on which the Contract becomes effective.

20. Engineer—The individual or entity named as such in the Agreement.

21. Field Order—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

22. Hazardous Environmental Condition—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

23. Laws and Regulations; Laws or Regulations—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
24. **Liens**—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

25. **Milestone**—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.

26. **Notice of Award**—The written notice by Owner to a Bidder of Owner’s acceptance of the Bid.

27. **Notice to Proceed**—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

28. **Owner**—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

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

30. **Project**—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

31. **Project Manual**—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.

32. **Resident Project Representative**—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or “RPR” includes any assistants or field staff of Resident Project Representative.

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

34. **Schedule of Submittals**—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals and the performance of related construction activities.

35. **Schedule of Values**—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.

36. **Shop Drawings**—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
37. Site—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.

38. Specifications—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

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

40. Substantial Completion—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.

41. Successful Bidder—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.

42. Supplementary Conditions—The part of the Contract that amends or supplements these General Conditions.

43. Supplier—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

44. Technical Data—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.

45. Underground Facilities—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

46. Unit Price Work—Work to be paid for on the basis of unit prices.

47. Work—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
48. **Work Change Directive**—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 **Terminology**

A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. **Intent of Certain Terms or Adjectives:**

1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. **Day:**

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

D. **Defective:**

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
   a. does not conform to the Contract Documents; or
   b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
   c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).

E. **Furnish, Install, Perform, Provide:**

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

2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

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

ARTICLE 2 – PRELIMINARY MATTERS

2.01 Delivery of Bonds and Evidence of Insurance

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

B. Evidence of Contractor’s Insurance: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.

C. Evidence of Owner’s Insurance: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 Copies of Documents

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 Before Starting Construction

A. Preliminary Schedules: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:

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

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

2.04 Preconstruction Conference; Designation of Authorized Representatives

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 Initial Acceptance of Schedules

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

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

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

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

2.06 Electronic Transmittals

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or
computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

**ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE**

**3.01 Intent**

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

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

**3.02 Reference Standards**

A. Standards Specifications, Codes, Laws and Regulations

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

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

**3.03 Reporting and Resolving Discrepancies**

A. Reporting Discrepancies:

1. *Contractor’s Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict,
error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. **Contractor’s Review of Contract Documents:** If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. **Resolving Discrepancies:**

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

### 3.04 Requirements of the Contract Documents

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

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer’s written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.
3.05 **Reuse of Documents**

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner’s express written consent, or violate any copyrights pertaining to such Contract Documents.

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

**ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK**

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

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

4.02 **Starting the Work**

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

4.03 **Reference Points**

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

4.04 **Progress Schedule**

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 Delays in Contractor’s Progress

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor’s entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor’s ability to complete the Work within the Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor’s performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor’s entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor’s ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor’s sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
2. abnormal weather conditions;
3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
4. acts of war or terrorism.

D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.

E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.
G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

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

5.01 Availability of Lands

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

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner’s interest therein as necessary for giving notice of or filing a mechanic’s or construction lien against such lands in accordance with applicable Laws and Regulations.

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

5.02 Use of Site and Other Areas

A. Limitation on Use of Site and Other Areas:

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor’s operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part.
by, or based upon, Contractor’s performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

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

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

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

5.03 **Subsurface and Physical Conditions**

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

1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
3. Technical Data contained in such reports and drawings.

B. **Reliance by Contractor on Technical Data Authorized**: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor’s purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.
5.04 **Differing Subsurface or Physical Conditions**

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

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

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

B. **Engineer’s Review:** After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner’s obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor’s resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer’s findings, conclusions, and recommendations.

C. **Owner’s Statement to Contractor Regarding Site Condition:** After receipt of Engineer’s written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer’s written findings, conclusions, and recommendations, in whole or in part.

D. **Possible Price and Times Adjustments:**

   1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor’s cost of, or time required for, performance of the Work; subject, however, to the following:
      
      a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
      
      b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
c. Contractor’s entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor’s ability to complete the Work within the Contract Times.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
   a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
   b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor’s making such commitment; or
   c. Contractor failed to give the written notice as required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor’s entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner’s issuance of the Owner’s written statement to Contractor regarding the subsurface or physical condition in question.

5.05 Underground Facilities

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

B. Notice by Contractor: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after
becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

C. **Engineer’s Review:** Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor’s resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer’s findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. **Owner’s Statement to Contractor Regarding Underground Facility:** After receipt of Engineer’s written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer’s written findings, conclusions, and recommendations in whole or in part.

E. **Possible Price and Times Adjustments:**

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor’s cost of, or time required for, performance of the Work; subject, however, to the following:
   
   a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
   
   b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
   
   c. Contractor’s entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor’s ability to complete the Work within the Contract Times; and
   
   d. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor’s entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner’s issuance of the Owner’s written statement to Contractor regarding the Underground Facility in question.
5.06 Hazardous Environmental Conditions at Site

A. Reports and Drawings: The Supplementary Conditions identify:

1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

2. Technical Data contained in such reports and drawings.

B. Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

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

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

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

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner’s written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.

H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner’s own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual’s or entity’s own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual’s or entity’s own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.
ARTICLE 6 – BONDS AND INSURANCE

6.01  Performance, Payment, and Other Bonds

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor’s obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.

B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual’s authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.

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

E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner’s termination rights under Article 16.

F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02  Insurance—General Provisions

A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is
maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.

H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.

I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.

J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 Contractor's Insurance

A. **Workers’ Compensation:** Contractor shall purchase and maintain workers’ compensation and employer’s liability insurance for:

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

2. United States Longshoreman and Harbor Workers’ Compensation Act and Jones Act coverage (if applicable).

3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor’s employees (by stop-gap endorsement in monopolist worker’s compensation states).
4. Foreign voluntary worker compensation (if applicable).

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

1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor’s employees.
2. claims for damages insured by reasonably available personal injury liability coverage.
3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

C. **Commercial General Liability—Form and Content:** Contractor’s commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage:
   a. Such insurance shall be maintained for three years after final payment.
   b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor’s contractual indemnity obligations in Paragraph 7.18.
3. Broad form property damage coverage.
4. Severability of interest.
5. Underground, explosion, and collapse coverage.
6. Personal injury coverage.
7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, “Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured” or its equivalent.

D. **Automobile liability:** Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.

E. **Umbrella or excess liability:** Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer’s liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.

F. **Contractor’s pollution liability insurance:** Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result
of pollution conditions arising from Contractor’s operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

G. **Additional insureds:** The Contractor’s commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.

H. **Contractor’s professional liability insurance:** If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

I. **General provisions:** The policies of insurance required by this Paragraph 6.03 shall:

1. include at least the specific coverages provided in this Article.
2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor’s performance of the Work and Contractor’s other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.

J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.
6.04 **Owner’s Liability Insurance**

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

B. Owner’s liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner’s liability policies for any of Contractor’s obligations to the Owner, Engineer, or third parties.

6.05 **Property Insurance**

A. **Builder’s Risk:** Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder’s risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder’s risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as “insureds.”

2. be written on a builder’s risk “all risk” policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder’s risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

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

4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).
5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).

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

7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder’s risk insurance.

8. allow for the waiver of the insurer’s subrogation rights, as set forth below.

9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.

10. not include a co-insurance clause.

11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.

12. include performance/hot testing and start-up.

13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.

B. Notice of Cancellation or Change: All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.

C. Deductibles: The purchaser of any required builder’s risk or property insurance shall pay for costs not covered because of the application of a policy deductible.

D. Partial Occupancy or Use by Owner: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder’s risk policy, or through Contractor) will provide notice of such occupancy or use to the builder’s risk insurer. The builder’s risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder’s risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder’s risk insurance.

E. Additional Insurance: If Contractor elects to obtain other special insurance to be included in or supplement the builder’s risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor’s expense.

F. Insurance of Other Property: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.
6.06 Waiver of Rights

A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder’s risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

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

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

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.

D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder’s risk insurance and any other property insurance applicable to the Work.

6.07 Receipt and Application of Property Insurance Proceeds

A. Any insured loss under the builder’s risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the
policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder’s risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR’S RESPONSIBILITIES

7.01 Supervision and Superintendence

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

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

7.02 Labor; Working Hours

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

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner’s written consent, which will not be unreasonably withheld.

7.03 Services, Materials, and Equipment

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and
guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

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

7.04 "Or Equals"

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or “or equal” item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an “or equal” item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

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

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

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

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

      4) it is not objectionable to Owner.

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

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

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

B. Contractor’s Expense: Contractor shall provide all data in support of any proposed “or equal” item at Contractor’s expense.

C. Engineer’s Evaluation and Determination: Engineer will be allowed a reasonable time to evaluate each “or-equal” request. Engineer may require Contractor to furnish additional data about the proposed “or-equal” item. Engineer will be the sole judge of acceptability. No “or-equal” item will be ordered, furnished, installed, or utilized until Engineer’s review is complete and Engineer determines that the proposed item is an “or-equal”, which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
D.  **Effect of Engineer’s Determination:** Neither approval nor denial of an “or-equal” request shall result in any change in Contract Price. The Engineer’s denial of an “or-equal” request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

E.  **Treatment as a Substitution Request:** If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an “or-equal” item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05  **Substitutes**

A.  Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.

1.  Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.

2.  The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

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

a.  shall certify that the proposed substitute item will:

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

   2)  be similar in substance to that specified, and

   3)  be suited to the same use as that specified.

b.  will state:

   1)  the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,

   2)  whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

   3)  whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

c.  will identify:

   1)  all variations of the proposed substitute item from that specified, and
2) available engineering, sales, maintenance, repair, and replacement services.

d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer’s Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer’s review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer’s determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

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

D. *Reimbursement of Engineer’s Cost*: Engineer will record Engineer’s costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

E. *Contractor’s Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor’s expense.

F. *Effect of Engineer’s Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer’s denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

### 7.06 Concerning Subcontractors, Suppliers, and Others

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.

B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor’s Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.
E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner’s requirement of replacement.

G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor’s own acts and omissions.

J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.

K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.

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

M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.
O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor

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

7.07 Patent Fees and Royalties

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

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 Permits

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

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

7.10 **Laws and Regulations**

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

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor’s responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor’s obligations under Paragraph 3.03.

C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor’s Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 **Record Documents**

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

7.12 **Safety and Protection**

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

1. all persons on the Site or who may be affected by the Work;
2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

C. Contractor shall comply with the applicable requirements of Owner’s safety programs, if any. The Supplementary Conditions identify any Owner’s safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor’s safety program with which Owner’s and Engineer’s employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor’s duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

G. Contractor’s duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 Safety Representative

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

7.14 Hazard Communication Programs

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

7.15 Emergencies

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

7.16 Shop Drawings, Samples, and Other Submittals

A. Shop Drawing and Sample Submittal Requirements:

1. Before submitting a Shop Drawing or Sample, Contractor shall have:
   a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
   b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
   c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
   d. determined and verified all information relative to Contractor’s responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

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

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

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

1. Shop Drawings:
   a. Contractor shall submit the number of copies required in the Specifications.
   b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to
provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. **Samples:**
   a. Contractor shall submit the number of Samples required in the Specifications.
   b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.

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

C. **Other Submittals:** Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. **Engineer’s Review:**
   1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer’s review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
   2. Engineer’s review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
   3. Engineer’s review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
   4. Engineer’s review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
   5. Engineer’s review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
   6. Engineer’s review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
   7. Neither Engineer’s receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.
8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. Resubmittal Procedures:

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

2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer’s time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer’s charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer’s charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 Contractor’s General Warranty and Guarantee

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor’s warranty and guarantee.

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

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

2. normal wear and tear under normal usage.

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

1. observations by Engineer;

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

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

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

5. any review and approval of a Shop Drawing or Sample submittal;

6. the issuance of a notice of acceptability by Engineer;

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

8. any correction of defective Work by Owner.
D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor’s performance obligations to Owner for the Work described in the assigned contract.

7.18 Indemnification

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers’ compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer’s officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

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

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

7.19 Delegation of Professional Design Services

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

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

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

D. Pursuant to this paragraph, Engineer’s review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer’s review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 Other Work

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner’s employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner’s employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner’s employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others’ work with the written consent of Engineer and the others whose work will be affected.

D. If the proper execution or results of any part of Contractor’s Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor’s Work. Contractor’s failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor’s Work except for latent defects and deficiencies in such other work.
8.02 Coordination

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner’s employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
2. an itemization of the specific matters to be covered by such authority and responsibility; and
3. the extent of such authority and responsibilities.

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

8.03 Legal Relationships

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

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner’s contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.

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

**ARTICLE 9 – OWNER’S RESPONSIBILITIES**

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

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

9.03  *Furnish Data*
A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04  *Pay When Due*
A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

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

9.06  *Insurance*
A. Owner’s responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07  *Change Orders*
A. Owner’s responsibilities with respect to Change Orders are set forth in Article 11.
9.08 **Inspections, Tests, and Approvals**
   A. Owner’s responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

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

9.10 **Undisclosed Hazardous Environmental Condition**
   A. Owner’s responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 **Evidence of Financial Arrangements**
   A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner’s obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 **Safety Programs**
   A. While at the Site, Owner’s employees and representatives shall comply with the specific applicable requirements of Contractor’s safety programs of which Owner has been informed.
   
   B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

**ARTICLE 10 – ENGINEER’S STATUS DURING CONSTRUCTION**

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

10.02 **Visits to Site**
   A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor’s executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer’s efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
   
   B. Engineer’s visits and observations are subject to all the limitations on Engineer’s authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during
or as a result of Engineer’s visits or observations of Contractor’s Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 Project Representative

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer’s consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 Rejecting Defective Work

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

10.05 Shop Drawings, Change Orders and Payments

A. Engineer’s authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.

B. Engineer’s authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.

C. Engineer’s authority as to Change Orders is set forth in Article 11.

D. Engineer’s authority as to Applications for Payment is set forth in Article 15.

10.06 Determinations for Unit Price Work

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

10.07 Decisions on Requirements of Contract Documents and Acceptability of Work

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

10.08 Limitations on Engineer’s Authority and Responsibilities

A. Neither Engineer’s authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor’s failure to perform the Work in accordance with the Contract Documents.

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

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

E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 Compliance with Safety Program

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

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

11.01 Amending and Supplementing Contract Documents

A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. Change Orders:

   a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

   b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.

2. Work Change Directives: A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive’s effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an
adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

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

11.02 **Owner-Authorized Changes in the Work**

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

11.03 **Unauthorized Changes in the Work**

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

11.04 **Change of Contract Price**

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on
the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor’s fee for overhead and profit (determined as provided in Paragraph 11.04.C).

C. **Contractor’s Fee**: When applicable, the Contractor’s fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
   
   a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor’s fee shall be 15 percent;
   
   b. for costs incurred under Paragraph 13.01.B.3, the Contractor’s fee shall be five percent;
   
   c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and 11.01.C.2.b is that the Contractor’s fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
   
   d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
   
   e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor’s fee by an amount equal to five percent of such net decrease; and
   
   f. when both additions and credits are involved in any one change, the adjustment in Contractor’s fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 **Change of Contract Times**

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.

B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor’s progress.

11.06 **Change Proposals**

A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under
the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. **Procedures:** Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.

2. **Engineer’s Action:** Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor’s supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer’s inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

3. **Binding Decision:** Engineer’s decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

**B. Resolution of Certain Change Proposals:** If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 **Execution of Change Orders**

**A.** Owner and Contractor shall execute appropriate Change Orders covering:

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

2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner’s acceptance of defective Work under Paragraph 14.04 or Owner’s correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer’s recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and

4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.
B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 Notification to Surety

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

ARTICLE 12 – CLAIMS

12.01 Claims

A. Claims Process: The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:

1. Appeals by Owner or Contractor of Engineer’s decisions regarding Change Proposals;
2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

B. Submittal of Claim: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor’s knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. Review and Resolution: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.

D. Mediation:

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim
submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator’s fees and costs.

E. Partial Approval: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. Denial of Claim: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. Final and Binding Results: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

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

13.01 Cost of the Work

A. Purposes for Determination of Cost of the Work: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. Costs Included: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers’ compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable
thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

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

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor’s Cost of the Work and fee shall be determined in the same manner as Contractor’s Cost of the Work and fee as provided in this Paragraph 13.01.

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

5. Supplemental costs including the following:
   a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor’s employees incurred in discharge of duties connected with the Work.
   b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
   c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
   d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
   e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
   f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes
other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor’s fee.

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

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

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

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

1. Payroll costs and other compensation of Contractor’s officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, 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 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor’s fee.

2. Expenses of Contractor’s principal and branch offices other than Contractor’s office at the Site.

3. Any part of Contractor’s capital expenses, including interest on Contractor’s capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. Contractor’s Fee: When the Work as a whole is performed on the basis of cost-plus, Contractor’s fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor’s fee shall be determined as set forth in Paragraph 11.04.C.

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

13.02 Allowances

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

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

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

C. **Contingency Allowance**: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 **Unit Price Work**

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor’s overhead and profit for each separately identified item.

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

E. Within 30 days of Engineer’s written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.
ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 Access to Work

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

14.02 Tests, Inspections, and Approvals

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner’s and Engineer’s acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor’s purchase thereof for incorporation in the Work.

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

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor’s expense unless Contractor had given Engineer timely notice of Contractor’s intention to
cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 **Defective Work**

A. *Contractor’s Obligation:* It is Contractor’s obligation to assure that the Work is not defective.

B. *Engineer’s Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner’s special warranty and guarantee, if any, on said Work.

F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 **Acceptance of Defective Work**

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

14.05 **Uncovering Work**

A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer’s observation, and then replace the covering, all at Contractor’s expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer’s request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor’s full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 Owner May Stop the Work

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 Owner May Correct Defective Work

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor’s services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner’s representatives, agents and employees, Owner’s other contractors, and Engineer and Engineer’s consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will
include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor’s defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner’s rights and remedies under this Paragraph 14.07.

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

15.01 Progress Payments

A. Basis for Progress Payments: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. Applications for Payments:

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner’s interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor’s legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. Review of Applications:

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer’s reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer’s recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer’s observations of the executed Work as an experienced and qualified design professional, and on Engineer’s review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer’s knowledge, information and belief:
a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor’s being entitled to such payment appear to have been fulfilled in so far as it is Engineer’s responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer’s review of Contractor’s Work for the purposes of recommending payments nor Engineer’s recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Work, or

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor’s failure to comply with Laws and Regulations applicable to Contractor’s performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer’s opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer’s opinion to protect Owner from loss because:

a. the Work is defective, requiring correction or replacement;

b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. Payment Becomes Due:

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

E. Reductions in Payment by Owner:

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
   a. claims have been made against Owner on account of Contractor’s conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor’s conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
   b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
   c. Contractor has failed to provide and maintain required bonds or insurance;
   d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
   e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
   f. the Work is defective, requiring correction or replacement;
   g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
   h. the Contract Price has been reduced by Change Orders;
   i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
   j. liquidated damages have accrued as a result of Contractor’s failure to achieve Milestones, Substantial Completion, or final completion of the Work;
   k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
   l. there are other items entitling Owner to a set off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount
remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner’s refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 Contractor’s Warranty of Title

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

15.03 Substantial Completion

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor’s notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner’s objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner’s use or occupancy of the Work following Substantial Completion, review the builder’s risk insurance policy with respect to the end of the builder’s risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner’s use or occupancy of the Work.
E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 Partial Use or Occupancy

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor’s performance of the remainder of the Work, subject to the following conditions:

1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.

2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder’s risk or other property insurance.

15.05 Final Inspection

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

15.06 Final Payment

A. Application for Payment:

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of
inspection, annotated record documents (as provided in Paragraph 7.11), and other
documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously
delivered) by:
   a. all documentation called for in the Contract Documents;
   b. consent of the surety, if any, to final payment;
   c. satisfactory evidence that all title issues have been resolved such that title to all
      Work, materials, and equipment has passed to Owner free and clear of any Liens
      or other title defects, or will so pass upon final payment.
   d. a list of all disputes that Contractor believes are unsettled; and
   e. complete and legally effective releases or waivers (satisfactory to Owner) of all
      Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as
   approved by Owner, Contractor may furnish receipts or releases in full and an affidavit
   of Contractor that: (a) the releases and receipts include all labor, services, material,
   and equipment for which a Lien could be filed; and (b) all payrolls, material and
   equipment bills, and other indebtedness connected with the Work for which Owner
   might in any way be responsible, or which might in any way result in liens or other
   burdens on Owner’s property, have been paid or otherwise satisfied. If any
   Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor
   may furnish a bond or other collateral satisfactory to Owner to indemnify Owner
   against any Lien, or Owner at its option may issue joint checks payable to Contractor
   and specified Subcontractors and Suppliers.

B. Engineer’s Review of Application and Acceptance:

   1. If, on the basis of Engineer’s observation of the Work during construction and final
      inspection, and Engineer’s review of the final Application for Payment and
      accompanying documentation as required by the Contract Documents, Engineer is
      satisfied that the Work has been completed and Contractor’s other obligations under
      the Contract have been fulfilled, Engineer will, within ten days after receipt of the final
      Application for Payment, indicate in writing Engineer’s recommendation of final
      payment and present the Application for Payment to Owner for payment. Such
      recommendation shall account for any set-offs against payment that are necessary in
      Engineer’s opinion to protect Owner from loss for the reasons stated above with
      respect to progress payments. At the same time Engineer will also give written notice
      to Owner and Contractor that the Work is acceptable, subject to the provisions of
      Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to
      Contractor, indicating in writing the reasons for refusing to recommend final payment,
      in which case Contractor shall make the necessary corrections and resubmit the
      Application for Payment.

C. Completion of Work: The Work is complete (subject to surviving obligations) when it is
   ready for final payment as established by the Engineer’s written recommendation of final
   payment.

D. Payment Becomes Due: Thirty days after the presentation to Owner of the final Application
   for Payment and accompanying documentation, the amount recommended by Engineer
   (less any further sum Owner is entitled to set off against Engineer’s recommendation,
including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

**15.07 Waiver of Claims**

A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor’s failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor’s continuing obligations under the Contract Documents.

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

**15.08 Correction Period**

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner’s written instructions:

1. correct the defective repairs to the Site or such other adjacent areas;
2. correct such defective Work;
3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner’s written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 Owner May Suspend Work

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

16.02 Owner May Terminate for Cause

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor’s persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor’s disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor’s repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses,
and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 Owner May Terminate For Convenience

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 Contractor May Stop Work or Terminate

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for
expenses or damage directly attributable to Contractor’s stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 Methods and Procedures

A. Disputes Subject to Final Resolution: The following disputed matters are subject to final resolution under the provisions of this Article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.

B. Final Resolution of Disputes: For any dispute subject to resolution under this Article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
2. agree with the other party to submit the dispute to another dispute resolution process; or
3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 Giving Notice

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 Computation of Times

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

18.03 Cumulative Remedies

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

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

18.05 No Waiver

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

18.06 Survival of Obligations

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

18.07 Controlling Law

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

18.08 Headings

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

A. Caption and Introductory Statements

Supplementary Conditions

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

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

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

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

SC-3.01 Intent

Add the following new paragraphs immediately after Paragraph 3.01.E:

A. The Specifications may vary in form, format and style. Some specification sections are written in varying degrees of streamlined or declarative style and some sections may be relatively narrative by comparison. Omissions of such words and phrases as "the Contractor shall," "in conformity with," "as shown," or "as specified" are intentional in streamlined sections. Omitted words and phrases shall be supplied by inference. Similar types of provisions may appear in various parts of a section or articles within a part depending on the format of the section. The Contractor shall not take advantage of any variation of form, format or style in making claims for extra Work.

B. The cross referencing of specification sections under the subparagraph heading "Related Sections include but are not necessarily limited to:" and elsewhere within each specification section is provided as an aid and convenience to the Contractor. The Contractor shall not rely on the cross referencing provided and shall be responsible to coordinate the entire Work under the Contract Documents and provide a complete Project whether or not the cross referencing is provided in each section or whether or not the cross referencing is complete.
ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.03 Subsurface and Physical Conditions

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.B:

C. The following reports of explorations and tests of subsurface conditions at or adjacent to the Site are known to Owner:

1. Report dated March 21, 2017, prepared by Terracon Consultants, Inc., Omaha, NE, entitled: “Geotechnical Engineering Report Fremont Waste Water Treatment Plant Additions, Morningside Road, Fremont, Nebraska”, consisting of 28 pages plus appendices. The Technical Data contained in such report upon whose accuracy Contractor may rely are those indicated in the definition of Technical Data in the General Conditions.

D. The following drawings of physical conditions relating to existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities) are known to Owner:

1. Drawings dated:
   b. Wastewater Treatment Plant Upgrade Fremont Nebraska; 2017; Prepared by HDR Engineering.

   1. Contents of such drawings is Technical Data on whose accuracy Contractor may rely.

SC-5.06 Hazardous Environmental Conditions

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

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

B. Not Used.

ARTICLE 6 – BONDS AND INSURANCE

SC-6.02 Insurance—General Provisions

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

1. Contractor may obtain worker’s compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the project is located, (b) is certified or authorized as a worker’s compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker’s compensation insurance for similar projects by the state within the last 12 months.
SC 6.03 Add the following new paragraph immediately after Paragraph 6.03.J:

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

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

   State: Statutory
   Applicable Federal (e.g., Longshoreman’s): Statutory

   Employer’s Liability: No Cap (must show sufficient coverage)

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

   General Aggregate $ 5,000,000
   Products - Completed Operations Aggregate $ 1,000,000
   Each Occurrence (Bodily Injury and Property Damage) $ 2,000,000

   Property Damage Liability Insurance will provide Explosion, Collapse, and Underground Coverage’s where applicable.

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

   Bodily Injury:
   Each person $ 1,000,000
   Each accident $ 2,000,000

   Property Damage:
   Each accident $ 2,000,000

4. Excess or Umbrella Liability:

   Per Occurrence $ 1,000,000
   General Aggregate $ 10,000,000
5. Contractor’s Pollution Liability:

- Each Occurrence $ ________________
- General Aggregate $ ________________

If box is checked, Contractor is not required to provide Contractor’s Pollution Liability insurance under this Contract

6. Contractual Liability:

- Bodily Injury
  - Each Accident $ 1,000,000
  - Annual Aggregate $ 10,000,000

- Property Damage
  - Each Accident $ 1,000,000
  - Annual Aggregate $ 10,000,000

7. Additional Insureds: In addition to Owner and Engineer, include as additional insureds the following:

   a. HDR Engineering, Inc.; 8404 Indian Hills Drive, Omaha, Nebraska 68114.
   b. Terracon Consultants, Inc.; 15080 A Circle, Omaha, Nebraska 68144.

SC-6.05 Property Insurance

SC-6.05.A. Delete Paragraph 6.05.A of the General Conditions and substitute the following in its place:

A. Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof.

1. This insurance shall:
   a. Include the interests of the Owner, Contractor, Subcontractors and any other individuals or entities identified herein, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them each of whom is deemed to have insurable interest and shall be listed as an insured or additional insured;
b. 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 and damage to the Work, temporary buildings, false work, and materials and equipment in transit and shall insure against at least the following perils or cause 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), explosion, underground exposures, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

c. Include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of Engineers and Architects);

d. 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 Owner;

e. Include testing and startup; and

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

2. Contractor shall be responsible for any deductible or self-insured retention.

SC-6.06 Waiver of Rights

SC-6.06.B. Delete Paragraph 6.06.B in its entirety.

ARTICLE 7 – CONTRACTOR’S RESPONSIBILITIES

SC-7.01 Supervision and Superintendence

SC-7.01.B. Amend Paragraph 7.01.B to add the following sentences: “The Contractor shall identify their representative at the Site that shall have authority to act on behalf of Contractor. All communications given to or received from this representative shall be binding on Contractor.”

SC-7.01.C. Add the following new paragraph immediately after Paragraph 7.01.B:

Any superintendent or other personnel, who repeatedly fails to follow the Engineer’s written or oral orders, directions, instructions, or determinations, shall be subject to removal from the project. Upon the written request of the Engineer, the Contractor shall immediately remove such superintendent or other personnel and name a replacement in writing. Noncompliance with the Engineer’s request to remove and replace personnel at any level shall be grounds for terminating the Contract.
SC-7.02  Labor; Working Hours

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

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

SC-7.03  Services, Materials, and Equipment

SC-7.03.B. Add the following new subparagraphs immediately after Paragraph 7.03.B:

1. Where the Work requires equipment be furnished, due to the lack of standardization of equipment as produced by the various manufacturers, it may become necessary to make minor modifications in the structures, buildings, piping, mechanical work, electrical work, accessories, controls, or other work, to accommodate the particular equipment offered. Contractor's bid price for any equipment offered shall include the cost of making any necessary changes subject to the approval of Engineer.

7.08  Permits

SC-7.08. Add the following paragraphs immediately after Paragraph GC-7.08A.:

B. In those instances where a certificate of occupancy must be obtained before the Work under this Contract can be occupied and placed into service by Owner, it shall be the responsibility of Contractor to arrange, coordinate, and pay any costs of obtaining said certificate.

C. Contractor shall obtain a building permit from the City of Fremont. Owner shall cover any costs associated with this permit.

D. Contractor shall be responsible for obtaining any permits required to discharge water during construction.

7.09  Taxes

SC 7.09 Add a new paragraph immediately after Paragraph 7.09.A:

B. Owner is exempt from payment of sales and compensating use taxes of the State of Nebraska and of cities and counties thereof on all materials to be incorporated into the Work.

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

2. Owner’s exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by Contractor, or to supplies or materials not incorporated into the Work.
a. 7.18 Indemnification

SC 7.18.A Amend the second sentence of Paragraph 7.18.A by striking out "negligent".

C. 8 – OTHER WORK AT THE SITE

a. 8.02 Coordination

SC-8.02 Delete Paragraphs 8.02.A and B in their entirety and replace with the following:

A. Owner has contracted with others for the performance of other work at the Site related to addition of a new aeration basin, blower building, site piping, and other miscellaneous site improvements.

B. Owner shall have authority and responsibility for coordination of the various contractors and work forces at the Site.

D. 10 – ENGINEER’S STATUS DURING CONSTRUCTION

a. 10.03 Project Representative

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

B. The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.

1. General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR’s dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.

2. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.

3. Liaison:

a. Serve as Engineer’s liaison with Contractor. Working principally through Contractor’s authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.

b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor’s operations affect Owner's on-Site operations.

c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.

4. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed.
5. Shop Drawings and Samples:
   a. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
   b. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.

6. Modifications: Consider and evaluate Contractor’s suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR’s recommendations, if any, to Engineer.

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

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

9. Records:
   a. Prepare a daily report or keep a diary or log book, recording Contractor’s hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.
   b. Maintain records for use in preparing Project documentation.
10. Reports:
   a. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.

11. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

12. Completion:
   a. Participate in Engineer’s visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
   b. Participate in Engineer’s final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.
   c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.

C. The RPR shall not:
   1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including “or-equal” items).
   2. Exceed limitations of Engineer’s authority as set forth in the Contract Documents.
   3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
   4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor’s work.
   5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
   6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
   7. Accept Sample submittals from anyone other than Contractor.
   8. Authorize Owner to occupy the Project in whole or in part.
ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

b. 15.01 Progress Payments

SC 15.01C Add the following new paragraph immediately after Paragraph 15.01.C.6.e.:

F. Items entitling Owner to retain set-offs from the amount recommended, include but are not limited to:

1. Owner compensation to Engineer at an estimated average rate of $180 per each extra hour for labor plus direct expenses because of Contractor caused overtime worked by Contractor necessitating Engineer, Related entities, Resident Project Representative to work overtime in accordance with SC-7.02.

c. 15.03 Substantial Completion

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

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

d. 15.07 Waiver of Claims

SC-15.07.B. Amend Paragraph 15.07.B to state “The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner and/or Engineer other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.”

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

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

SC-17.02 Arbitration

A. All matters subject to final resolution under this Article will be decided by arbitration in accordance with the rules of an Owner selected Arbitration Agency, subject to the conditions and limitations of this paragraph. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in this Article, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred.
by the applicable statute of limitations. The demand for arbitration should include specific reference to Paragraph SC-17.02.D below.

C. No arbitration arising out of or relating to the Contract shall include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer’s consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

1. the inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and

2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.

D. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include a concise breakdown of the award, and a written explanation of the award specifically citing the Contract provisions deemed applicable and relied on in making the award.

E. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.

F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by Owner and Contractor.
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes execution requirements to establish a minimum standard of quality for the design and construction of the work.

1.2 PRECONSTRUCTION CONFERENCE
A. A preconstruction conference shall be held at the Fremont Wastewater Treatment Plant or City of Fremont offices after Award of Contract.
   1. Engineer will notify the Contractor as to the date and time of the conference two (2) weeks in advance of the proposed date.
   2. Contractor's Project Manager and Project Superintendent and Contractor's Subcontractor Representatives shall attend.

1.3 PROJECT SIGNS
A. Contractor's Standard Company Sign: Restricted to: 4 FT x 8 FT.
B. Coordinate sign locations with Owner.
C. Signs not listed in this Specification Section permitted only upon approval of Owner.

1.4 CONTRACTOR'S SUPERINTENDENT'S FIELD OFFICE
A. Establish at site of Project.
B. Equipment: Telephone, telecopy, mailing address, and sanitary facilities.
C. Ensure attendance at this office during the normal working day.
D. At this office, maintain complete field file of Shop Drawings, posted Contract Drawings and Specifications, and other files of field operations including provisions for maintaining "As Recorded Drawings."
E. Remove field office from site upon acceptance of the entire work by the Owner.

1.5 DRAWINGS AND CONTRACT DOCUMENTS FOR CONTRACTOR USE
A. Refer to General Conditions.
B. Contractor shall pick up all "no-charge" documents within 10 days from date of Notice to Proceed.
C. Additional documents after "no-charge" documents will be furnished to Contractor at cost.

1.6 PROJECT MEETINGS
A. Construction Meetings:
   1. The Engineer will conduct construction meetings involving:
      a. Contractor's project manager.
      b. Contractor's project superintendent.
      c. Owner's designated representative(s).
      d. Engineer's designated representative(s).
      e. Contractor's subcontractors as appropriate to the Work in progress.
      f. Owner's Construction Quality Control Consultant.
   2. Meetings will be conducted every two (2) weeks.
3. The Engineer will take meeting minutes and submit copies of meeting minutes to participants and designated recipients identified at the Preconstruction Conference.
   a. Corrections, additions or deletions to the minutes shall be noted and addressed at the following meeting.
4. The Engineer will schedule meetings for most convenient time frame.
5. The Engineer will have available at each meeting full chronological files of all previous meeting minutes.
6. The Contractor shall have available at each meeting up-to-date Record Drawings.

1.7 SPECIAL CONSIDERATIONS RELATED TO ADJACENT PROPERTIES AND FACILITIES

A. Contractor shall be responsible for negotiations of any waivers or alternate arrangements required to enable transportation of materials to the site.

B. Access, Traffic Control, and Parking:
   1. Maintain conditions of access road to site such that access is not hindered as the result of construction related deterioration.
   2. Do not permit driving across or transporting materials or equipment across areas outside the construction limits shown on the Drawings.
   3. Provide traffic control devices and personnel necessary to ensure a safe interface of construction traffic with business traffic to and from adjacent sites.
   4. Provide access routes for emergency vehicles at all times.
   5. Provide sweeping of hard-surface roadways as needed to remove soils tracked onto roadway.
   6. Provide on site parking for all staff. Coordinate location of parking with Owner.

1.8 HISTORICAL AND ARCHAEOLOGICAL

A. If during the course of construction, evidence of deposits of historical or archeological interest is found, the Contractor shall cease operations affecting the find and shall notify Owner.
   1. No further disturbance of the deposits shall ensue until the Contractor has been notified by Owner that Contractor may proceed.
   2. Owner will issue a notice to proceed after appropriate authorities have surveyed the find and made a determination to Owner.
   3. Compensation to the Contractor, if any, for lost time or changes in construction resulting from the find, shall be determined in accordance with changed or extra work provisions of the Contract Documents.

1.9 ADMINISTRATIVE PROCEDURES

A. Standard forms contained in HDR’s Project Tracker Collaboration System will be used for Requests for Information, Field Orders, Change Proposal Requests, Change Orders, and Work Change Directions.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION
SECTION 01 30 05
EGG SHAPED ANAEROBIC DIGESTER: GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes an overview description of work associated with this Project, requirements for Professional Engineering and Architectural Services, standards of quality to be used in design and construction of the Project, coordination requirements with Owner, Engineer and WWTP contractor, submittal requirements, product delivery, storage and handling requirements and startup, testing and commissioning requirements for the facilities.

1.2 OVERVIEW DESCRIPTION OF WORK
A. The general scope of this Contract consists of the multi-discipline engineering and architectural design, materials and equipment procurement, construction, startup and commissioning of the defined work included within the limits of construction shown on the Contract Drawings related to the addition of the new Egg Shaped Anaerobic Digester (ESAD No. 2) at the Fremont Wastewater Treatment Plant (WWTP).
B. The primary work on the Project is associated with the ESAD No. 2 Complex. This Complex consists of a steel egg shaped digester tank supported on a concrete cradle which forms a piping and equipment area (Equipment Gallery 65100) beneath the tank. A separate structure contained within the cradle forms a small electrical and control room (Control Room 65102). A third component of the Complex is a separate space that extends partially beneath the outer portion of the tank and extends beyond the tank boundary. This space (Boiler Room 65101) houses various equipment for heating the digester and the various spaces in the Complex. All structural components of the Complex including walls, floor slabs, foundations and roof are to be cast-in-place concrete, masonry, precast concrete, or Engineer approved equal.
  1. Contract Documents depict the Boiler Room (Room 65101) as integral with the ESAD gallery Ringwall. Contractor, at their option and with approval of the Engineer, may provide a Boiler Room as separate structure from the ESAD with the same requirements as are required by the Contract Documents.
C. Modifications connecting piping from ESAD No. 2 to the existing Sludge/Gas Storage Vessel, and to piping, valves and flow meters in the equipment gallery under ESAD No. 1 are also included in the Project as well as limited underground piping and utilities connecting the Complex to existing process piping and existing utility services. Limits of responsibility for buried piping and utilities and final connection of systems are defined in the Drawings.

1.3 PROFESSIONAL ENGINEERING AND ARCHITECTURAL SERVICES
A. Engineering and architectural services for the Work shall be provided by properly licensed professionals in the State of Nebraska, whose signatures and seals shall appear on all Drawings, calculations, Specifications, certifications, Shop Drawings and other design submittals prepared by such Professionals.
B. Shop Drawings and other submittals related to the Work designed or certified by such professionals, if prepared by others, shall bear such professional's written approval when submitted.
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 the Contractor all performance and design criteria that such services must satisfy.
D. Engineer's review and approval of design calculations, design documents, Shop Drawings and other submittals will be only for the limited purpose of check for conformance with performance and design criteria given and the design concept expressed in the Contract Documents.

1.4 STANDARD OF QUALITY

A. The Drawings and Specifications provided by the Engineer establish a minimum standard of quality that is to be used by the Contractor during its design, construction, startup and commissioning of the Project.

B. The Contract Documents contain the following preliminary Drawing information upon which the Contractor shall develop its design and construct the Project:

1. General site plan identifying the limits of construction and main travel route to be used by the Contractor.
2. Exterior site piping/utility plan identifying general piping/utility orientation and locations of interfacing connections with existing piping/utilities as well as piping/utilities to be installed by the WWTP contractor.
3. Preliminary interior process piping layouts (piping 4 IN and above) reflecting the process piping functions defined on the P&IDs as well as general location of major equipment developed to provide reasonable Owner access for operation and maintenance.
4. Preliminary exterior process piping layouts (piping 4 IN and above) reflecting overhead piping from ESAD No. 1 to ESAD No. 2.
5. Preliminary interior and exterior HVAC equipment orientation as well as preliminary HVAC system and heating water schematics defining basic system requirements.
6. Preliminary locations of floor drains in Equipment Gallery 65100 for equipment requiring drainage. Additional floor drains required for floor wash down are the design responsibility of the Contractor.
7. Preliminary mechanical schedules of HVAC equipment to identify preliminary magnitude of system component sizing.
8. Preliminary layout of electrical equipment in Control Room 65102.
9. Piping and Instrumentation Drawings (P&IDs) identifying a minimum level of design functions for the process and mechanical systems for:
   a. The digester sludge feed, mixing and withdrawal piping functions.
   b. The digester gas and non-potable water system piping functions.
   c. The sludge recirculation pumps and heat exchanger system piping functions.
   d. The boiler and hot water system piping functions.
   e. The sludge transfer pump system piping functions.
10. Preliminary one-line diagram identifying:
    a. Power connection of ESAD No. 2 to the Headworks Building.
    b. Preliminary power requirements for major equipment components.
    c. Preliminary equipment and motor control sizing and space requirements.
11. Work shown within the Contractor’s limits of construction but is the responsibility of the WWTP contractor is specifically identified on the Drawings.

C. The Contract Documents contain the following basic Specification information upon which the Contractor shall develop its final design and construct the Project:

1. Specifications contained in Division 01-General Requirements.
2. Specifications contained in Division 05-Metals.
3. Specifications contained in Division 07-Thermal and Moisture Protection.
4. Specifications contained in Division 08-Openings.
5. Specifications contained in Division 09-Finishes.
6. Specifications contained in Division 10-Specialties.
7. Specifications contained in Division 22-Plumbing.
9. Specifications contained in Division 26-Electrical.
10. Specifications contained in Division 31-Earthwork.
11. Specifications contained in Division 40-Process Interconnections.

D. Design Standards for Spaces:
1. The tables following this section provide the basic design requirements for each space associated with the ESAD No. 2 Complex and should be used in the design and construction of those spaces.

E. Building Code
1. Contractor shall design in accordance with the City of Fremont Nebraska’s adopted building codes effective on the date of the Bid opening.
2. Contractor shall coordinate requirements for building permits with the City of Fremont Nebraska’s Building Permits and Inspections Department.

1.5 COORDINATION

A. Design Review Meetings:
1. Within 2 weeks after submittal of the preliminary submittal requirements defined in Article 1.6, conduct a submittal overview meeting with the Owner and Engineer to obtain input on the preliminary design. As deemed appropriate, incorporate comments arising from that meeting into the final design documents.
2. Within 2 weeks after submittal of the final design documents defined in Article 1.6, conduct a submittal overview meeting with the Owner and Engineer to obtain input on the final design. As deemed appropriate, incorporate comments arising from that meeting into the Construction Documents.

B. WWTP contractor Coordination:
1. Construction of work associated with a major WWTP expansion will be occurring concurrently with this Project.
2. Separate storage and staging areas are identified for each contract. However, some traffic routes on site may be commonly used and there will be interfacing of Contractor’s piping/utility systems to some piping installed by the WWTP contractor.
3. It is a shared responsibility between both Contractor’s to coordinate their activities to provide minimal conflicts between work in each project and to perform the respective work tasks in as efficient manner as possible.

C. Work Interfacing with Existing Facilities-Coordination with Owner:
1. Contractor shall organize and plan its construction activities so that the number and length of any required interfacing work with existing facilities is minimized. Show all interruptions to existing facilities on the overall Project schedule and on the Contractor’s two-week look ahead schedule.
2. Existing process operation may be interrupted only for brief periods to facilitate interfacing construction with existing facilities. No complete WWTP or overall Solids Handling Facility shutdowns will be approved.
3. Provide minimum 7 days written notification to Owner of any connection/modification work. Some interruptions will require a significantly longer advance notice to allow for scheduling and execution of Owner’s responsibilities.
4. It is preferred that, when possible, shutdowns for different tie-ins be done at the same time.
Owner will cooperate to accommodate requests for interruption of existing processes and taking process units out of service. However, Owner may, at its option, cancel shutdowns within 24 HRS of the scheduled shutdown time for any reason. If this occurs, Contractor and Owner will mutually agree on a revised date and time for the shutdown.

a. Interfacing work:
   1) Egg Shaped Digester No. 1 (ESAD No. 1) Sludge Piping Modifications/Connections To Egg Shaped Digester No. 2:
      a) Maximum of 8 HRS flow interruption is permitted for tie-in to the existing ESAD No. 1 Digester sludge feed pipe.
   2) Sludge Gas Connections and Bypass, Bridge Work and Instrumentation at Existing Sludge Gas Storage Vessel:
      a) Sludge Gas Storage Vessel is not on-line during Owner’s winter shutdown period which is November 1st and March 1st. Complete all work at the Vessel during this time period.
   3) Maximum of 4 HRS is permitted for tie-in to non-potable water piping.

1.6 ENGINEERING SUBMITTALS

A. General:
   1. See Article 1.3 for requirements related to Professional Services.
   2. In all submittals referencing equipment, utilize equipment names and identification numbers established in the Contract Documents. For additional equipment provided in the Contractor’s design but not identified in the Contract Documents, utilizing the naming and numbering approach identified in the Contract Documents.
   3. In all submittals referencing piping systems, utilize piping system abbreviations established in the Contract Documents. For additional piping systems provided in the Contractor’s design but not identified in the Contract Documents, utilizing the pipe naming and pipe sizing approach identified in the Contract Documents.
   4. Provide detailed schedule indicating tasks and durations required for engineering, design, submittal, review/approval, equipment procurement/fabrication/assembly, and delivery for each major system component or section as defined herein.
      a. Submitted within 1 month of issuance of Notice-To-Proceed.

B. Preliminary Submittal Requirements:
   1. Process and Instrumentation Drawings (P&ID):
      a. Complete for all systems including ancillary systems.
      b. Include piping, valves, equipment and instrumentation pursuant to ISA 5.1.
      c. Submitted and accepted within 2 months of issuance of Notice-To-Proceed.
   2. Layout Drawings and Preliminary Equipment Selection:
      a. Interior space layouts including definition of each space identified on the Engineer’s Drawings.
      b. Housekeeping pad locations for all major equipment.
      c. Preliminary sizing of all concrete walls and structural elements.
      d. Definition of foundation approach to be utilized with sufficient details to convey approach to be used and suitable for Engineer review.
      e. Submitted within 4 months of issuance of Notice-To-Proceed.
      f. Cut sheets identifying proposed equipment to be utilized with appropriate detail to show compliance with the Contract Documents.
         1) All major multi-discipline equipment to be included in this submittal.

C. Final Design Documents:
   1. Calculations:
      a. Final design calculations for structural, mechanical, process and electrical design elements.
      b. Organize calculations in single design book with each discipline’s calculations contained under a separate section.
c. Provide subsection for each separate system design, clearly marked to identify system for which calculations apply.
d. Identify all assumptions used in calculation development at front of each design calculation subsection.

2. Drawings:
   a. General:
      1) Scaled Drawings (minimum 3/16 = 1 IN) with same orientation as shown in Engineer’s Drawings.
      2) Drawing components listed below are minimum requirements. Provide Drawings sufficient to effectively and accurately construct work.
      3) Utilize philosophy for presentation of Drawings used in Engineer’s Drawings (separation of discipline work on different Drawings, use of half tone verses full tone Drawings, clear presentation of graphics and notes, etc.).
      4) Submitted within 5 months of issuance of Notice-To-Proceed.
      5) Note – Final Design Documents do not include Record Documents (As Recorded), which shall be submitted at the completion of the project, see General Conditions Article 7.11.
   b. Architectural:
      1) Space layouts reflecting space definitions, egress and access locations including door and window sizing and location.
      2) Exterior Elevations
      3) Surface finishes.
      4) Roof system details.
      5) Stairs and landings.
      6) Provisions for thermal and moisture protection.
      7) Personnel safety items such as guardrails, fire extinguishers, etc.
   c. Structural:
      1) Concrete foundation layout and details.
      2) Tank anchorage details.
      3) Welding details for tank assembly.
      4) Details for assembly and installation of support skirt.
      5) Thickness, reinforcement and ancillary items associated with cast-in-place concrete construction.
      6) Details of metal walkways, stairs and platforms.
      7) Design loads utilized for all structural sizing.
      8) Statement of Special Inspections required.
   d. Mechanical (HVAC and Plumbing):
      1) Location of all equipment.
      2) Routing of all ductwork.
      3) Routing of all piping 4 IN and above including valve and piping appurtenance locations.
      4) Schematics for routing of piping systems below 4 IN in size.
      5) Piping and ductwork supports.
      6) Definition of air flow (supply and return) in each space.
      7) Location of all louvers, vents and other penetrations made through concrete surfaces and definition of how those penetrations will be made and sealed.
      8) Placement of equipment and general floor drains.
   e. Electrical:
      1) Location of all equipment.
      2) Final one-line diagram.
      3) Details for connection to WWTP power.
      4) Lighting system layout for both interior and exterior spaces.
      5) Details of electrical grounding system.
   f. Process:
      1) Tank plan and sections showing interface with Sludge/Gas Storage Tank.
      a) Location of all nozzles and appurtenances.
b) Details for application of insulation system.
2) Location of all equipment.
3) Routing of all piping 4 IN and above including valve and piping appurtenance
   locations.
4) Schematics for routing of piping systems below 4 IN in size.
5) Piping supports.
6) Location of all penetrations made through concrete surfaces and definition of how
   those penetrations will be made and sealed.

h. Instrumentation:
   1) PLC system architecture.
   2) Location of all field elements and other elements requiring power.
   3) Definition of all signals routed to the plant PLC system from the ESAD PLC.

i. Sitework:
   1) Extent of all piping/conduit provided in Contract and connection details for final
      connection (where defined) to existing or WWTP contractor installed
      piping/conduit.
   2) Construction details utilized for bedding of conduit and piping.
   3) Details for pads for equipment located on-site with footings extending below frost
      line.

3. Submittal to NDEQ:
   a. Submit final stamped Design Drawings to NDRQ to obtain required construction
      permit.

D. Submittals and Operation and Maintenance Manuals:
   1. Furnish submittals (Shop Drawings and informational submittals) in accordance with
      Specification Section 01 33 00 and requirements of other Specifications and additional
      designer’s requirements.
   2. Include all quality control test results, mix designs and other such construction
      documentation.
   3. See Specification Section 01 61 03-Equipment: Basic Requirements for general equipment
      submittal information requirements.
   4. Furnish Operation and Maintenance Manuals in accordance with Specification Section 01
      33 04.

1.7 EXISTING SLUDGE/GAS STORAGE VESSEL

A. Evaluate existing Sludge/Gas Storage Vessel to determine if bridge access shown on Drawings
   from the top of ESAD No. 2 to the top of Sludge/Gas Storage Vessel can be accomplished.
   Structural modifications to the existing Sludge/Gas Storage Vessel may be required to
   accommodate the additional loads from the new access bridge. These modifications will be part
   of the Contractor’s design and construction. If analysis indicates connection is not possible,
   provide exterior access to the top of ESAD No. 2 via an exterior tank stairwell not attached to
   ESAD No. 2 or an external stairwell supported by ESAD No. 2.
B. Connecting a bridge from the top of ESAD No. 2 to the top of the existing Sludge/Gas Holding
   Tank is the preferred facility design.

1.8 FOUNDATION DESIGN AND CONSTRUCTION

A. Design based on the allowable soil bearing frost depth, at the specified bearing strata and in
   consideration of the estimated settlements which are addressed in the Geotechnical Engineering
   Report. The Geotechnical Engineering Report is provided as information and is not a Contract
   Document. Contractor to collect its own geotechnical data as necessary to design and construct
   the foundation.
B. Settlement:
   1. Refer to Soils Report for settlement anticipated for ESAD No. 2 area.
2. Consider use of ESAD, filled with plant effluent for hydro-pneumatic testing, to preload area to minimize differential settlement which may impact piping/utility systems associated with the structure.
   a. Monitor settlement and perform connections with site piping when settlement is within levels that can be accommodated for piping/utility connections.
   b. Design connections to accommodate remaining anticipated settlement.
   c. Consider concrete pipe encasement integral with structure floor slab to protect integrity of under slab piping/utility systems.

C. Protect existing adjacent structures, their foundations and other supporting systems and piping/utility systems during construction to prevent damage and settlement.

1.9 DELIVERY, STORAGE AND HANDLING OF EQUIPMENT AND MATERIALS

A. Contractor has been assigned a specific staging and layout area for its work along with a defined route of travel to the work area. Variations from these limits or travel routes shall be approved by Owner.

B. Adhere to all manufacturer requirements for delivery, storage and handling of products and equipment.
   1. Inspect all deliveries when received and reject deliveries that are in any way unsuitable for use on the Project.
   2. Include manufacturer’s written instructions for delivery, storage and handling within Shop Drawing submittals.
   3. No payment will be made to Contractor for equipment or materials not properly stored and insured or without approved Shop Drawings. Previous payments for items will be deducted from subsequent progress estimate(s) if proper storage procedures are not observed.

C. Contractor may either provide a temporary storage building on-site to house environmentally sensitive products and equipment or shall rent off-site storage providing the necessary protection.
   1. All costs for off-site storage, including transportation, labor and equipment for travel to and from off-site location, shall be included in its Bid.
   2. Owner reserves the right to inspect both on-site and off-site storage at any time.

D. It is Contractor’s sole responsibility to schedule deliveries as required to maintain its schedule.

1.10 TESTING AND SPECIAL INSPECTIONS

A. Inspection and testing including pile testing and monitoring (if any); concrete and grout materials testing; reinforcing steel placement; soil and soil compaction testing to be performed by independent Testing Agency hired by the Owner.
   1. Testing related to the structural components (materials and welding) of the steel ESAD vessel by Contractor.

B. Contractor’s Design Professional in Responsible Charge (DPRC) shall submit to the Building Code Officials a Statement of Special Inspection providing a detailed explanation of the Special Inspections and Testing being provided for the Project.
   1. Monthly Special Inspection reports will be submitted to the DPRC and the Building Official.
   2. Special Inspection will be performed by Owner’s Testing Agency.

1.11 STARTUP, TESTING AND COMMISSIONING

A. Furnish on-site Owner training, system start up, testing and commissioning of all equipment in accordance with Specification Section 01 75 00 and other Specifications.

END OF SECTION
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<thead>
<tr>
<th>DESCRIPTION OF DESIGN ELEMENT</th>
<th>DESIGN REQUIREMENT</th>
<th>COMMENTS</th>
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<td>Architectural</td>
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<tr>
<td>• Materials of Construction</td>
<td>- Walls and Floor Slabs To Be Cast-in-Place Concrete - Railings to be Aluminum - Doors - Pedestrian Doors to be FRP. - Overhead Doors to be Aluminum. - Borrow Lites to be FRP. - Coatings to be High Performance Industrial Coatings</td>
<td>See Structural Requirements for Concrete Below. See Specifications for Additional Information.</td>
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<td>• Roof</td>
<td>Not Applicable</td>
<td>Egg and Skirt to Provide Weather Tight Enclosure.</td>
</tr>
<tr>
<td>• Atmospheric Conditions Affecting materials of Construction and Installation Methods</td>
<td>Provide Corrosion Resistant Materials such as Aluminum, FRP, or Stainless Steel Wherever Practicable. Coat Ferrous Metals with High Performance Industrial Coatings to Resist Microbiologically Induced Corrosion.</td>
<td>Potential for Corrosive Digester Gas Accumulation.</td>
</tr>
<tr>
<td>• Concrete Finishes</td>
<td>- Horizontal Surfaces - Troweled Finish For Interior Floor Slabs, Exposed Roof Slabs And Base Slabs Of Structures, Equipment Bases, and Column Bases - Broom Finish For Structural Stoops - All Other Concrete Work Floated Finish - Vertical Surfaces - Smooth Form Finish for Interior Walls, Columns, and Similar Vertical Surfaces. - Polymer Modified Cementitious Coating to Match Existing at Exterior Surfaces.</td>
<td></td>
</tr>
<tr>
<td>Structural</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Digester Support Cradle, Floor, Dividing Walls Between Spaces</td>
<td>- Cast-In-Place Concrete - Wall Between Boiler Room and Equipment Gallery Minimum 12 IN Thickness - 3/4 IN Chamfer Strips In Forms To Produce 3/4 IN Wide Beveled Exposed Edges</td>
<td>Concrete to Conform to ACI 301-10 With The Following Additional Requirements - 28-Day Compressive Strength Fc' = 4000 PSI Minimum - Maximum Water/Cement Ratio 0.45 - Slump 1 To 4 IN, - Air Content 5 to 7 PCT - Aggregate ASTM C33, 3/4 IN Maximum Size - ASTM A625 Grade 60 Reinforcing, No Welding</td>
</tr>
<tr>
<td>• Foundation</td>
<td>- Reinforced Concrete Mat / Slab- On-Grade - Level To Within ± 1/4 IN Within</td>
<td></td>
</tr>
<tr>
<td><strong>Item</strong></td>
<td><strong>Detail</strong></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Total Circumference Of The Foundation</strong></td>
<td>-Boiler Room Wall Foundation Designed As Strip Footing</td>
<td></td>
</tr>
<tr>
<td><strong>Ceiling</strong></td>
<td>None-Formed By Shell Of Digester</td>
<td></td>
</tr>
<tr>
<td><strong>Floor Loading</strong></td>
<td>200 PSF</td>
<td></td>
</tr>
<tr>
<td><strong>Mechanical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Inside Design Temperature Winter</strong></td>
<td>(DEGF) Design for 55</td>
<td></td>
</tr>
<tr>
<td><strong>Inside Design Temperature Summer</strong></td>
<td>(DEGF) Design for 10 DEGF above ambient</td>
<td></td>
</tr>
<tr>
<td><strong>Heating Approach</strong></td>
<td>Glycol Unit Heaters</td>
<td></td>
</tr>
<tr>
<td><strong>Cooling Approach</strong></td>
<td>Cooled By Ventilation</td>
<td></td>
</tr>
<tr>
<td><strong>Ventilation</strong></td>
<td>Provide 1 ACH Minimum Continuously During Winter And 4 ACH Minimum Continuously During Summer</td>
<td></td>
</tr>
<tr>
<td><strong>Water Supply</strong></td>
<td>Non-Potable Water for Wash Down</td>
<td></td>
</tr>
<tr>
<td><strong>Natural Gas Supply</strong></td>
<td>Sized per loads in accordance with International Fuel Gas Code and NFPA 54</td>
<td></td>
</tr>
<tr>
<td><strong>Sanitary Drainage</strong></td>
<td>-4 IN Floor Drain Within 5 FT Of Each Piece of Equipment Requiring Seal Water -Minimum Of Two 4 IN Floor Drains For Wash down</td>
<td></td>
</tr>
<tr>
<td><strong>Piping System Materials</strong></td>
<td>As Specified In Division 40</td>
<td></td>
</tr>
<tr>
<td><strong>Pipe Sizing</strong></td>
<td>Design Velocity Between 3-8 FPS</td>
<td></td>
</tr>
<tr>
<td><strong>Valves</strong></td>
<td>As Shown On Schematics and Specified In Division 40</td>
<td></td>
</tr>
<tr>
<td><strong>Ductwork Sizing</strong></td>
<td>Pressure Drop Of 0.08 IN WC/100 FT Of Duct</td>
<td></td>
</tr>
<tr>
<td><strong>Fire and Personnel Protection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fire Extinguishers</strong></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Gas Detection System</strong></td>
<td>(CGB) Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Room Classification</strong></td>
<td>Wet and Corrosive, Class I, Division 2</td>
<td></td>
</tr>
<tr>
<td><strong>Emergency Power</strong></td>
<td>None.</td>
<td></td>
</tr>
<tr>
<td><strong>Luminaire Type</strong></td>
<td>Light Emitting Diode (LED)</td>
<td></td>
</tr>
<tr>
<td><strong>Illumination</strong></td>
<td>40 FT Candle Intensity average</td>
<td></td>
</tr>
<tr>
<td><strong>Signage</strong></td>
<td>Exit Signage IBC 1011</td>
<td></td>
</tr>
<tr>
<td><strong>Egress Lighting</strong></td>
<td>Yes IBC 1006</td>
<td></td>
</tr>
<tr>
<td><strong>Conduit Type</strong></td>
<td>Rigid Aluminum Steel Surface Mounted</td>
<td></td>
</tr>
<tr>
<td><strong>Cast-Outlet, Pull &amp; Junction Boxes</strong></td>
<td>NEMA 7 Surface Mounted</td>
<td></td>
</tr>
<tr>
<td><strong>Process</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>
| **Wiring Devices**  
(Receptacles, etc.) | None |
| **Piping System**  
Materials | As Specified In Division 43 |
| **Pipe Sizing** | - Suction Design Velocity  
Between 3-4 FPS  
- Discharge Design Velocity  
Between 6-8 FPS |
| **Valves** | As Shown On P&IDs and  
Specified In Division 40 |
### Architectural

<table>
<thead>
<tr>
<th>DESIGN ELEMENT</th>
<th>DESIGN REQUIREMENT</th>
<th>COMMENTS</th>
</tr>
</thead>
</table>
| **Materials of Construction**         | - Walls and Roof Deck To Be Cast-in-Place Concrete, Concrete Masonry, Precast Concrete, or Engineer Approved Equal.  
- Railings to be Aluminum  
- Doors  
  - Pedestrian Doors to be FRP.  
  - Overhead Doors to be Aluminum.  
- Borrow Lites to be FRP.  
- Coatings to be High Performance Industrial Coatings  
- See Structural Requirements for Concrete Below  
- See Specifications for Additional Information | - See Structural Requirements for Concrete Below  
- See Specifications for Additional Information |
| **Roof**                              | - Metal Roofing to Match Existing Solids Handling Building  
- See Specification Section 07 61 13 | - See Specification Section 07 61 13 |
| **Atmospheric Conditions Affecting materials of Construction and Installation Methods** | - Provide Corrosion Resistant Materials such as Aluminum, FRP, or Stainless Steel Wherever Practicable.  
- Coat Ferrous Metals with High Performance Industrial Coatings to Resist Microbiologically Induced Corrosion | Potential for Corrosive Digester Gas Accumulation |
| **Concrete Finish**                   | - Horizontal Surfaces  
  - Troweled Finish For Interior Floor Slabs, Exposed Roof Slabs And Base Slabs Of Structures, Equipment Bases, and Column Bases  
  - Broom Finish For Structural Stoops  
  - All Other Concrete Work Floated Finish  
- Vertical Surfaces  
  - Smooth Form Finish for Interior Walls, Columns, and Similar Vertical Surfaces  
  - Polymer Modified Cementitious Coating to Match Existing at Exterior Surfaces | |
| **Concrete Masonry Finish**           | - Exterior Face:  
  - Split-Face Masonry Units to Match Existing Solids Processing Building Texture and Integral Colors.  
- Interior Face:  
  - Smooth, unpainted CMU. | |
| **Precast Concrete Finish**           | - Wall Panels Exterior Face:  
  - Split-Face CMU Form Liner to Match Aeration Blower Building Texture and | |
**Integral Colors.**

- Wall Panels Interior Face:
  - Medium Abrasive Blasted Gray Concrete to Match Aeration Blower Building.
- Hollow-Core, Double-Tees, or Similar Structural Units:
  - Standard smooth form finish.

**Structural**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior Walls, Floor, Dividing Walls Between Spaces</td>
<td>Cast-In-Place Concrete Wall Between Boiler Room and Equipment Gallery Minimum 12 IN Thickness, -3/4 IN Chamfer Strips In Forms To Produce 3/4 IN Wide Beveled Exposed Edges</td>
</tr>
<tr>
<td>Foundation Type</td>
<td>Reinforced Concrete Mat / Slab-On-Grade Level To Within ± 1/4 IN Within The Total Circumference Of The Foundation -Boiler Room Wall Foundation Designed As Strip Footing</td>
</tr>
<tr>
<td>Roof Structure</td>
<td>Sloped Cast-In-Place Concrete</td>
</tr>
<tr>
<td>Floor Loading</td>
<td>200 PSF</td>
</tr>
</tbody>
</table>

**Mechanical**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside Design Temperature Winter (DEGF)</td>
<td>Design For 55</td>
</tr>
<tr>
<td>Inside Design Temperature Summer (DEGF)</td>
<td>Design For 10 DEGF Above Ambient</td>
</tr>
<tr>
<td>Heating Approach</td>
<td>Heated By Air From Make-Up Air Unit</td>
</tr>
<tr>
<td>Cooling Approach</td>
<td>Cooled By Ventilation</td>
</tr>
<tr>
<td>Ventilation</td>
<td>Ventilated With Make-Up Air Unit And Exhaust Fan -Filtered Louver Code Required Combustion Air Intake(s)</td>
</tr>
<tr>
<td>Water Supply</td>
<td>Non-Potable Water With Reduced Pressure Backflow Preventer For Boiler-Make-Up Water -Non-potable water for wash down</td>
</tr>
<tr>
<td>Sanitary Drainage</td>
<td>4 IN Floor Drain Within 5 FT Of Each Piece of Equipment Requiring Seal Water -Minimum Of Two 4 IN Floor Drains For Wash Down</td>
</tr>
<tr>
<td>Piping System Materials</td>
<td>As Specified In Division 40</td>
</tr>
<tr>
<td>Pipe Sizing</td>
<td>Design Velocity Between 3-8 FPS</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>Room Classification</td>
<td>Dry, Unclassified</td>
</tr>
<tr>
<td></td>
<td>Per NFPA 820 when ventilated at 6 AC/HR area is reduced one classification from C1D2 to Unclassified</td>
</tr>
<tr>
<td></td>
<td>System to be monitored by PLC to ensure active AC</td>
</tr>
<tr>
<td>Emergency Power</td>
<td>None</td>
</tr>
<tr>
<td>Luminaire Type</td>
<td>Light Emitting Diode (LED)</td>
</tr>
<tr>
<td>Illumination</td>
<td>-40 FT Candle Intensity average</td>
</tr>
<tr>
<td>Signage</td>
<td>Exit Signage</td>
</tr>
<tr>
<td></td>
<td>IBC 1011</td>
</tr>
<tr>
<td>Egress Lighting</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>IBC 1006</td>
</tr>
<tr>
<td>Conduit Type</td>
<td>Rigid Aluminum Steel</td>
</tr>
<tr>
<td></td>
<td>Surface Mounted</td>
</tr>
<tr>
<td>Cast-Outlet, Pull &amp; Junction Boxes</td>
<td>NEMA 12 Aluminum</td>
</tr>
<tr>
<td></td>
<td>Surface Mounted</td>
</tr>
<tr>
<td>Wiring Devices (Receptacles, etc.)</td>
<td>Provide GFCI with Aluminum</td>
</tr>
<tr>
<td></td>
<td>While-in-Use Cover</td>
</tr>
<tr>
<td>Process</td>
<td></td>
</tr>
<tr>
<td>Piping System Materials</td>
<td>As Specified In Division 40</td>
</tr>
<tr>
<td>Pipe Sizing</td>
<td>Suction Design Velocity Between 3-4 FPS</td>
</tr>
<tr>
<td></td>
<td>Discharge Design Velocity Between 6-8 FPS</td>
</tr>
<tr>
<td>Valves</td>
<td>As Shown On P&amp;IDs and Specified In Division 40</td>
</tr>
</tbody>
</table>
**CONTROL ROOM 65102**

<table>
<thead>
<tr>
<th>DESCRIPTION OF DESIGN ELEMENT</th>
<th>DESIGN REQUIREMENT</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Architectural</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Materials of Construction</td>
<td>- Walls, Floor Slabs, and Ceiling To Be Cast-in-Place Concrete - Railings to be Aluminum - Doors • Pedestrian Doors to be FRP • Overhead Doors to be Aluminum - Borrow Lites to be FRP - Coatings to be High Performance Industrial Coatings</td>
<td>-See Structural Requirements for Concrete Below -See Specifications for Additional Information</td>
</tr>
<tr>
<td>• Roof</td>
<td>Not Applicable</td>
<td></td>
</tr>
<tr>
<td>• Atmospheric Conditions Affecting materials of Construction and Installation Methods</td>
<td>-Provide Corrosion Resistant Materials such as Aluminum, FRP, or Stainless Steel Wherever Practicable -Coat Ferrous Metals with High Performance Industrial Coatings to Resist Microbiologically Induced Corrosion</td>
<td>-Potential for Corrosive Digester Gas Accumulation</td>
</tr>
<tr>
<td><strong>Concrete Finish</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Horizontal Surfaces</td>
<td>Troweled Finish For Interior Floor Slabs, Exposed Roof Slabs And Base Slabs Of Structures, Equipment Bases, and Column Bases • Broom Finish For Structural Stoops • All Other Concrete Work Floated Finish</td>
<td></td>
</tr>
<tr>
<td>• Vertical Surfaces</td>
<td>Smooth Form Finish for Interior Walls, Columns, and Similar Vertical Surfaces • Polymer Modified Cementitious Coating to Match Existing at Exterior Surfaces</td>
<td></td>
</tr>
<tr>
<td><strong>Structural</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Floor, Dividing Walls Between Spaces</td>
<td>Cast-In-Place Concrete Wall Between Control Room and Equipment Gallery Minimum 12 IN Thickness -3/4 IN Chamfer Strips In Forms To Produce 3/4 IN Wide Beveled Exposed Edges</td>
<td>-Concrete to Conform to ACI 301-10 With The Following Additional Requirements - 28-Day Compressive Strength Fc'= 4000 PSI Minimum - Maximum Water/Cement Ratio 0.45 - Slump 1 To 4 IN, - Air Content 5 to 7 PCT - Aggregate ASTM C33, 3/4 IN Maximum Size -ASTM A625 Grade 60 Reinforcing, No Welding</td>
</tr>
<tr>
<td>• Foundation Type</td>
<td>-Reinforced Concrete Mat / Slab-On-Grade -Level To Within ± 1/4 IN Within The Total Circumference Of The Foundation</td>
<td></td>
</tr>
</tbody>
</table>
- Boiler Room Wall Foundation Designed As Strip Footing

- Ceiling - Cast-In-Place Concrete
- Floor Loading - 200 PSF

**Mechanical**

- Inside Design Temperature Winter (DEGF) - Design for 60
- Inside Design Temperature Summer (DEGF) - Design for 80
- Heating Approach - Electric Unit Heater
- Cooling Approach - Direct Expansion Split System
- Ventilation - Positive Pressurization At 250 CFM - Louver Sizing With Intake Velocity Below 300 FPM
- Water Supply - None
- Sanitary Drainage - None
- Piping System Materials - As Specified In Division 40
- Pipe Sizing - Design Velocity Between 3-8 FPS
- Valves - As Shown On Schematics and Specified In Division 40
- Ductwork Sizing - Pressure Drop Of 0.08 IN WC/100 FT Of Duct

**Fire and Personnel Protection**

- Fire Extinguishers - Yes
- Gas Detection System - No

**Electrical**

- Room Classification - Dry, Unclassified
- Emergency Power - None
- Luminaire Type - Light Emitting Diode (LED)
- Illumination - 40 Foot Candle Intensity average
- Signage - Exit Signage - IBC 1011
- Egress Lighting - Yes - IBC 1006
- Conduit Type - Rigid Aluminum Steel - Surface Mounted
- Cast-Outlet, Pull & Junction Boxes - NEMA 12 Aluminum - Surface Mounted
- Wiring Devices (Receptacles, etc.) - GFCI

**Process**

- Piping System Materials - None
- Pipe Sizing - None
- Valves - None
### TOP OF DIGESTER AND WALKWAY

<table>
<thead>
<tr>
<th>DESCRIPTION OF DESIGN ELEMENT</th>
<th>DESIGN REQUIREMENT</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Guardrails</td>
<td>-Aluminum</td>
<td>-See Specification Section 05 52 02.</td>
</tr>
<tr>
<td>Structural</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Walkway Between Top of ESAD No. 2 And Top Of Sludge/Gas Holding Tank</td>
<td>-Fabricated From ASTM A992 Wide Flange Beams And ASTM A36 Structural Steel For Cross Bracing Between Beams -Welded To ESAD No. 2 Gas Dome -Bridge Beam Center-To-Center Distance Maximum 4 FT -Grating Conforming To NAAMM MBG 531 Minimum</td>
<td></td>
</tr>
<tr>
<td>Mechanical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire and Personnel Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fire Extinguishers</td>
<td>-Yes</td>
<td></td>
</tr>
<tr>
<td>• Gas Detection System</td>
<td>-Yes</td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Classification</td>
<td>-Wet, Corrosive, Class 1, Division 1</td>
<td>-Per NFPA 820 Table 6.2.2(a) Row 16(a) C1D1 area extends 10 FT above highest point of cover and 10 FT around valves and gas handling equipment C1D2 area extends 15 FT above C1D1 area.</td>
</tr>
<tr>
<td>• Luminaire Type</td>
<td>-Light Emitting Diode (LED)</td>
<td>-Provide general Area light at top of ESAD and at walkway.</td>
</tr>
<tr>
<td>• Conduit Type</td>
<td>-Rigid Aluminum</td>
<td></td>
</tr>
<tr>
<td>• Cast-Outlet, Pull &amp; Junction Boxes</td>
<td>-NEMA 7</td>
<td></td>
</tr>
<tr>
<td>• Wiring Devices (Receptacles, etc.)</td>
<td>-None</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Piping System Materials</td>
<td>-As Specified In Division 43</td>
<td></td>
</tr>
<tr>
<td>• Pipe Sizing</td>
<td>-Sludge Discharge Pipe Design Velocity Between 6-8 FPS</td>
<td></td>
</tr>
<tr>
<td>• Valves</td>
<td>-As Shown On P&amp;IDs and Specified In Division 40</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes specific requirements for the preparation, submittal, updating, and status reporting of the construction Progress Schedule.

B. Review of the CPM Schedule:
1. In so far as the Contractor is solely responsible for its means and methods and the CPM schedule represents in part its means and methods, the review of the CPM schedules (preliminary, baseline, updates, revisions, etc.) is for compliance with the requirements as defined in the Contract Documents.
2. The review of the CPM schedule is not intended to be complete or exhaustive or check every activity and its relation to the work.
3. The Engineer will provide comments on the CPM schedule compliance with those contract requirements and anomalies that might appear to the Engineer.
4. If the Contractor fails to include contract requirements (e.g. specified cure times, commissioning periods) in the CPM schedule, or the Engineer fails to notify the Contractor of anomalies the Contractor is not relieved of the contract requirements.
5. Acceptance of the CPM schedule does not imply that the Owner has approved or accepted the Contractor’s means and methods or sequence for performing the work to construct the project.
6. If the Contractor has questions or concerns about comments, the Contractor and Engineer shall meet to resolve those issues prior to issuance of future updates or revisions.

1.2 QUALITY ASSURANCE
A. The person preparing, updating and revising the construction Progress Schedule shall be experienced in the preparation of schedules of similar complexity.

1.3 DEFINITIONS
A. The following definitions shall apply to this Specification Section:
1. EXECUTION OF THE CONTRACT: The date the contract is signed by the last party, either the Owner or the Contractor.
2. WORKING DAYS: Monday through Friday except holidays as directed by the Owner.
3. PRELIMINARY SCHEDULE: A schedule showing detailed activity for the first 90 days of the Project, and a general work plan for construction activity from the 91st day until the Contractual Completion Date.
4. BASELINE SCHEDULE: The initial detailed Progress Schedule prepared by the Contractor defining its plan for constructing the Project in accordance with the Contract Documents.
5. SCHEDULE UPDATE: The initially accepted Baseline Schedule, or subsequently approved Revised Baseline Schedules, updated each month to reflect actual start and finish dates of each schedule activity and the remaining duration of activities that began during the period.
6. CURRENT SCHEDULE: The current schedule is either the Baseline Schedule or Revised Baseline Schedule including and incorporating Schedule Updates.
7. REVISED BASELINE SCHEDULE: The initially accepted Baseline Schedule revised to reflect approved contract change orders and modifications.
8. RECOVERY SCHEDULE:
   a. A schedule indicating the Contractor’s plan for recovering lost time.
9. SHORT INTERVAL SCHEDULE:
   a. Schedule prepared by the Contractor reflecting the work planned for the coming weeks.
   b. This is also known as a Look-Ahead Schedule.
10. RESOURCES: Manpower, materials, permanent equipment, and construction equipment
    needed to construct the work.

1.4 SUBMITTALS

A. Project Schedule Preparation:
   1. Within five (5) days from Execution of the Contract, Contractor shall submit the name of
      the person responsible for the preparation, maintenance, updating and revision of all
      schedules.
   2. Qualifications necessary:
      a. Produced, updated, and maintained for at least five (5) years complex construction
         schedules for projects of similar type, size and complexity.
      b. Proficient in the use of the scheduling program selected for this project.
      c. If the Contractor changes the person responsible for developing and maintaining the
         schedule, the Contractor will provide documentation verifying the new person meets
         the minimum qualifications.

B. Preliminary Schedule:
   1. Submittal and review:
      a. Submit within 10 days after Execution of the Contract or the effective date of the
         contract, whichever is earlier.
      b. The Engineer will review and provide comments to the Contractor within ten (10)
         working days after receipt of the schedule.
      c. The Contractor will review and modify the preliminary schedule and return the
         schedule within five (5) working days. If there are concerns about the comments
         provided, the Engineer and Contractor will meet to review and resolve those concerns.
   2. Submittal package:
      a. Provide a detailed plan for the first ninety (90) days of the project and summary
         activities of the work to achieve the project milestones.
      b. CPM time-scaled network diagram:
         1) A printed logic diagram and PDF that include the following information:
            a) Unique activity number/identifier; numeric, alpha or combination of
               numeric/alpha.
            b) Activity description.
            c) Activity duration.
            d) Early start and early finish for each activity.
            e) Late start and late finish for each activity.
            f) Total float (TF) for each activity.
            g) Predecessor activities.
            h) Successor activities.
            i) Bar showing the early start and completion dates of each activity.
         2) The activities will be sorted by area, trades, and subcontractors as agreed on with
            the Engineer.
         3) Print the CPM time-scaled network diagram on minimum sheet size of
            11 IN x 17 IN.

C. Baseline Schedule and Narrative Report:
   1. Submittal and review:
      a. Submit within 30 days after Execution of the Contract or the effective date of the
         contract, whichever is earlier.
b. The Engineer shall review the baseline schedule and provide comments to the Contractor within twenty (20) working days after receipt of the schedule.
c. After receiving comments, the Contractor and Engineer shall meet to review the comments within five (5) working days.
d. After the meeting, the Contractor will modify the schedule as agreed and resubmit the baseline schedule within 5 working days.
e. After the Engineer confirms that the Contractor has made the changes as agreed, the schedule will become the baseline schedule.

2. Submittal package:
   a. CPM time-scaled network diagram:
      1) A printed logic diagram and PDF that include the following information:
         a) Unique activity number/identifier; numeric, alpha or combination of numeric/alpha.
         b) Activity description.
         c) Activity duration.
         d) Early start and early finish for each activity.
         e) Late start and late finish for each activity.
         f) Total float (TF) for each activity.
         g) Predecessor activities.
         h) Successor activities.
         i) Cost/budget to complete the work in the activity.
         j) Resources needed to complete the activity.
         k) Bar showing the early start and completion dates of each activity.
      2) The activities will be sorted by area, trades, and subcontractors as agreed on with the Engineer.
      3) Print the CPM time-scaled network diagram on minimum sheet size of 11 IN x 17 IN.
      4) Provide electronic data in accordance with the Early Completion paragraph in the GENERAL REQUIREMENTS Article.
   b. Narrative report:
      1) The Contractor shall provide a Narrative Report along with the CPM time-scaled network diagram that will include the following information:
         a) Executive Summary explaining how the Contractor plans to execute its plan to construct the project.
         b) Assumptions used to develop the schedule.
         c) Constraints included in the schedule as defined by the Contract Documents.
         d) The critical path and near critical path activities with an explanation of why those activities are included on those paths.
         e) Number of planned working days per week including shifts per day.
         f) Manpower plan including craft on site per day.
         g) Production rates assumptions.
         h) Major equipment planned for the project and durations for their use.
         i) Resource constraints.
         j) Identification of unusual conditions or restrictions regarding labor, equipment or material.
         k) Calendar(s) used in the contract and how the multiple calendars are used.
         l) Holidays observed during construction.

D. Schedule Updates Including:
   1. Submittal and Review:
      a. The Contractor shall provide a Schedule Update each month after the Baseline Schedule is completed on the date agreed to at the Pre-Construction Conference.
      b. The Engineer shall provide comments to the Contractor on the Schedule Update.
      c. The Contractor shall incorporate the Engineer comments into the next Schedule Update.
2. CPM time-scaled network diagram as described for the Baseline Schedule:
   a. Do not change the description of an activity number.
      1) Any activity added to the schedule shall have a new unique activity number and
description.
      2) If activities are deleted, the deleted activity number(s) will not be used again.
   b. Provide a narrative report with each Schedule Update detailing the work completed
during the month, any changes to the schedule logic, any changes to activity durations,
any changes to the critical path, and any changes to its assumptions for constructing the
Work, including assumed constraints included in the schedule as defined by the
Contract Documents, permits, or the Contractor.
   c. Indicate the reasons the Contractor made the changes to logic, durations, and the critical
path.
3. Narrative Schedule Report identifying the following:
   a. Do not change the description of an activity number.
      1) Any activity added to the schedule shall have a new unique activity number and
description.
      2) If activities are deleted, the deleted activity number(s) will not be used again.
   b. Provide a narrative report with each Schedule Update detailing the work completed
during the month, any changes to the schedule logic, any changes to activity durations,
any changes to the critical path, and any changes to its assumptions for constructing the
Work, including assumed constraints included in the schedule as defined by the
Contract Documents, permits, or the Contractor.
   c. Indicate the reasons the Contractor made the changes to logic, durations, and the critical
path.
4. Revised Baseline Schedule:
   a. Provide a Revised Baseline Schedule to reflect approved Change Orders as requested
by the Engineer.
   1) Submit with ten (10) working days
   b. Activities will be added or the durations modified to reflect the work approved in
Change Orders.
   c. The Engineer will review and provide comments to the Contractor on the Revised
Baseline Schedule within five (5) working days.
   d. Incorporate the Engineer comments into the Revised Baseline Schedule.
   e. After acceptance by the Engineer, the Revised Baseline Schedule, use for future
Schedule Updates.
5. Recovery Schedule:
   a. When the activities on the critical path or the completion milestones appear to be fifteen
(15) working days beyond the contract time, the Engineer may request and the Contractor
shall provide a Recovery Schedule demonstrating how the Contractor will recover the lost
time so that the Work will be completed within the Contract Time.
   b. Provide the Recovery schedule within ten (10) working days after requested by the
Engineer.
   c. Activities will be added or the durations modified to reflect the changes to the work.
   d. The Engineer will review and provide comments to the Contractor on the Recovery
Schedule within five (5) working days.
   e. Incorporate the Engineer comments into the Recovery Schedule.
   f. After acceptance by the Engineer use the Recovery Schedule for future Schedule Updates.
   g. CPM time-scaled network diagram as described for the Baseline Schedule:
      1) Any activity added to the schedule shall have a new activity number and
description.
      2) If activities are deleted, the deleted activity number(s) will not be used again.
6. Provide a narrative with an explanation of the changes in logic, duration of activities.
1.5 GENERAL REQUIREMENTS

A. Prepare and submit construction progress schedules as specified herein.

1. Develop and maintain Baseline, Updates and Recovery schedules using Primavera P3, P6, or Constructor by Primavera Systems, unless approved by the Engineer.

a. Scheduling Software Features:
   1) The following specific features are not allowed to be applied in the Baseline and Record Schedules:
      a) Resource leveling.
      b) Activity or event constraints, other than those specified by the Contract Documents.
   2) Durations shall have positive values.

b. Default progress data:
   1) Start and finish dates shall not be automatically updated.
   2) Update with actual start and finish dates documented from field reports.
   3) Update work activities by actual Work progression, not cash flow driven.
   4) Updating of activity percent complete and remaining duration shall be independent functions, not one parameter calculated from the other.
   5) Out-of-sequence progress shall be accounted for through retained logic, not a default option of progress override.

2. Include the following information:
   a. Construction start dates (Notice to Proceed date).
   b. Procurement activities.
   c. Preparation of key submittals for materials and equipment.
   d. Engineers review and approval of key submittals.
   e. Material and equipment fabrication lead times.
   f. Material and equipment deliveries for Contractor, Owner and third parties.
   g. Water curing of concrete after placement for all structures
   h. Shutdowns.
   i. Utility tie-ins.
   j. Plant tie-ins.
   k. Traffic changes and closers.
   l. Inspections and hold points.
   m. Start-up of equipment.
   n. Testing of equipment and systems.
   o. Commissioning.
   p. Contract milestones:
      1) Intermediate milestones.
      2) Substantial Completion Date.
      3) Physical Completion Date.
   q. Costs for each activity.
   r. Resources: Number of craft per day (not crews per day) for each activity and construction equipment planned for each activity.

3. Do not utilize any float suppression techniques or other software features that effect the pure mathematical model calculating the critical path.

4. The following CPM schedule outputs will be rejected without further review:
   a. Schedules indicating the start of the critical path at a date point or activity beyond the date of Notice to Proceed, or schedules indicating a discontinuous critical path from Notice to Proceed to Contract completion.
   b. Schedules defining critical activities as those on a path or paths having some minimum value of float.
   c. Schedules with multiple critical paths.
   d. Schedules indicating a completion date beyond the contractual completion date.
B. The number of activities shall be sufficient to assure adequate planning of the project, to permit monitoring and evaluation of progress, and to do an analysis of time impacts.

1. Work activities shall not exceed durations of 10 days or 2 weeks.
   a. Procurement and fabrication activity durations may exceed 10 days or 2 weeks.

2. Schedule activities shall include the following:
   a. A clear and legible description.
   b. At least one (1) predecessor and one (1) successor activity, except for project start and finish milestones.

C. Early Completion Schedule:

1. Contractor may show early completion time on any schedule provided that the requirements of the contract are met.
2. Contractor may increase early completion time by improving production, reallocating resources to be more efficient, performing sequential activities concurrently or by completing activities earlier than planned.
3. Any time between the Contractor’s early completion and the Contract Time will be considered float.

D. Plan working durations to incorporate the effects of normal weather impacts.

E. Float:
   1. The project owns the float, therefore neither the Owner nor the Contractor has exclusive use of the float; the float can be used by either party.
   2. Once float is used, liability for delay of the project completion date rests with the party actually causing delay to the project completion date.

1.6 START-UP, DEMONSTRATION, TRAINING, AND FINAL COMPLETION

A. The Baseline Schedule must include broad-based activities for start-up, operator training, and final completion.

1. The Baseline Schedule may not necessarily contain sufficient detail on all activities listed in Specification Section 01 75 00 for start-up and demonstration.
2. At least 90 days prior to any activities, submit a detailed schedule in conformance with the requirements of Specification Section 01 75 00:
   a. Identify task for the substantial completion notification.
   b. Pre-demonstration period:
      1) Identify equipment start-up for all major equipment.
      2) Identify all operator trainings required by individual Specification Sections.
   c. Demonstration period: Identify for each project classified system.

1.7 CONSTRUCTION SCHEDULING MEETINGS

A. The Contractor and Engineer will participate in a pre-construction scheduling meeting.

1. The meeting shall occur within ten (10) working days after Execution of the Contract.
2. The Contractor’s Project Manager, Superintendent(s), Scheduler and other key personnel shall attend the pre-construction scheduling meeting.
3. The pre-construction scheduling meeting will review the requirements of this Specification Section and other specified scheduling and sequencing requirements defined in the Contract Documents.

B. The Contractor shall meet with the Engineer monthly to review the CPM schedule.

1. The meeting agenda will include review of changes made since the previous schedule submittal and Engineer comments.

1.8 TIME IMPACT ANALYSIS (TIA)

A. The Contractor shall provide a TIA to support all requests for increases to the Contract Time.
B. The Contractor shall use the Current Schedule to develop the TIA.
   1. The TIA must be attached to any change order proposal prior to approval of any change to
time or cost when requesting additional time.
   2. Contractor shall submit a written narrative report to the Engineer with each request for
adjustment to the Contract Time, or when Contractor or Engineer consider that an approved
or anticipated change may impact the critical path or progress of the work.
      a. Include a description of delaying factors and their impact with an explanation of
corrective actions taken or proposed.
      b. The TIA shall illustrate the impacts of each change or delay on the current scheduled
completion date or internal milestone, as appropriate.
      c. The analysis shall use the schedule that has a data date closest to and prior to the event
or change.
      d. The analysis shall identify the activities on the critical path prior to the event or change,
the activities added or extended as a result of the event or change, and the impact of
those changes on the critical path activities.
      e. The analysis shall identify the impacts that the Contractor attributed to the change or
Owner, those impacts that are the result of the Contractor’s actions and those impacts
that are considered concurrent.
      f. If the impact schedule shows that incorporating the event modifies the critical path and
scheduled completion date of the accepted CPM Schedule, the difference between
scheduled completion dates of the two (2) schedules shall be equal to the adjustment of
Contract Time.

C. Contractor shall submit a TIA within fifteen (15) working days of receiving a written request for
   a TIA from the Engineer or after the event.
   1. Contractor shall allow the Engineer thirty (30) days after receipt to approve or reject the
submitted TIA.
   2. All approved TIA schedule changes shall be shown on the next Schedule Update.

D. Rejections of a TIA:
   1. If a TIA submitted by the Contractor is rejected by the Engineer, the Contractor shall meet
with the Engineer to discuss and resolve issues related to the TIA.
   2. If agreement is not reached, the Contractor will be allowed ten (10) working days from the
meeting with the Engineer to give notice.
   3. The Engineer will withhold a portion of the progress payment if a TIA is requested by
Engineer and not submitted by Contractor within fifteen (15) working days.
   4. The payment will resume on the next estimate after the requested TIA is submitted and
accepted by the Engineer.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mechanics and administration of the submittal process for:
      a. Shop Drawings.
      b. Samples.
      c. Informational submittals.
   2. General content requirements for Shop Drawings.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Construction Progress Schedule submittal requirements are specified in Specification Section 01 32 16.
   4. Operations and Maintenance Manual submittal requirements are specified in Specification Section 01 33 04.
   5. Technical Specification Sections identifying required submittals.

1.2 DEFINITIONS

A. Shop Drawings:
   1. See General Conditions.
   2. Product data and samples are Shop Drawing information.

B. Informational Submittals:
   1. Submittals other than Shop Drawings and samples required by the Contract Documents that do not require review and/or approval by the Engineer.
   2. Representative types of informational submittal items include but are not limited to:
      a. HVAC test and balance reports.
      b. Installed equipment and systems performance test reports.
      c. Manufacturer's installation certification letters.
      d. Instrumentation and control commissioning reports.
      e. Warranties.
      f. Service agreements.
      g. Construction photographs.
      h. Survey data.
      i. Health and Safety Plans.
      j. Work Plans.
      k. Delegated designs per performance specification requirements
   3. For-Information-Only submittals upon which the Engineer is not expected to conduct review or take responsive action may be so identified in the Contract Documents.

1.3 SUBMITTAL SCHEDULE

A. Schedule of Shop Drawings:
   1. Submitted and approved within 30 days of receipt of Notice to Proceed.
   2. Account for multiple transmittals under any specification section where partial submittals will be transmitted.

B. Shop Drawings: Submittal and approval prior to 30 PCT completion of project.
C. Informational Submittals:
   1. Reports and installation certifications submitted within seven (7) days of conducting testing, installation, or examination.
   2. Submittals showing compliance with required qualifications submitted twenty (20) days prior to any work beginning using the subject qualifications.

D. The submittal schedule shall include the following columns as a minimum:

<table>
<thead>
<tr>
<th>Submittal Section</th>
<th>Submittal Description</th>
<th>Planned Submittal Date</th>
<th>Submittal Need Date</th>
<th>Actual Submittal Date</th>
<th>Actual Return Date</th>
<th>Disposition</th>
</tr>
</thead>
</table>

1.4 PREPARATION OF SUBMITTALS

A. General:
   1. All submittals and all pages of all copies of a submittal shall be completely legible.
   2. Submittals which, in the Engineer's sole opinion, are illegible will be returned without review.
   3. Minimize extraneous information for equipment and products not relevant to the submittal.
   4. Contractors or vendors written comments on the submittal drawings shall be in green

B. Shop Drawings, Product Data, and Samples:
   1. Scope of any submittal and letter of transmittal:
      a. Limited to one (1) Specification Section.
      b. Submittals with more than one Specification section included will be rejected.
      c. Do not submit under any Specification Section entitled (in part) "Basic Requirements" unless the product or material submitted is specified, in total, in a "Basic Requirements" Specification Section.
   2. Numbering letter of transmittal:
      a. Include as prefix the Specification Section number followed by a series number, "-xx", beginning with "01" and increasing sequentially with each additional transmittal for that Specification Section.
      b. If more than one (1) submittal under any Specification Section, assign consecutive series numbers to subsequent transmittal letters.
   3. Describing transmittal contents:
      a. Provide listing of each component or item in submittal capable of receiving an independent review action.
      b. Identify for each item:
         1) Manufacturer and Manufacturer's Drawing or data number.
         2) Contract Document tag number(s).
         3) Contract Drawing Section or detail number if appropriate.
         4) Specification Section Article/Paragraph number if appropriate.
         5) Unique page numbers for each page of each separate item.
      c. When submitting "or-equal" items that are not the products of named manufacturers, include the words "or-equal" in the item description.
   4. Contractor certification of review and approval:
      a. Contractor's review and approval certification stamp shall be applied either to the letter of transmittal or a separate sheet preceding each independent item in the submittal.
      1) Stamp may be either a wet ink stamp or electronically embedded.
      2) Clearly identify the person who reviewed the submittal and the date it was reviewed.
      3) Shop Drawing submittal stamp shall read "(Contractor's Name) has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval as stipulated in the General Conditions."
      or

HDR Project # 10045587
City of Fremont, Nebraska
Egg-Shaped Anaerobic Digester - ESAD -
SUBMITTALS
01 33 00 - 2
b. Contractor shall execute Exhibit AA, Contractor's Submittal Certification form, to indicate Contractor has reviewed and approved the submittal contents.
   1) Clearly identify the person who reviewed the submittal and the date it was reviewed.

c. Submittals containing multiple independent items shall be prepared with each item listed on the letter of transmittal or on an index sheet for all items listing the discrete page numbers for each page of each item, which shall be stamped with the Contractor's review and approval stamp.
   1) Each independent item shall have a cover sheet with the transmittal number and item number recorded.
      a) Provide clear space of 3 IN SQ for Engineer stamping.
   2) Individual pages or sheets of independent items shall be numbered in a manner that permits the entire contents of a particular item to be readily recognized and associated with Contractor's certification.

5. Resubmittals:
   a. Number with original Specification Section and series number with a suffix letter starting with "A" on a (new) duplicate transmittal form.
   b. Do not increase the scope of any prior transmittal.
   c. Provide cover letter indicating how each "B", "C", or "D" Action from previous submittal was addressed and where the correction is found in the resubmittal.
   d. Account for all components of prior transmittal.
      1) If items in prior transmittal received "A" or "B" Action code, list them and indicate "A" or "B" as appropriate.
         a) Do not include submittal information for items listed with prior "A" or "B" Action in resubmittal.
      2) Indicate "Outstanding-To Be Resubmitted At a Later Date" for any prior "C" or "D" Action item not included in resubmittal.
         a) Obtain Engineer's approval to exclude items.

6. Contractor shall not use red color for marks on transmittals.
   a. Duplicate all marks on all copies transmitted, and ensure marks are photocopy reproducible.
   b. Engineer will use red marks or enclose marks in a cloud.

7. Transmittal contents:
   a. Coordinate and identify Shop Drawing contents so that all items can be easily verified by the Engineer.
   b. Provide submittal information or marks defining specific equipment or materials utilized on the Project.
      1) Generalized product information, not clearly defining specific equipment or materials to be provided, will be rejected.
   c. Identify equipment or material project use, tag number, Drawing detail reference, weight, and other Project specific information.
   d. Provide sufficient information together with technical cuts and technical data to allow an evaluation to be made to determine that the item submitted is in compliance with the Contract Documents.
   e. Do not modify the manufacturer's documentation or data except as specified herein.
   f. Indicate exact item or model and all options proposed by arrow and leader.
   g. When a Shop Drawing submittal is called for in any Specification Section, include as appropriate, scaled details, sizes, dimensions, performance characteristics, capacities, test data, anchoring details, installation instructions, storage and handling instructions, color charts, layout Drawings, rough-in diagrams, wiring diagrams, controls, weights and other pertinent data in addition to information specifically stipulated in the Specification Section.
      1) Arrange data and performance information in format similar to that provided in Contract Documents.
      2) Provide, at minimum, the detail specified in the Contract Documents.
h. If proposed equipment or materials deviate from the Contract Drawings or Specifications in any way, clearly note the deviation and justify the said deviation in detail in a separate letter immediately following transmittal sheet. Any deviation from Plans or Specifications not depicted in the submittal or included but not clearly noted by the Contractor may not have been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility for any error or deviation from contract requirements.

8. Samples:
a. Identification:
   1) Identify sample as to transmittal number, manufacturer, item, use, type, project designation, tag number, Specification Section or Drawing detail reference, color, range, texture, finish and other pertinent data.
   2) If identifying information cannot be marked directly on sample without defacing or adversely altering samples, provide a durable tag with identifying information securely attached to the sample.
b. Include application specific brochures, and installation instructions.
c. Provide Contractor's review and approval certification stamp or Contractor's Submittal Certification form as indication of Contractor's checking and verification of dimensions and coordination with interrelated work.
d. Resubmit revised samples of rejected items.

C. Informational Submittals:
   1. Prepare in the format and detail specified in Specification requiring the informational submittal.

1.5 TRANSMITTAL OF SUBMITTALS

A. Shop Drawings and Samples:
   1. Transmit all submittals to:
      HDR
      8404 Indian Hill Drive
      Omaha, NE  68114
      Attn: Mr. Scott Anderson

   2. Utilize attached Exhibit A to transmit all Shop Drawings and samples.
   3. All submittals must be from Contractor.
      a. Submittals will not be received from or returned to subcontractors.

B. Informational Submittals:
   1. Transmit under Contractor's standard letter of transmittal or letterhead.
   2. Submit in triplicate or as specified in individual Specification Section.
   3. Transmit to:
      HDR
      8404 Indian Hill Drive
      Omaha, NE  68114
      Attn: Mr. Eric Berggren, P.E.

C. Electronic Transmission of Submittals:
   1. Transmittals shall be made electronically.
      a. Use HDR's Project Tracker Collaboration System (PTCS).
      b. Protocols and processes will be determined at the Pre-Construction Conference.
   3. Do not password protect or lock the PDF document.
4. Drawings or other graphics must be converted to PDF file format from the original drawing file format and made part of the PDF document.
   a. Scanning of Drawings is to be used only where actual file conversion is not possible and Drawings must be scanned at a resolution of 300 DPI or greater.
   b. Required signatures may be applied prior to scanning for transmittal.
5. Electronic Drawings shall be formatted to be at full-scale (or half-scale when printed to 11 x 17 IN).
   a. Do not reduce Drawings by more than 50 PCT in size.
   b. Reduced Drawings shall be clearly marked "HALF-SIZE" and shall scale accurately at that size.
6. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is opened the sheet is in the appropriate position for viewing.
7. Create bookmarks in the bookmarks panel for the cover, the Table of Contents, and each major section of the document.
8. Using Adobe Acrobat Standard or Adobe Acrobat Professional, set the PDF document properties, initial view as follows:
   a. Select File \(\rightarrow\) Properties \(\rightarrow\) Initial View.
   d. Select the Magnification: Fit Page.
   e. Select Open to page: 1.
   f. Set the file to open to the cover page with bookmarks to the left, and the first bookmark linked to the cover page.
9. Set the PDF file "Fast Web View" option to open the first several pages of the document while the rest of the document continues to load.
   a. To do this:
      1) Select Edit \(\rightarrow\) Preferences \(\rightarrow\) Documents \(\rightarrow\) Save Settings.
      2) Check the Save As optimizes for Fast Web View box.
10. File naming conventions:
   a. File names shall use a "ten dot three" convention (XXXXXX-YY-Z.PDF) where XXXXXXX is the Specification Section number, YY is the Shop Drawing Root number and Z is an ID number used to designate the associated volume.
11. Labeling:
   a. As a minimum, include the following labeling on all CD-ROM discs and jewel cases:
      1) Project Name.
      2) Equipment Name and Project Tag Number.
      3) Project Specification Section.
      4) Manufacturer Name.
      5) Vendor Name.
12. Binding:
   a. Include labeled CD(s) in labeled jewel case(s).
      1) Bind jewel cases in standard three-ring binder Jewel Case Page(s), inserted at the front of the Final paper copy submittal.
      2) Jewel Case Page(s) to have means for securing Jewel Case(s) to prevent loss (e.g., flap and strap).

1.6 ENGINEER'S REVIEW ACTION

A. Shop Drawings and Samples:
   1. Items within transmittals will be reviewed for overall design intent and will receive one (1) of the following actions:
      a. A - FURNISH AS SUBMITTED.
      b. B - FURNISH AS NOTED (BY ENGINEER).
      c. C - REVISE AND RESUBMIT.
      d. D - REJECTED.
      e. E - ENGINEER'S REVIEW NOT REQUIRED.
2. Submittals received will be initially reviewed to ascertain inclusion of Contractor's approval stamp.
   a. Submittals not stamped by the Contractor or stamped with a stamp containing language other than that specified herein will not be reviewed for technical content and will be returned rejected.

3. In relying on the representation on the Contractor’s review and approval stamp, Owner and Engineer reserve the right to review and process poorly organized and poorly described submittals as follows:
   a. Submittals transmitted with a description identifying a single item and found to contain multiple independent items:
      1) Review and approval will be limited to the single item described on the transmittal letter.
      2) Other items identified in the submittal will:
          a) Not be logged as received by the Engineer.
          b) Be removed from the submittal package and returned without review and comment to the Contractor for coordination, description and stamping.
          c) Be submitted by the Contractor as a new series number, not as a re-submittal number.
   b. Engineer, at Engineer’s discretion, may revise the transmittal letter item list and descriptions, and conduct review.
      1) Unless Contractor notifies Engineer in writing that the Engineer’s revision of the transmittal letter item list and descriptions was in error, Contractor’s review and approval stamp will be deemed to have applied to the entire contents of the submittal package.

4. Submittals returned with Action "A" or "B" are considered ready for fabrication and installation.
   a. If for any reason a submittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal.
   b. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.

5. Submittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:
   a. The portion of the submittal given "C" or "D" will not be distributed for construction.
   b. Items marked "A" or "B" will be fully distributed.
   c. If a portion of the items or system proposed are acceptable, however, the major part of the individual Drawings or documents are incomplete or require revision, the entire submittal may be given "C" or "D" Action.
      1) This is at the sole discretion of the Engineer.
      2) In this case, some Drawings may contain relatively few or no comments or the statement, "Resubmit to maintain a complete package."

6. Failure to include any specific information specified under the submittal paragraphs of the Specifications will result in the submittal being returned to the Contractor with "C" or "D" Action.

7. Calculations required in individual Specification Sections will be received for information purposes only, as evidence calculations have been stamped by the professional as defined in the specifications and for limited purpose of checking conformance with given performance and design criteria. The Engineer is not responsible for checking the accuracy of the calculations and the calculations will be returned stamped "E. Engineer's Review Not Required" to acknowledge receipt.

8. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than two submittals. Engineer will record Engineer’s time for reviewing a third or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer’s charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
9. Transmittals of submittals which the Engineer considers as "Not Required" submittal information, which is supplemental to but not essential to prior submitted information, or items of information in a transmittal which have been reviewed and received "A" or "B" action in a prior submittal, will be returned with action "E. Engineer's Review Not Required."

10. Samples may be retained for comparison purposes.
    a. Remove samples when directed.
    b. Include in bid all costs of furnishing and removing samples.

11. Approved samples submitted or constructed, constitute criteria for judging completed work.
    a. Finished work or items not equal to samples will be rejected.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION
### EXHIBIT A  Shop Drawing Transmittal

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Mfr/Vendor Dwg or Data No.</th>
<th>Action Taken*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>C - Revise and Submit</td>
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<td>2. Supplemental Information. Submittal retained for informational purposes only.</td>
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<td>3. Information reviewed and approved on prior submittal.</td>
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<td>5. Delegated Design - Submittal received as requested by the Contractor Documents. The Engineer did not review the engineering or technical content of the submittal.</td>
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</tbody>
</table>

* The Action designated above is in accordance with the following legend:

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. Any deviation from plans or specifications not depicted in the submittal or included but not clearly noted by the Contractor may not have been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility for any error or deviation from contract requirements.

### Remarks:

By [Date]

### Distribution:

- Contractor
- File
- Field
- Owner
- Other

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EXHIBIT AA  Contractor's Submittal Certification

Shop Drawing Transmittal No.: ____________________________________________

Contract/Project Name: ________________________________________________

Company Name: _______________________________________________________

has

1. reviewed and coordinated this Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

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

3. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

4. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

☐ This Submittal does not contain any variations from the requirements of the Contract Documents.

☐ This Submittal does contain variations from the requirements of the Contract Documents. A separate description of said variations and a justification for them is provided in an attachment hereto identified as:

“Shop Drawing Transmittal No. ____________________________ Variation and Justification Documentation”

Insert picture file or electronic signature of Authorized Representative

Authorized Representative ___________________________ Date

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PART 1 - GENERAL

1.1 SUMMARY
A. Section includes administration of the submittal process for Operation and Maintenance Manuals and content requirements for Operation and Maintenance Manuals.

1.2 DEFINITIONS
A. Equipment Operation and Maintenance Manuals:
   1. Contain the technical information required for proper installation, operation and maintenance of process, electrical and mechanical equipment and systems.

B. Building Materials and Finishes Operation and Maintenance Manuals:
   1. Contain the information required for proper installation and maintenance of building materials and finishes.

1.3 SUBMITTALS
A. List of all the Operation and Maintenance Manuals required by the Contract as identified in the Technical Specification Sections. These may be referred to as "Operation and Maintenance Data" submittals.

B. Operation and Maintenance Manuals:
   1. Draft and final electronic copies.
   2. Final paper copies: Two (2).

1.4 SUBMITTAL SCHEDULE
A. List of Required Operation and Maintenance Manuals:
   1. Submit list with Specification Section number and title within 60 days after receipt of Notice to Proceed.

B. Draft Operation and Maintenance Manuals:
   1. Submit approvable draft manuals in electronic format (PDF) within 30 days following approval of the respective Shop Drawing.
      a. Include placeholders or fly sheet pages where information is not final or is missing from the draft manual.
   2. All Draft Operation and Maintenance Manuals shall be received by no later than 50 percent project completion.

C. Final Operation and Maintenance Manuals:
   1. Final approval of Operation and Maintenance Manuals in electronic format (PDF) must be obtained 45 days prior to equipment start-up.
   2. Provide paper copies and CD-ROMs of approved final Operation and Maintenance Manuals in electronic format (PDF), a minimum of 30 days prior to equipment start-up.
   3. Issue both electronic and paper copies of addenda to Final Approved Operation and Maintenance Manual to include:
      a. Equipment data that requires collection after start-up, for example but not limited to HVAC balancing reports, electrical switchgear, automatic transfer switch and circuit breaker settings.
      b. Equipment field testing data.
      c. Equipment start-up reports.
1.5 PREPARATION OF SUBMITTALS

A. General:
   1. All pages of the Operation and Maintenance Manual submittal shall be legible.
      a. Submittals which, in the Engineer’s sole opinion, are illegible will be rejected without
         review.
   2. Identify each equipment item in a manner consistent with names and identification numbers
      used in the Contract Documents, not the manufacturer’s catalog numbers.
   3. Neatly type any data not furnished in printed form.
   4. Operation and Maintenance Manuals are provided for Owner's use, to be reproduced and
      distributed as training and reference materials within Owner's organization.
      a. This requirement is:
         1) Applicable to both paper copy and electronic files.
         2) Applicable to materials containing copyright notice as well as those with no
            copyright notice.
   5. Notify supplier and/or manufacturer of the intended use of Operations and Maintenance
      Manuals provided under the Contract.

B. Operation and Maintenance Manual Format and Delivery:
   1. Draft electronic submittals:
      b. Create one (1) PDF file for each equipment Operation and Maintenance Manual.
      c. Do not password protect or lock the PDF document.
      d. Scanned images of paper documents are not acceptable. Create the Operation and
         Maintenance Manual PDF file from the original source document.
      e. Drawings or other graphics must be converted to PDF file format from the original
         drawing file format and made part of the PDF document.
      f. Scanning of Drawings is to be used only where actual file conversion is not possible
         and Drawings must be scanned at a resolution of 300 dpi or greater.
      g. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is
         opened the sheet is in the appropriate position for viewing.
      h. Create bookmarks in the bookmarks panel for the Operation and Maintenance Manual
         cover, the Table of Contents and each major section of the Table of Contents.
      i. Using Adobe Acrobat Standard or Adobe Acrobat Professional, set the PDF document
         properties, initial view as follows:
            1) Select File ➔ Properties ➔ Initial View.
            2) Select the Navigation tab: Bookmarks Panel and Page.
            3) Select the Page layout: Single Page Continuous.
            4) Select the Magnification: Fit Page.
            5) Select Open to page: 1.
            6) Set the file to open to the cover page of the manual with bookmarks to the left, and
               the first bookmark linked to the cover page.
            7) Window Options: Check the "Resize window to initial page" box.
      j. Set the PDF file "Fast Web View" option to open the first several pages of the
         document while the rest of the document continues to load.
         1) To do this:
            a) Select Edit ➔ Preferences ➔ Documents ➔ Save Settings.
            b) Check the "Save As optimizes for Fast Web View" box.
      k. PDF file naming convention:
         1) Use the Specification Section number, the manufacturer’s name and the equipment
            description, separated by underscores.
         2) Example: 46 51 21_Sanitaire_Coarse_Bubble_Diffusers.pdf.
         3) Do not put spaces in the file name.
   2. Final electronic submittals:
      a. Submit two (2) copies in PDF file format on two (2) CD-ROM discs (one (1) copy per
         CD-ROM), each secured in a jewel case.
b. CD-ROM Labeling:
   1) Provide the following printed labeling on all CD-ROM discs:
      a) Project name.
      b) Specification Section.
      c) Equipment names and summary of tag(s) covered.
      d) Manufacturer name.
      e) Date (month, year).

c. CD-ROM Jewel Case Holder:
   1) Insert jewel cases containing labeled CD-ROM discs in three-ring binder holder (C-Line Products, www.c-lineproducts.com stock number CLI-61968 or equivalent) at the front of each final paper copy.

3. Final paper copy submittals:
   a. Quantity: Provide two (2) copies.
   b. Paper: 8.5 x 11 IN or 11 x 17 IN bright white, 20 LB paper with standard three-hole punching.
   c. 3-Ring Binder:
      1) Provide D-ring binder with clear vinyl sleeves (i.e. view binder) on front and spine.
      2) Insert binder title sheet with the following information under the front and spine sleeves:
         a) Project name.
         b) Specification Section.
         c) Equipment names and summary of tag(s) covered.
         d) Manufacturer name.
         e) Date (month, year).
      3) Provide plastic sheet lifters prior to first page and following last page.
   d. Drawings:
      1) Provide all Drawings at 11 x 17 IN size, triple folded and three-hole punched for insertion into manual.
      2) Where reduction is not practical to ensure readability, fold larger Drawings separately and place in three-hole punched vinyl envelopes inserted into the binder.
      3) Identify vinyl envelopes with Drawing numbers.
   e. Use plastic coated dividers to tab each section of each manual in accordance with the Table of Contents.

C. Equipment Operation and Maintenance Manual Content:
1. Provide a cover page as the first page of each manual with the following information:
   a. Manufacturer(s) Name and Contact Information.
   b. Vendor’s Name and Contact Information.
   c. Date (month, year).
   d. Project Owner and Project Name.
   e. Specification Section.
   f. Project Equipment Tag Numbers.
   g. Model Numbers.
   h. Engineer’s Name.
   i. Contractor’s Name.
2. Provide a Table of Contents for each manual.
3. Provide Equipment Record sheets as follows:
   a. Printed copies of the Equipment Record (Exhibits B1, B2 and B3), as the first tab following the Table of Contents.
   b. Exhibits B1-B3 are available as Fillable PDF Form documents from the Engineer.
   c. Each section of the Equipment Record must be completed in detail; simply referencing the related equipment Operation and Maintenance Manual sections for nameplate, maintenance, spare parts or lubricant information is not acceptable.
   d. For equipment involving separate components (for example, a motor and gearbox), a fully completed Equipment Record is required for each component.
e. Submittals that do not include the Equipment Record(s) will be rejected without further content review.

4. Provide a printed copy of the Manufacturer’s Field Services report as required by Specification Section 01 75 00 following the Equipment Record sheets.

5. Provide the following detailed information, as applicable:
   a. Use equipment tag numbers from the Contract Documents to identify equipment and system components.
   b. Equipment function, normal and limiting operating characteristics.
   c. Instructions for assembly, disassembly, installation, alignment, adjustment, and inspection.
   d. Operating instructions for start-up, normal operation, control, shutdown, and emergency conditions.
   e. Lubrication and maintenance instructions.
   f. Troubleshooting guide.
   g. Mark each sheet to clearly identify specific products and component parts and data applicable to the installation for the Project; delete or cross out information that does not specifically apply to the Project.
   h. Parts lists:
      1) A parts list and identification number of each component part of the equipment.
      2) Exploded view or plan and section views of the equipment with a detailed parts callout matching the parts list.
      3) A list of recommended spare parts.
      4) List of spare parts provided as specified in the associated Specification Section.
      5) A list of any special storage precautions which may be required for all spare parts.
   i. General arrangement, cross-section, and Assembly Drawings.
   j. Electrical diagrams, including elementary diagrams, wiring diagrams, connection diagrams, and interconnection diagrams.
   k. Test data and performance curves.
   l. As-constructed fabrication or Layout Drawings and wiring diagrams.
   m. Copy of the equipment manufacturer’s warranty meeting the requirements of the Contract.
   n. Copy of any service contracts provided for the specific piece of equipment as part of the Contract.

6. Additional information as required in the associated equipment or system Specification Section.

D. Building Materials and Finishes Operation and Maintenance Manual Content:

1. Provide a cover page as the first page of each manual with the following information:
   a. Manufacturer(s) Name and Contact Information.
   b. Vendor’s Name and Contact Information.
   c. Date (month, year).
   d. Project Owner and Project Name.
   e. Specification Section.
   f. Model Numbers.
   g. Engineer’s Name.
   h. Contractor’s Name.

2. Provide a Table of Contents for each manual.

3. Building products, applied materials and finishes:
   a. Include product data, with catalog number, size, composition and color and texture designations.
   b. Provide information for ordering custom manufactured products.

4. Necessary precautions:
   a. Include product MSDS for each approved product.
   b. Include any precautionary application and storage guidelines.
5. Instructions for care and maintenance:
   a. Include manufacturer's recommendations for cleaning agents and methods, precautions
      against detrimental agents and methods and recommended schedule for cleaning and
      maintenance.
6. Moisture protection and weather exposed products:
   a. Include product data listing, applicable reference standards, chemical composition, and
      details of installation.
   b. Provide recommendations for inspections, maintenance and repair.
7. Additional requirements as specified in individual product specifications.

1.6 TRANSMITTAL OF SUBMITTALS

A. Operation and Maintenance Manuals:
   1. Submit draft Operation and Maintenance Manual in electronic format (PDF) using HDR’s
      Project Tracker Collaboration System (PTCS) to Engineer until manual is approved.
   2. Transmit final electronic and final paper copy submittals to the address specified in
      Specification Section 01 33 00 – Submittals.
   3. Use Operation and Maintenance Manual Transmittal Form, Exhibit A.
   4. Transmittal numbering:
      a. Number each submittal with the Specification Section number followed by a series
         number beginning with ".01" and increasing sequentially with each additional
         transmittal, followed by ".OM" (for example: 43 23 14-01-OM).

1.7 ENGINEER'S REVIEW ACTION

A. Draft Electronic (PDF) Submittals:
   1. Engineer will review and indicate one of the following review actions:
      a. A - ACCEPTABLE
      b. B - FURNISH AS NOTED
      c. C - REVISE AND RESUBMIT
      d. D - REJECTED
   2. Submittals marked as Acceptable or Furnish as Noted will be retained; however, the
      transmittal form will be returned with a request for the final paper and electronic documents
      to be submitted.
   3. Copies of submittals marked as Revise and Resubmit or Rejected will be returned with the
      transmittal form marked to indicate deficient areas.
   4. Resubmit until approved.

B. Final Paper Copy Submittals:
   1. Engineer will review and indicate one (1) of the following review actions:
      a. A - ACCEPTABLE
      b. D - REJECTED
   2. Submittals marked as Acceptable will be retained with the transmittal form returned as
      noted.
   3. Submittals marked as Rejected will be returned with the transmittal form marked to indicate
      deficient areas.
   4. Resubmit until approved.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION
**EXHIBIT A** Operation and Maintenance Manual

Transmittal (Spec Section) - OM

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<tr>
<th>No.</th>
<th>Description of Item</th>
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<th>Dwg. or Data No.</th>
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Remarks:


**To:** HDR Engineering, Inc.

**From:**

HDR Engineering, Inc.

**Date:**

* The Action designated above is in accordance with the following legend:

**A** - Acceptable, provide one (1) additional paper copy and two (2) electronic copies on CD-ROM for final review.

**B** - Furnish as Noted - Not Used

**C** - Revise and Resubmit

This Operation and Maintenance Manual Submittal is deficient in the following area:

1. Equipment Records.
2. Functional description.
3. Assembly, disassembly, installation, alignment, adjustment & checkout instructions.
4. Operating instructions.

**D** - Rejected - Not Used

Comments:


Distribution: ESAD | File | Field | Owner | Other

## Equipment Data and Spare Parts Summary

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<tr>
<th>Project Name</th>
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<td>Project Equipment Tag No(s).</td>
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<td>Project/Order No.</td>
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<td>Web Site</td>
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<td>Local Vendor/Service Center</td>
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<td>Address</td>
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<td>Fax</td>
<td>Web Site</td>
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### Mechanical Nameplate Data

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<td>Frame No. HP RPM Cap.</td>
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<td>Size TDH Imp. Sz. CFM PSI Other:</td>
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### Electrical Nameplate Data

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<td>Frame No. HP V. Amp. HZ PH RPM SF Duty Code Ins. Cl. Type NEMA C Amb. Temp. Rise Rating Other:</td>
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### Spare Parts Provided Per Contract

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### Recommended Spare Parts

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## Recommended Maintenance Summary

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<th>Equipment Description</th>
<th>Project Equip. Tag No(s.)</th>
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<th>PM TASK INTERVAL *</th>
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<tr>
<td></td>
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<td>D W M Q S A RT Hours</td>
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**RECOMMENDED BREAK-IN MAINTENANCE (FIRST OIL CHANGES, ETC.)**

**RECOMMENDED PREVENTIVE MAINTENANCE**

* D = Daily  W = Weekly  M = Monthly  Q = Quarterly  S = Semiannual  A = Annual  Hours = Run Time

# Lubrication Summary

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<table>
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SECTION 01 35 05
ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes minimizing the pollution of air, water, or land; control of noise, the disposal of solid waste materials, and protection of deposits of historical or archaeological interest.

1.2 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Prior to the start of any construction activities submit:
      a. A detailed proposal of all methods of control and preventive measures to be utilized for environmental protection.
      b. A drawing of the work area, haul routes, storage areas, access routes and current land conditions including trees and vegetation.
      c. A copy of the approved pollution prevention plan.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION
3.1 INSTALLATION
A. Employ and utilize environmental protection methods, obtain all necessary permits, and fully observe all local, state, and federal regulations.

B. Land Protection:
   1. Except for any work or storage area and access routes specifically assigned for the use of the ESAD System Contractor, the land areas outside the limits of construction shall be preserved in their present condition.
      a. ESAD System Contractor shall confine his construction activities to areas defined for work within the Contract Documents.
   2. Manage and control all borrow areas, work or storage areas, access routes and embankments to prevent sediment from entering nearby water or land adjacent to the work site.
   3. Restore all disturbed areas including borrow and haul areas and establish permanent type of locally adaptable vegetative cover.
   4. Unless earthwork is immediately paved or surfaced, protect all side slopes and backslopes immediately upon completion of final grading.
   5. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.
   6. The ESAD System Contractor shall not deface, injure or destroy trees and vegetation, nor remove, cut, or disturb them without approval of the Engineer.
      a. Any damage caused by the ESAD System Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the ESAD System Contractor's expense.
C. Surface Water Protection:
1. The WWTP contractor shall obtain all local environmental agency permits for storm water
discharges and prepare pollution prevention plan as required. The ESAD System Contractor
shall provide the WWTP contractor all information necessary to obtain and maintain
permits and pollution prevention plans.
2. Erosion control methods around the ESAD shall be installed and maintained by the WWTP
Contractor.

D. Solid Waste Disposal:
1. Collect solid waste on a daily basis.
2. Provide disposal of degradable solid waste to an approved solid waste disposal site.
3. Provide disposal of non-degradable solid waste to an approved solid waste disposal site or
in an alternate manner approved by Engineer and regulatory agencies.
4. No building materials wastes or unused building materials shall be buried, dumped, or
disposed of on the site.

E. Fuel and Chemical Handling:
1. Store and dispose of chemical wastes in a manner approved by regulatory agencies.
2. Take special measures to prevent chemicals, fuels, oils, greases, herbicides, and insecticides
from entering drainage ways.
3. Do not allow water used in onsite material processing, concrete curing, cleanup, and other
waste waters to enter a drainage way(s) or stream.
4. The ESAD System Contractor shall provide containment around fueling and chemical
storage areas to ensure that spills in these areas do not reach waters of the state.

F. Control of Dust:
1. The control of dust shall mean that no construction activity shall take place without
applying all such reasonable measures as may be required to prevent particulate matter from
becoming airborne so that it remains visible beyond the limits of construction.
a. Reasonable measures may include paving, frequent road cleaning, planting vegetative
groundcover, application of water or application of chemical dust suppressants.
b. The use of chemical agents such as calcium chloride must be approved by the Nebraska
Department of Transportation (NDOR).
2. Utilize methods and practices of construction to eliminate dust in full observance of agency
regulations.
3. The Engineer will determine the effectiveness of the dust control program and may request
the ESAD System Contractor to provide additional measures, at no additional cost to
Owner.

G. Burning:
1. Do not burn material on the site.
2. If the ESAD System Contractor elects to dispose of waste materials by burning, make
arrangements for an off-site burning area and conform to all agency regulations.

H. Control of Noise:
1. Control noise by fitting equipment with appropriate mufflers.

I. Completion of Work:
1. Upon completion of work, leave area in a clean, natural looking condition.
2. Ensure all signs of temporary construction and activities incidental to construction of
required permanent work are removed.

J. Historical Protection: See Section 01 30 00.
SECTION 01 61 03
EQUIPMENT: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable stand of quality requirement provided in this Specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

B. Electrical Equipment and Connections Testing Program:
1. Testing firm:
   a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
   b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.

2. Field personnel:
   a. Minimum of one (1) year field experience covering all phases of electrical equipment inspection, testing, and calibration.
   b. Relay test technician having previous experience with testing and calibration of relays of the same manufacturer and type used on project and proficient in setting and testing the types of protection elements used.
   c. Supervisor certified by NETA or NICET.

3. Analysis personnel:
   a. Minimum three (3) years combined field testing and data analysis experience.
   b. Supervisor certified by NETA or NICET.

C. Miscellaneous:
1. A single manufacturer of a "product" shall be selected and utilized uniformly throughout Project even if:
   a. More than one (1) manufacturer is listed for a given "product" in Specifications.
   b. No manufacturer is listed.
2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall fully comply with specific NEC requirements related to area classification and to NEMA 250 and NEMA ICS 6 designations shown on Electrical Power Drawings.

1.3 DEFINITIONS

A. Product: Manufactured materials and equipment.

B. Major Equipment Supports - Supports for Equipment:
1. Located on or suspended from elevated slabs with supported equipment weighing 2000 LBS or greater, or;
2. Located on or suspended from roofs with supported equipment weighing 500 LBS or greater, or;
3. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.

C. Equipment:
1. One (1) or more assemblies capable of performing a complete function.
2. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection.

3. Not limited to items specifically referenced in "Equipment" articles within individual Specifications.

D. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
1. General for all equipment:
   a. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   b. Product technical data including:
      1) Acknowledgement that products submitted meet requirements of the established standard of quality.
   c. Data sheets that include manufacturer's name and complete product model number.
      1) Clearly identify all optional accessories that are included.
   d. Manufacturer's delivery, storage, handling, and installation instructions.
   e. Equipment identification utilizing numbering system and name utilized in Drawings.
   f. Equipment installation details:
      1) Location of anchorage.
      2) Type, size, and materials of construction of anchorage.
      3) Anchorage setting templates.
      4) Manufacturer's installation instructions.
   g. Equipment area classification rating.
   h. Shipping and operating weight.
   i. Equipment physical characteristics:
      1) Dimensions (both horizontal and vertical).
      2) Materials of construction and construction details.
   j. Equipment factory primer and paint data.
   k. Manufacturer's recommended spare parts list.
   l. Equipment lining and coatings.
   m. Equipment utility requirements include air, natural gas, electricity, and water.

2. Mechanical and process equipment:
   a. Operating characteristics:
      1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
      2) Brake horsepower requirements.
      3) Copies of equipment data plates.
   b. Piping and duct connection size, type and location.
   c. Equipment bearing life certification.
   d. Equipment foundation data:
      1) Equipment center of gravity.
      2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.

3. Electric motor:
   a. Motor manufacturer and model number.
   b. Complete motor nameplate data.
   c. Weight.
   d. NEMA design type.
   e. Enclosure type.
   f. Frame size.
   g. Winding insulation class and temperature rise.
h. Starts per hour.

i. Performance data:
   1) Motor speed-torque curve superimposed over driven machine speed-torque curve
during start-up acceleration and at rated terminal voltage a minimum permissible or
specified terminal voltage for all motors over 10HP.
   2) Time-current plots with acceleration versus current and thermal damage curves at
the operating and ambient temperatures and at rated terminal voltage and minimum
permissible or specified terminal voltage for all motors over 10 HP.
   3) Guaranteed minimum efficiencies at 100 percent, 75 percent, and 50 percent of full
load.
   4) Guaranteed minimum power factor at 100 percent, 75 percent, and 50 percent of
full load.
   5) Locked rotor and full load current at rated terminal voltage and minimum
permissible or specified terminal voltage.
   6) Starting, full load, and breakdown torque at rated terminal voltage and minimum
permissible or specified terminal voltage.

j. Bearing data and lubrication system.

k. Thermal protection system including recommended alarm and trip settings for winding
and bearing RTD’s.

l. Fabrication and/or layout Drawings:
   1) Dimensioned outlined Drawing.
   2) Connection diagrams including accessories (strip heaters, thermal protection, etc.).

m. Electrical gear:
   1) Provide voltage, continuous current, kVA, watts, short circuit with stand, etc., as
applicable.
   2) Control panels:
      a) Panel construction.
      b) Point-to-point ladder diagrams.
      c) Scaled panel face and subpanel layout.
      d) Technical product data on panel components.
      e) Panel and subpanel dimensions and weights.
      f) Panel access openings.
      g) Nameplate schedule.
      h) Panel anchorage.

4. Systems schematics and data:
   a. Provide system schematics where required in System Specifications.
      1) Acknowledge all system components being supplied as part of the system.
      2) Utilize equipment, instrument and valving tag numbers defined in the Contract
Documents for all components.
      3) Provide technical data for each system component showing compliance with the
Contract Document requirements.
      4) For piping components, identify all utility connections, vents and drains which will
be included as part of the system.

5. For factory painted equipment, provide paint submittals in accordance with Specification
Section 09 96 00.

6. Qualifications for electrical equipment and connections testing firm and personnel.

7. Equipment Monitoring and Testing plans, in accordance with PART 3 of this Specification
Section:
   a. Electrical equipment and connection testing.

B. Contract Closeout Information:

1. Operation and Maintenance Data:
   a. See Specification Section 01 33 04 for requirements for the mechanics, administration,
      and the content of Operation and Maintenance Manual submittals.
C. Informational Submittals:

1. Sample form letter for equipment field certification.
2. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
3. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
4. Notification, at least one (1) week in advance, that motor testing will be conducted at factory.
5. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
7. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.
8. Preliminary field quality control testing format to be used as a basis for final field quality control reporting.
9. Testing and monitoring reports in accordance with PART 3 of this Specification Section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester-General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Or-equal manufacturers will be considered by the Engineer for approval when Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Motors:
   a. Baldor.
   b. General Electric.
   c. WEG.

2.2 MANUFACTURED UNITS

A. Electric Motors:
   1. Design for frequent starting duty equivalent to duty service required by driven equipment.
   2. Design for full voltage starting.
   3. Design bearing life based upon actual operating load conditions imposed by driven equipment.
   4. Size for altitude of Project.
   5. Furnish with stainless steel nameplates which include all data required by NEC Article 430.
   6. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.
   7. AC electric motors less than 1/3 HP:
      a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
      b. Permanently lubricated sealed bearings conforming to ABMA standards.
      c. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
   8. AC electric motors 1/3 to 1 HP:
      a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
b. Permanently lubricated sealed bearings conforming to ABMA standards.
   1) For single phase motors, provide built-in manual reset thermal protector or
      integrally mounted manual motor starter with thermal overload element.

9. AC electric motors 1-1/2 to 10 HP:
   a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
   b. Permanently lubricated sealed bearings conforming to ABMA standards.
   c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA
      standards.

10. AC electric motors greater than 10 HP:
    a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.
    c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA
       standards.

11. Severe duty motor to have the following minimum features:
    a. All cast iron construction.
    b. Gasketed conduit box.
    c. Epoxy finish for corrosion protection.
    d. Hydroscopic varnish on windings for corrosion protection.
    e. Drain plug and breather.

B. NEMA Design Squirrel Cage Induction Motors:
   1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific
      duty imposed by the driven equipment.
   2. Motors to meet NEMA MG 1 NEMA Premium efficiencies.
   3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard
      for the assigned NEMA code letter.
   4. Design motor insulation in accordance with NEMA standards for Class F insulation with
      Class B temperature rise above a 40 DEGC ambient.
   5. Design motors for continuous duty.
   6. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 PCT
      greater than the maximum HP requirements of the driven equipment over its entire
      operating range.
      a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate
         HP is at least equal to the maximum HP requirements of the driven equipment over its
         entire operating range.
   7. Motor enclosure and winding insulation application:
      a. The following shall apply unless modified by specific Specification Sections:

<table>
<thead>
<tr>
<th>MOTOR LOCATION</th>
<th>MOTOR ENCLOSURE / WINDING INSULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unclassified Indoor Areas</td>
<td>TEFC, Standard Insulation WP-I (for vertical motors)</td>
</tr>
<tr>
<td>Wet indoor Areas</td>
<td>TEFC, Standard Insulation WP-II (for vertical motors)</td>
</tr>
<tr>
<td>Wet outdoor Areas</td>
<td>TEFC, Extra Dip and Bake for Moisture</td>
</tr>
<tr>
<td>Corrosive Areas</td>
<td>TEFC, Severe/ Chemical Duty</td>
</tr>
<tr>
<td>Class I, Division 1 Areas</td>
<td>Explosion Proof, Approved for Class I Division 1 Locations</td>
</tr>
<tr>
<td>Class II, Division 1 Areas</td>
<td>Explosion Proof, Approved for Class II Division 1 Locations</td>
</tr>
<tr>
<td>Class I or Class II, Division 2 Areas</td>
<td>Explosion Proof, Approved for Division 1 Locations or TEFC with maximum external frame temperature compatible with the gas or dust in the area, Extra Dip and Bake for moisture</td>
</tr>
</tbody>
</table>

NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.
8. Provide oversize conduit box complete with clamp type grounding terminals inside the
conduit box.

C. V-Belt Drive:
1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
3. Provide static proof belts.

2.3 COMPONENTS

A. Gear Drives and Drive Components:
1. Size drive equipment capable of supporting full load including losses in speed reducers and
power transmission.
2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to
nameplate horsepower of drive motor.
3. Design drive units for 24 HR continuous service, constructed so oil leakage around shafts is
precluded.
4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and
flexible couplings meeting applicable standards of AGMA.
5. Gear reducers:
   a. Provide gear reducer totally enclosed and oil lubricated.
   b. Utilize antifriction bearings throughout.
   c. Provide worm gear reducers having a service factor of at least 1.20.
   d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a
      service factor of at least 1.50.

2.4 ACCESSORIES

A. Guards:
1. Provide each piece of equipment having exposed moving parts with full length, easily
removable guards, meeting OSHA requirements.
2. Interior applications:
   a. Construct from expanded galvanized steel rolled to conform to shaft or coupling
      surface.
   b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
   c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
3. Exterior applications:
   a. Construct from 16 GA stainless steel or aluminum.
   b. Construct to preclude entrance of rain, snow, or moisture.
   c. Roll to conform to shaft or coupling surface.
   d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Anchorage:
1. Cast-in-place anchorage:
   a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
   b. Configuration and number of anchor bolts shall be per manufacturer's
      recommendations.
   c. Provide two (2) nuts for each bolt.
2. Drilled anchorage:
   a. Adhesive anchors:
      1) Hilti:
         a) HIT RE 500-SD (ICC-ES ESR-2322).
         b) HIT RE 500 V3 (ICC ESR-3814).
   b. Threaded rods same as cast-in-place.

C. Data Plate:
1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
2. Permanently stamp information on data plate including manufacturer’s name, equipment operating parameters, serial number and speed.

D. Gages:
   1. Provide gages in accordance with Specification Section 40 91 10.
   2. Utilize tapping sleeves for mounting per Specification Section 40 05 00.

E. Lifting Eye Bolts or Lugs:
   1. Provide on all equipment 50 LBS or greater.
   2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.

F. Platforms and Ladders:
   1. Design and fabricate in accordance with OSHA Standards.
   2. Fabricate components from aluminum.

2.5 FABRICATION

A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.

B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.

C. Furnish like parts of duplicate units to be interchangeable.

D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.

E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
   1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.

F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer’s standard option.
   1. Provide drain connection for 3/4 IN PVC tubing.

G. Machine the mounting feet of rotating equipment.

H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that can not be properly prepared and painted.
   1. When such back to back fabrication can not be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
   2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Specification Section 07 92 00.

I. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
   1. Manufacturer’s standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.
   2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer’s standard engineered design, unless specific requirements are required in the specific equipment Specification Section.
   3. Affix entire assembly with a UL 508A label "Listed Enclosed Industrial Control Panel" prior to delivery.
      a. Control panels without an affixed UL 508A label shall be rejected.
2.6 SHOP OR FACTORY PAINT FINISHES

A. Electrical Equipment:
   1. Provide factory-applied paint coating system(s) for all electrical equipment.

B. If field paint is selected, paint in accordance with Specification Section 09 96 00.

2.7 SOURCE QUALITY CONTROL

A. Motor Tests:
   1. Test motors in accordance with NEMA and IEEE standards.
   2. Provide routine test for all motors.
   3. The Owner reserves the right to select and have tested, either routine or complete, any motor included in the project.
      a. The Owner will pay all costs, including shipping and handling, for all motors successfully passing the tests.
      b. The Contractor shall pay all costs, including shipping and handling, for all motors failing the tests.
      c. If two (2) successive motors of the same manufacturer fail testing, the Owner has the right to reject all motors from that manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Utilize templates for anchorage placement for slab-mounted equipment.

B. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain.
   1. Route clear of major traffic areas and as approved by Engineer.

C. DO NOT construct foundations until major equipment supports are approved.

D. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings from closest operating floor level.

E. Equipment Base:
   1. Construct level in both directions.
   2. Take particular care at anchor bolt locations so these areas are flat and level.

F. Machine Base:
   1. Mount machine base of rotating equipment on equipment base.
      a. Level in both directions, using a machinist level, according to machined surfaces on base.
   2. Level machine base on equipment base and align couplings between driver and driven unit using steel blocks and shims.
      a. Size blocks and shims to provide solid support at each mounting bolt location.
         1) Provide area size of blocks and shims approximately 1-1/2 times area support surface at each mounting bolt point.
      b. Provide blocks and shims at each mounting bolt.
         1) Furnish blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on mounting bolts.
      c. After all leveling and alignment has been completed and before grouting, tighten mounting bolts to proper torque value.

G. Rotating Equipment Couplings:
   1. Align in the annular and parallel positions.
      a. For equipment rotating at 1200 RPM or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller.
b. Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.

c. For equipment rotating at speeds greater than 1200 RPM allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.

2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.

3. Check surfaces for runout before attempting to trim or align units.

H. Grouting:
1. After machine base has been shimmed, leveled onto equipment base, couplings aligned and mounting bolts tightened to correct torque value, place a dam or formwork around base to contain grouting between equipment base and equipment support pad.
   a. Extend dam or formwork to cover leveling shims and blocks.
   b. Do not use nuts below the machine base to level the unit.

2. Saturate top of roughened concrete subbase with water before grouting.
   a. Add grout until entire space under machine base is filled to the top of the base underside.
   b. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.

3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface.
   a. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout.
   b. When the grout has fully hardened (after a minimum of seven (7) days) tighten all anchor bolts to engage equipment base to grout, shims, and equipment support pad.
   c. Recheck driver-driven unit for proper alignment.

3.2 INSTALLATION CHECKS

A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.

B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
1. Has been properly installed and lubricated.
2. Is in accurate alignment.
3. Is free from any undue stress imposed by connecting piping or anchor bolts.
4. Has been operated under full load conditions and that it operated satisfactorily.
   a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.

C. No separate payment shall be made for installation checks.
1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

A. Identify equipment and install hazard warning signs in accordance with Specification Section 10 14 00.

3.4 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.

B. Coat connection with oxidation eliminating compound for aluminum wire.

C. Terminate motor circuit conductors with copper lugs bolted to motor leads.
D. Tape stripped ends of conductors and associated connectors with electrical tape.
   1. Wrapping thickness shall be 150 PCT of the conductor insulation thickness.
E. Connections to carry full ampacity of conductors without temperature rise.
F. Terminate spare conductors with electrical tape.

3.5 FIELD QUALITY CONTROL

A. General:
   1. Furnish equipment manufacturer’s field quality control services and testing as specified in
      the individual equipment Specification Sections.
   2. Execute pre-demonstration requirements in accordance with Specification Section 01 75 00.
   3. Perform and report on all tests required by the equipment manufacturer’s Operation and
      Maintenance Manual.
   4. Provide testing of electrical equipment and connections in accordance with the Electrical
      specifications.
   5. Equip testing and analysis personnel with all appropriate project related reference material
      required to perform tests.

B. Equipment Monitoring and Testing Plans:
   1. Approved in accordance with Shop Drawing submittal schedule.
   2. Included as a minimum:
      a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
      b. List and description of testing and analysis equipment to be utilized.
      c. List of all equipment to be testing, including:
         1) Name and tag numbers identified in the Contract Documents.
         2) Manufacturer’s serial numbers.
         3) Other pertinent manufacturer identification,

C. Instruments Used in Equipment and Connections Quality Control Testing:
   1. Minimum calibration frequency:
      a. Field analog instruments: Not more than 6 months.
      b. Field digital instruments: Not more than 12 months.
      c. Laboratory instruments: Not more than 12 months.
      d. If instrument manufacturer’s calibration requirements are more stringent, those
         requirements shall govern.
   2. Carry current calibration status and labels on all testing instruments.
   3. See individual testing programs for additional instrumentation compliance requirements.

D. Testing and Monitoring Program Documentation:
   1. Provide reports with tabbed sections for each piece of equipment tested.
   2. Include all testing results associated with each piece of equipment under that equipment’s
      tabbed section.
      a. Include legible copies of all forms used to record field test information.
   3. Prior to start of testing, submit one (1) copy of preliminary report format for Engineer
      review and comment
      a. Include data gathering and sample test report forms that will be utilized.
   4. In the final report, include as a minimum, the following information for all equipment
      tested:
      a. Equipment identification, including:
         1) Name and tag numbers identified in the Contract Documents.
         2) Manufacturer’s serial numbers.
         3) Other pertinent manufacturer identification,
      b. Date and time of each test.
      c. Ambient conditions including temperature, humidity, and precipitation.
      d. Visual inspection report.
      e. Description of test and referenced standards, if any, followed while conducting tests.
      f. Results of initial and all retesting.
g. Acceptance criteria.

h. "As found" and "as left" conditions.

i. Corrective action, if required, taken to meet acceptance.

j. Verification of corrective action signed by the ESAD System Contractor, equipment supplier, and Owner’s representative.

k. Instrument calibration dates of all instruments used in testing.

5. Provide three (3) bound final reports prior to Project final completion.

E. Electrical Equipment and Connections Testing Program:

1. Perform testing on Electrical equipment and connections in accordance with the Electrical specification requirements.

2. Testing of motors:
   a. After installation and prior to energizing the motor, perform inspections and tests per NETA ATS 7.15 for all motors 10 HP or above.
   b. Ensure motor has been lubricated.
   c. Bump motor to check for correct rotation.

3. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.

3.6 DEMONSTRATION

A. Demonstrate equipment in accordance with Specification Section 01 75 00.

END OF SECTION
SECTION 01 73 20
OPENINGS AND PENETRATIONS IN CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable stand of quality requirement provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements for individual area classifications.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Pipe Sleeves:
   1. Areas listed in Specification Section 01 30 05 as Corrosive Areas:
      a. Stainless steel, Type 316L.
      b. Penetrations 24 IN DIA or less: ASTM A269, ASTM A312 or ASTM A554, Schedule 40.
   2. All other Areas:
      a. Steel, Hot-dipped galvanized after fabrication.
      b. Penetrations 24 IN DIA or less: ASTM A53, Schedule 40.
B. Backing Rod and Sealant: See Specification Section 07 92 00.
C. Sheet Metal Sleeves:
   1. Areas listed in Specification Section 01 30 05 as Corrosive Areas: Stainless steel: ASTM A240, Type 316L.
   2. All other areas: Galvanized steel: ASTM A653, G90.
   3. Minimum 12 GA.
D. Commercial Wall Castings:
   1. Ductile iron, ASTM A536.
   2. For wet/corrosive areas either side of penetration: Stainless Steel, ASTM A352 or ASTM A995.
   3. Grade equal to connecting piping system.
PART 3 - EXECUTION

3.1 FABRICATION

A. Fabricate sheet metal sleeves in accordance with Specification Section 07 62 00.

B. Provide waterstop plate/anchor flange for piping, ducts, castings and sleeves cast-in-place in concrete.
   1. For fabricated units, weld plate to sleeve, pipe, or ductwork.
   2. For commercial castings, cast water stop/anchor with wall pipe.
   3. Plate is to be same thickness as sleeve, pipe, casting or ductwork.
   4. For fabricated units, diameter of plate or flange to be 4 IN larger than outside diameter of sleeve, pipe or ductwork.
   5. For commercial castings, waterstop/anchor size to be manufacturer standard.
   6. Provide continuous around entire circumference of sleeve, pipe, or ductwork.

C. Factory or shop-coat painted components in accordance with Specification Section 09 96 00.

3.2 INSTALLATION AND APPLICATION

A. Seal openings and penetrations in non-fire-resistance-rated construction in accordance with Specification Section 07 92 00.

B. Perform HVAC penetrations in accordance with NFPA 90A.

C. Perform electrical penetrations in accordance with NFPA 70, Article 501.

D. When mechanical or electrical work cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, insets, fixtures or devices necessary to permit installation later.
   1. Lay out chases, holes or other openings which must be provided in masonry, concrete or other work.

E. Size sleeves, blockouts and cutouts which will receive sealant seal such that free area to receive sealant is minimized and seal integrity may be obtained.

F. For insulated piping and ducts, size sleeves, blockouts and cutouts large enough to accommodate full thickness of insulation.

G. Where pipes, conduits or ducts pass through grating, provide banding at the entire perimeter of the opening.

H. Do not cut into or core drill any beams, joists, or columns.

I. Do not install sleeves in beams, joists, or columns.

J. Do not install recesses in beams, joists, columns, or slabs.

K. Field Cutting and Coring:
   1. Saw or core drill with non-impact type equipment.
   2. Mark opening and drill small 3/4 IN or less holes through structure following opening outline.
   3. Sawcut opening outline on both surfaces.
      a. Knock out within sawcuts using impact type equipment.
      b. Do not chip or spall face of surface to remain intact.
      c. Do not allow any overcut with saw kerf.

L. For interior wall applications where backer rod and sealant are specified, provide backer rod and sealant at each side of wall.

M. Use full depth expanding foam sealant for seal applications where single or multiple pipes, conduits, etc., pass through a single sleeve.

N. Backer Rod and Sealant:
   1. Install in accordance with Specification Section 07 92 00.
2. Provide backer rod and sealant for modular mechanical seal applications.
   a. Apply on top side of slab penetrations and on interior, dry side wall penetrations.

3.3 SCHEDULES

A. General Schedule of Penetrations through Floors, Roofs, Foundation Base Slabs, Foundation Walls, Foundation Footings, Partitions and Walls for Ductwork, Piping, and Conduit:

1. Provide the following opening and penetration types:
   a. Type A - Block out 2 IN larger than outside dimensions of duct, pipe, or conduits.
   b. Type B - Saw cut or line-drill opening. Place new concrete with integrally cast sheet metal or pipe sleeve.
   c. Type C - Fabricated sheet metal sleeve or pipe sleeve cast-in-place. Provide pipe sleeve with water ring for wet and/or washdown areas.
   d. Type F - Integrally cast pipe, duct or conduit.
   e. Type G - Saw cut or line-drill and remove area 1 IN larger than outside dimensions of duct, pipe or conduit.
   f. Type H - Core drill.
   g. Type J- Grating Banding for any field cut openings.

2. Provide seals of material and method described as follows.
   a. Category 2 - Roof curb and flashing according to SMACNA specifications unless otherwise noted on Drawings. Refer to Specification Section 07 62 00 and roofing Specification Sections for additional requirements.
   b. Category 4 - Backer rod and sealant.
   c. Category 5 - Full depth compressible sealant with escutcheons on both sides of opening.
   d. Category 6 - Full depth compressible sealant and flanges on both sides of opening. Flanges constructed of same material as duct, fastened to duct and minimum 1/2 IN larger than opening.
   e. Category 8 - Banding for all grating openings and banding and cover plate of similar materials for abandoned openings.

3. Furnish openings and sealing materials through new floors, roofs, grating, partitions and walls in accordance with Schedule A, Openings and Penetrations for New Construction.

4. Furnish openings and sealing materials through existing floors, grating, roofs, partitions and walls in accordance with Schedule B, Openings and Penetrations for Existing Construction.
### SCHEDULE A. OPENINGS AND PENETRATIONS SCHEDULE FOR NEW CONSTRUCTION

<table>
<thead>
<tr>
<th>APPLICATIONS</th>
<th>DUCTS</th>
<th>PIPING</th>
<th>CONDUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OPENING TYPE</td>
<td>SEAL CATEGORY</td>
<td>OPENING TYPE</td>
</tr>
<tr>
<td>Through floors on grade above water table</td>
<td>NA</td>
<td>NA</td>
<td>F</td>
</tr>
<tr>
<td>Through exterior wall above grade</td>
<td>A</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>Roof penetrations</td>
<td>A</td>
<td>2</td>
<td>A</td>
</tr>
<tr>
<td>Through interior walls and slabs not covered by the above applications</td>
<td>A</td>
<td>4</td>
<td>A</td>
</tr>
<tr>
<td>Grating openings and penetrations</td>
<td>J</td>
<td>8</td>
<td>J</td>
</tr>
</tbody>
</table>

### SCHEDULE B. OPENINGS AND PENETRATIONS SCHEDULE FOR EXISTING CONSTRUCTION

<table>
<thead>
<tr>
<th>APPLICATIONS</th>
<th>DUCTS</th>
<th>PIPING</th>
<th>CONDUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OPENING TYPE</td>
<td>SEAL CATEGORY</td>
<td>OPENING TYPE</td>
</tr>
<tr>
<td>Through exterior wall above grade</td>
<td>G</td>
<td>6</td>
<td>G</td>
</tr>
<tr>
<td>Through interior walls and slabs not covered by the above applications</td>
<td>G</td>
<td>4</td>
<td>G</td>
</tr>
</tbody>
</table>

(1) Multiple piping 3 IN and smaller or multiple conduits.
(2) Single pipe 3 IN and smaller or single conduit.
(3) Single pipe or conduit larger than 3 IN.
SECTION 01 73 29
DEMOLITION, CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Or-equal manufacturers will be considered by the Engineer for approval when Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   1. Non-shrink grout:
      a. NS Grout by Euclid Chemical.
      b. Masterflow 713 Plus by BASF Building Systems.
      c. Sika Grout 212 by Sika.
   2. Epoxy bonding adhesive:
      a. Euco No.452 MV by Euclid Chemical Co.
      b. Sikadur 32, Hi-Mod by Sika Corporation.
   3. Epoxy patch:
      a. Depth of patch:
         2) Between 1/8 IN and 3/4 IN: Five Star Fluid Epoxy.

2.2 MATERIALS
A. Temporary Partitions:
   1. Plywood: 1/2 IN minimum for interior or exterior use.
B. Non-Shrink Grout:
   1. Non-metallic, non-corrosive and non-staining.
2. Premixed with only water to be added in accordance with manufacturer's instructions at jobsite.
3. Grout to produce a positive but controlled expansion.
   a. Mass expansion not to be created by gas liberation or by other means.
4. Minimum compressive strength at 28 days to be 6500 PSI.
5. Coat exposed edges of grout with a cure/seal compound recommended by grout manufacturer.

C. Epoxy Bonding Adhesive:
1. Two component, moisture insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide and maintain temporary partitions as required in public areas.
   1. Construct partitions of braced plywood in exterior areas.
   2. Adequately braced paneling may be used in interior areas.
B. Provide and maintain covered passageways where necessary to ensure safe passage of persons in or near areas of work.
C. Provide and maintain substantial barricades and safety lights as required.
D. Provide and maintain temporary dustproof partitions where indicated or necessary.
   1. Prevent infiltration of dust into occupied areas.
E. Provide and maintain temporary weather protection as necessary.
F. Provide adequate temporary bracing to maintain safety, stability and to resist all loads to which the structure may be subjected.

3.2 DEMOLITION

A. Cutting and Removal:
   1. Remove existing work indicated to be removed, or as necessary for installation of new work.
   2. Neatly cut and remove materials, and prepare all openings to receive new work.
   3. Remove masonry or concrete in small sections.
B. Modification of Existing Concrete:
   1. Where indicated, remove existing concrete and finish remaining surfaces.
      a. Make openings by sawing through the existing concrete.
         1) Core drill with 6 IN DIA core at the corners of rectangular openings to avoid overcutting at corners.
         b. Break out concrete after initial saw cuts in the event concrete thickness prevents cutting through.
         c. Where saw cutting is not possible, make openings by drilling holes around perimeter of opening and then chipping out the concrete.
         1) Holes shall be sufficient in number to prevent damage to remaining concrete.
   2. Oversize required openings in existing concrete 1 IN on all sides and build back to required opening size by means of grout epoxy bonded to the existing concrete.
   3. Where oversized openings cannot be made, remove the concrete to the required opening size and cut back exposed reinforcing 2 IN from face of concrete and fill resulting holes with bonding agent and non-shrink grout.
   4. Protect remaining concrete from damage.
      a. If existing concrete to remain becomes damaged, cease demolition and make corrections as required to avoid further damage.
      b. Notify Engineer immediately of any damage to remaining concrete.
C. Removal of Existing Anchor Bolts or Other Protruding Elements:
   1. Remove all protruding elements.
   2. Remove to a depth of 1/4 IN from finished surface.
   3. Fill void with epoxy patch.

D. Matching and Patching:
   1. Walls, ceilings, floors or partitions:
      a. Repair abutting walls, ceilings, floors or partitions disturbed by removal.
      b. Match and patch existing construction disturbed during installation of new work.
   2. Methods and materials:
      a. Similar in appearance, and equal in quality to adjacent areas for areas or surfaces being
         repaired.
      b. Subject to review of Owner.
   3. Reinforcing steel that is cut and exposed:
      a. Remove to a depth of 2 IN.
      b. Fill void with epoxy patch.

E. Clean Up: Transport debris and legally dispose of off-site.

END OF SECTION
SECTION 01 74 13
CLEANING

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Schedule cleaning operations so that dust and other contaminants disturbed by cleaning process will not fall on newly painted surfaces.

1.3 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester -General Requirements.
B. Store cleaning products and cleaning wastes in containers specifically designed for those materials.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Cleaning Agents:
   1. Compatible with surface being cleaned.
   2. New and uncontaminated.
   3. For Manufactured Surfaces: Material recommended by manufacturer.

PART 3 - EXECUTION

3.1 CLEANING - GENERAL
A. Prevent accumulation of wastes that create hazardous conditions.
B. Conduct cleaning and disposal operations to comply with laws and safety orders of governing authorities.
C. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains or sewers.
D. Dispose of degradable debris at an approved solid waste disposal site.
E. Dispose of non-degradable debris at an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.
F. Handle materials in a controlled manner with as few handlings as possible.
G. Do not drop or throw materials from heights greater than 4 FT or less than 4 FT if conditions warrant greater care.
H. On completion of work, leave area in a clean, natural looking condition.
   1. Remove all signs of temporary construction and activities incidental to construction of
      required permanent Work.

I. Do not burn on-site.

3.2 INTERIOR CLEANING

A. Cleaning During Construction:
   1. Keep work areas clean so as not to hinder health, safety or convenience of personnel in
      existing facility operations.
   2. At maximum weekly intervals, dispose of waste materials, debris, and rubbish.
   3. Vacuum clean interior areas when ready to receive finish painting.
      a. Continue vacuum cleaning on an as-needed basis, until substantial completion.
   4. Control dust in work areas of existing facilities.
      a. Provide protection to existing electrical and mechanical equipment as required to
         eliminate detrimental effects due to construction.
      b. Weekly check air handling filters in existing units having construction activities.
         1) Replace as necessary.
      c. At maximum monthly intervals, check interior of existing electric panels and vacuum if
         dust accumulation has occurred.
      d. At maximum weekly intervals, sweep all floors, walkways, and pick up and dispose of
         all debris.
         1) Use dust suppressant sweeping compound in areas open to areas of existing facility
            operations.

B. Final Cleaning:
   1. Complete immediately prior to Demonstration Period.
   2. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign
      materials from sight-exposed surfaces.
   3. Wipe all lighting fixture reflectors, lenses, lamps and trims clean.
   4. Wash and shine glazing and mirrors.
   5. Polish glossy surfaces to a clear shine.
   6. Ventilating systems:
      a. Clean permanent filters and replace disposable filters if units were operated during
         construction.
      b. Clean ducts, blowers and coils if units were operated without filters during
         construction.
   7. Replace all burned out lamps.
   8. Broom clean process area floors.

3.3 EXTERIOR (SITE) CLEANING

A. Cleaning During Construction:
   1. Construction debris:
      a. Confine in strategically located container(s):
         1) Cover to prevent blowing by wind.
         2) Haul from site minimum once a week.
      b. Remove from work area to container daily.
   2. Vegetation: Keep weeds and other vegetation trimmed to 3 IN maximum height.
   3. Soils, sand, and gravel deposited on paved areas and walks:
      a. Remove as required to prevent muddy or dusty conditions.
      b. Do not flush into storm sewer system.

B. Final Cleaning:
   1. Remove trash and debris containers from site.
   a. Re-seed areas disturbed by location of trash and debris containers.
3.4 FIELD QUALITY CONTROL

A. Immediately prior to Demonstration Period, conduct an inspection with Engineer to verify condition of all work areas.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes procedures and actions, required of the Contractor, which are necessary to meet Project Pre-Demonstration and Demonstration requirements.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 DEFINITIONS

A. Facility Start-Up Consists of the Following Two Periods:

1. Pre-Demonstration Period: The period of time, of unspecified duration after initial major construction and installation activities during which Contractor, with assistance from manufacturer's representatives, performs in the following sequence:
   a. Completion of construction work to bring Project to a state of Substantial Completion.
   b. Start-up of equipment.
   c. Training of personnel.
   d. Completion of the filing of all required submittals.
   e. Filing of Contractor's Notice of Substantial Completion and Request for Inspection.

2. Demonstration Period: The period of time, starting when Owner begins to transfer sludge to the new facility, during which the Contractor and the Owner operate the facility to prove the functional integrity of the design, equipment and the control interfaces of the comprising the facility as evidence of Substantial Completion.

1.4 SUBMITTALS

A. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.

B. Pre-Demonstration Period Submittals:

1. Pre-Demonstration Period Start-up Plan:
   a. Schedule for Contractor’s installation certification and start-up of equipment/systems.
      1) Submit at least 21 days prior to first system start-up.
      2) Indicate plan, procedures, checklist, and log format.
   b. Include plan for management of water for testing/start-up.
      1) Describe use of non-potable water or treated effluent for start-up of various systems and how water will be provided, handled, and disposed.
   c. Manufacturer’s representative identification and resumes for individuals performing equipment checkout.
   d. Manufacturer’s representative identification and resumes for individuals conducting training sessions.

2. Pre-Demonstration Period Equipment Start-up Notices:
   a. Provide written request to Owner to witness pre-demonstration start-up of all equipment.
      1) Request to be received by Owner minimum 1 week before start-up activities.

3. Pre-Demonstration Period Training Submittals:
   a. General:
      1) Owner reserves the right to insist on a minimum seven (7) days' notice of rescheduled training session not conducted on master schedule target date for any reason.
      2) Training schedules shall include holidays observed by Owner.
      3) Schedule to be resubmitted until approved.
b. Master Operation and Maintenance Training Schedule:
   1) Submit 30 days (minimum) prior to first training session for Owner's personnel.
   2) Schedule to include:
      a) Target date for a planning and coordination meeting 90 calendar days prior to
         first anticipated training session.
      b) Target date and time for Owner witnessing of initial start-up of
         equipment/system.
      c) Target dates for individual manufacturer's training sessions.
      d) Target date and time for Operation and Maintenance training for each system,
         both field and classroom.

c. Training Materials:
   1) Submit written outlines of proposed training sessions not less than 21 days prior to
      scheduled training.
   2) Provide complete training materials to include operation and maintenance data to
      be retained by trainee.

d. Notice of Training Session:
   1) Submit Notice of Training Session to confirm date, time, location, and agenda of
      each training session not less than 7 days prior to each session so that Owner may
      schedule staff.
   2) Owner reserves the right to insist on a minimum 7 days notice of rescheduled
      training session not conducted on notified date for any reason.
   3) Training sessions may not be held until systems/equipment have been started-up,
      the corresponding final O&M Manuals have been approved and delivered per
      Section 01 33 00 and Section 01 33 04, and the corresponding Training Materials
      have been submitted.

4. Pre-Demonstration Period Quality Control Submittals:
   a. Manufacturer’s Certificates of Proper Installation:
      1) For all major equipment/systems, submit certificate certifying:
         a) The equipment or system has been installed in accordance with the
            manufacturer’s recommendations, inspected by the manufacturer’s authorized
            representative, and serviced with the proper lubricants.
         b) Necessary safety equipment has been properly installed.
         c) Electrical and mechanical connections have been made meeting quality and
            safety standards as required.
         d) Equipment is free from undue stress imposed by exterior connection or loads.
         e) Adjustments have been made and the equipment or system is ready for testing,
            facilities start-up, and operation.
      2) See Section 40 90 00 for additional instrumentation and controls requirements.
   b. Certificate of Successful Start-up:
      1) Prepare certificate and submit upon completion of successful testing and start-up of
         respective equipment system, subsystem or component. Include:
         a) Log of manufacturer’s representative present.
         b) Completed log/checklists for start-up of each system.
         c) Certifications of calibration for analytical instruments and testing equipment.
         d) See Section 40 90 00 for additional instrumentation and controls requirements.

5. Notice of Completion of Pre-Demonstration Period:
   a. Notice that all Pre-Demonstration Period tasks are completed and Project is ready for
      Demonstration Period.
      1) Notice represents that Contractor certifies that the Project has reached a state of
         tentative Substantial Completion and will be substantially completed after
         successful completion of Demonstration Period.
      2) Notice shall include a request for inspection.
      3) Notice shall represent that all Pre-Demonstration tasks have been completed,
         specifically including the following:
         a) Pre-Demonstration start-up of systems.
         b) Personnel training.
C. Demonstration Period Submittals:

1. Demonstration Period Plan:
   a. Functional Contractor operating plan for demonstration of new Work. Include staffing, analytical testing to be performed, logging/documentation templates, and any other specific operational plan elements requested by Owner.
      1) Submit minimum of four weeks before start of Demonstration Period.
      2) Meet with Owner and Engineer for comment review and plan finalization.
      3) Contractor, Owner and Engineer shall jointly establish and document in this plan the criteria to be utilized to determine successful completion of the Demonstration Period.
         a) Criteria shall include ranges for acceptable analytical test results for acceptable biological digestion as recognized by industry standards potentially including:
            (1) Temperature.
            (2) pH.
            (3) Alkalinity.
            (4) Volatile fatty acids concentration (VCA).
            (5) VFA/Alkalinity ratio.
            (6) Residual alkalinity.
            (7) Ammonia concentration.
            (8) Volatile solids reduction.
            (9) Calculation of biogas production.
            (10) Analysis of biogas composition.
         b) Criteria shall include acceptable limits for downtime for mechanical equipment/systems within the Demonstration Period.
   2. Weekly Demonstration Period Reports:
      a. Submit each week on day agreed to by Owner and Contractor.
      b. Provide overview narrative of facility performance from previous week.
      c. Describe operational scenarios utilized or simulated during demonstration.
      d. Submit log and description of problems, outages, failures, and alarms.
         1) Describe any corrective actions taken.
      e. Log of sludge flow into and out of facility as well as recorded gas production and other analytical data obtained from sampling.
   3. Final Demonstration Report:
      a. Compile all previous documentation on single CD and provide to Owner.
      b. Include summary tables/graphs of analytical testing results documenting facility performance over entire Demonstration Period including a final set of analytical values for the last day of the Demonstration Period.

1.5 COST OF START-UP

A. Contractor to pay all costs associated with facility start-up.

B. Owner will pay for utility costs (power, natural gas) during demonstration period.
PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION

3.1 PRE-DEMONSTRATION PERIOD

A. Complete the Work to bring the Project to a state of substantial completion.

B. Start-Up of Equipment:

1. Unique requirements for individual pieces of equipment are included in the technical specification sections.

2. At a minimum, perform the following activities as part of equipment start up as applicable to the specific type of equipment:
   a. Prepare the equipment so it will operate properly and safely and be ready to demonstrate functional integrity during the Demonstration Period.
   b. Perform equipment start-up to extent possible without introducing product flow.
      1) Test tanks, pumping and other equipment with NPW or treated effluent.
   c. Test or check and correct deficiencies of:
      1) Power, control, and monitoring circuits for continuity prior to connection to power source.
      2) Voltage of all circuits.
      3) Phase sequence.
      4) Cleanliness of connecting piping systems.
      5) Alignment of connected machinery.
      6) Vacuum and pressure of all closed systems.
      7) Lubrication.
      8) Valve orientation and position status for manual operating mode.
      9) Tankage for integrity using clean water.
     10) Pumping equipment using clean water.
     11) Instrumentation and control signal generation, transmission, reception, and response per Specification Section 40 90 00.
     12) Tagging and identification systems.
     13) All equipment: Proper connections, alignment, calibration and adjustment.
   d. Calibrate all safety equipment.
   e. Manually rotate or move moving parts to assure freedom of movement.
   f. "Bump" start electric motors to verify proper rotation.
   g. Perform other tests, checks, and activities required to make the equipment ready for Demonstration Period.

3. Obtain equipment start up certifications, without restrictions or qualifications, and deliver to Engineer:
   a. Manufacturer's equipment installation check letters (sometimes referred to as Manufacturer’s Field Services report).
   b. Instrumentation Supplier's instrumentation installation certificate.

C. Personnel Training:

1. See individual equipment specification sections.

2. Conduct all personnel training after completion of Equipment Start-up for the equipment for which training is being conducted.
   a. Personnel training on individual equipment or systems will not be considered completed unless:
      1) All pre-training deliverables are received and approved before commencement of training on the individual equipment or system.
      2) No system malfunctions occur during training.
      3) All provisions of field and classroom training specifications are met.
   b. Training not in compliance with the above will be performed again in its entirety by the manufacturer at no additional cost to Owner.
3. Field and classroom training requirements:
   a. Hold classroom training on-site.
   b. Notify each manufacturer specified for on-site training that the Owner reserves the right to video record any or all training sessions.
      1) Organize each training session in a format compatible with video recording.
   c. Training instructor qualification: Factory trained and familiar with giving both classroom and "hands-on" instructions.
   d. Training instructors:
      1) Be at classes on time.
      2) Session beginning and ending times to be coordinated with the Owner and indicated on the master schedule.
      3) Normal time lengths for class periods can vary, but brief rest breaks should be scheduled and taken.
   e. Organize training sessions into maintenance verses operation topics and identify on schedule.
   f. Plan for minimum class attendance of 6 people at each session and provide sufficient classroom materials, samples, and handouts for those in attendance.
   g. Instructors to have a typed agenda and well prepared instructional material.
      1) The use of visual aids, e.g., films, pictures, and slides is recommended for use during the classroom training programs.
      2) Deliver agendas to the Engineer a minimum of seven (7) days prior to the classroom training.
      3) Provide equipment required for presentation of films, slides, and other visual aids.
   h. In the on-site training sessions, cover the information required in the Operation and Maintenance Manuals submitted according to Specification Section 01 33 04:
      1) Operation of equipment.
      2) Lubrication of equipment.
      3) Maintenance and repair of equipment.
      4) Troubleshooting of equipment.
      5) Preventive maintenance procedures.
      6) Adjustments to equipment.
      7) Inventory of spare parts.
      8) Optimizing equipment performance.
      9) Capabilities.
      10) Operational safety.
      11) Emergency situation response.
      12) Takedown procedures (disassembly and assembly).
   i. Address above Paragraphs 1), 2), 8), 9), 10), and 11) in the operation sessions. Address above Paragraphs 3), 4), 5), 6), 7), and 12) in the maintenance sessions.
   j. Maintain a log of classroom training provided including: Instructors, topics, dates, time, and attendance.
   k. Provide instruction, divided among the systems as follows:
      1) ESAD System - 8 HRS (2 x 4 HR sessions).
      2) Digester Gas Systems – 8 HRS (2 x 4 HR sessions).
      3) Sludge Recirculation Pumps and Heat Exchanger Systems – 8 HRS (2 x 4 HR sessions).
      4) Boiler and Hot Water Systems – 8 HRS (2 x 4 HR sessions).
      5) Sludge Transfer Pump System – 4 HRS (2 x 2 HR sessions).
      6) PLC and Instrumentation System – 8 HRS (2 x 4 HR sessions).
      7) Electrical System – 8 HRS (2 x 4 HR sessions).
      8) Heating and Ventilation Systems – 8 HRS (2 x 4 HR sessions).
   D. Complete the filing and approval of all required submittals:
      1. Shop Drawings.
      2. Informational Submittals.
      3. Operation and Maintenance Manuals.
4. Training material.

E. File Contractor's Notice of Substantial Completion and Request for Inspection of Project:
   1. File the notice when the following have been completed:
      a. Construction work (brought to state of Substantial Completion).
      b. Equipment Start-up.
      c. Personnel Training.
      d. Submittal of all required documents.
   2. Engineer will review required submittals for completeness within 5 calendar days of
      Contractor's notice. If complete, Engineer will complete inspection of the Work, within 10
      calendar days of Contractor's notice.
   3. Engineer will inform Contractor in writing of the status of the Work reviewed, within 14
      calendar days of Contractor's notice.
      a. Work determined not meeting state of Substantial Completion:
         1) Contractor: Correct deficiencies noted or submit plan of action for correction
            within 5 days of Engineer's determination.
         2) Engineer: Re-inspect work within 5 days of Contractor's notice of correction of
            deficiencies.
         3) Re-inspection costs incurred by Engineer will be billed to Owner who will deduct
            them from final payment due Contractor.
      b. Work determined to be in state of tentative Substantial Completion: Engineer to
         prepare tentative "Engineer's Certificate of Substantial Completion."
      c. Engineer's Certificate of Substantial Completion:
         1) Certificate tentatively issued subject to successful Demonstration of functional
            integrity.
         2) Issued for Project as a whole.
         3) Issued subject to completion or correction of items cited in the certificate (punch
            list).
         4) Issued with responsibilities of Owner and Contractor cited.
         5) Executed by Engineer.
         6) Accepted by Owner.
         7) Accepted by Contractor.
      d. Upon successful completion of Demonstration Period, Engineer will endorse certificate
         attesting to the successful demonstration, and citing the hour and date of ending the
         successful Demonstration Period of functional integrity as the effective date of
         Substantial Completion.

3.2 DEMONSTRATION PERIOD

A. Owner will provide operational personnel to provide process decisions affecting overall plant
   performance.
   1. Owner's assistance will be available only for process decisions.
   2. Contractor will perform all other functions associated with the operation of the Work until
      successful completion of the Demonstration Period.

B. Owner reserves the right to request simulation of operational variables, equipment failures, routine
   maintenance scenarios, etc., to verify the functional integrity of automatic and manual backup
   systems and alternate operating modes.

C. Time of beginning and ending any Demonstration Period shall be agreed upon by Contractor,
   Owner, and Engineer in advance of initiating Demonstration Period.

D. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's
   questions and provide final field instruction.

E. Provide all labor, supervision, chemicals, maintenance, equipment, vehicles or any other item
   necessary to operate and demonstrate all systems being demonstrated.
F. Successful completion of the Demonstration Period will be determined by Owner and Engineer after comparison of the Demonstration Period documentation against pre-established criteria identified in the Demonstration Period Plan.

END OF SECTION
SECTION 05 52 02
ALUMINUM RAILINGS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Qualifications:
   1. Contractor’s Railing Design Engineer: Professional Structural Engineer licensed in the State of Nebraska.
   2. Qualify welding procedures and welding operators in accordance with AWS or ASME Section IX.

1.3 DEFINITIONS
A. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.
B. Handrail: A railing provided for grasping with the hand for support.
C. Railing: A generic term referring to guardrail, handrail and/or stair rails.
D. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at handrail height and serving the function of a handrail.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Fabrication and/or layout Drawings and details.
   4. Certification that railings have been designed and fabricated to meet the loading requirements specified.
   5. Calculations for all styles of railings and mounting conditions.
      a. Calculations shall be performed, sealed, signed and dated by Contractor’s Railing Design Engineer.
B. Informational Submittals:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   2. Certification of welders and welding procedures indicating compliance with AWS or ASME requirements.
1.5 DELIVERY, STORAGE AND HANDLING
   A. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   B. Deliver, handle, and store railings to preclude damage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
   A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   B. Welded Railing Systems:
      3. Peak-to-Peak “Welded Railing System.”

2.2 MATERIALS
   A. Alloy 6061-T6, 32,000 PSI tensile yield strength minimum.
      1. ASTM B209 for sheets and plates.
      2. ASTM B221 and ASTM B308 for shapes - beams, channels, angles, tees, and zees.
      3. ASTM B247 for forgings.
   B. Alloy 6063-T5 or T6, 15,000 PSI tensile yield strength minimum.
      1. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
   C. Cast Fittings: Aluminum, ASTM B108.
   D. Shims: Aluminum of same alloy as component being shimmed.
   E. Fasteners: Stainless Steel.
   F. Electrodes for Welding:
      1. Aluminum: AWS D1.2.
      2. Filler alloy 5356 or 4043.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS
   A. All railing systems and mounting conditions shall be designed by Contractor’s Railing Design Engineer.
      1. Design railings and anchorage system in accordance with NAAMM AMP 521 to resist loading as required by Building Code.
         a. Maximum allowable stresses per AA ADM 1.
         b. Refer to drawings and include vertical and horizontal loads for all piping, electrical equipment, disconnects, conduit and similar items indicated to be mounted to the railing.
      2. Calculations shall be specific to this Project and shall include all assumptions, references and design interpretations used to achieve the results obtained by the Engineer.
      3. Reduction in load criteria is not acceptable as reason for deviation from requirements indicated in the Specification.

2.4 COMPONENTS
   A. Guardrail:
      1. Rails and vertical posts: Minimum 1-1/2 IN nominal diameter pipe.
         a. Internally reinforce vertical posts as necessary to meet loading requirements.
   B. Handrail: 1-1/4 IN nominal diameter Schedule 40 pipe.
C. Mounting Hardware:
   1. Base plate for vertical guardrail posts mounted to top of concrete surface:
      a. 6 x 6 IN square plate welded to vertical post.
      b. Predrilled to accept four (4) anchors.
   2. Base plate for vertical guardrail post mounted to flange of metal structure:
      a. 3 x 8 IN plate welded to vertical post.
      b. Predrilled to accept two (2) fasteners.
   3. Bracket for mounting to vertical concrete surface or web of metal structural member:
      a. Manufacturer’s standard cast or extruded aluminum fitting as necessary to meet loading
         requirements.
      b. Railing shall be secured by stainless steel socket-head set screws.
         1) Tek screws or sheet metal screws are not acceptable.
   4. Removable railing mounting:
      a. Manufacturer’s standard cast or extruded aluminum fitting as necessary to meet loading
         requirements.
      b. Railing shall be secured by stainless steel socket-head set screws.
         1) Tek screws or sheet metal screws are not acceptable.

D. Toeboard:
   1. 4 IN high extruded toeboard with stiffener ribs and angled toe.
   2. Similar to Moultrie “WIIKP20”.

E. Guardrail Gates:
   1. Constructed of same material and sizes as the guardrail system.
   2. Width of gate as shown on Drawings.
   3. Hinges:
      a. Cast aluminum.
      b. Self-closing.
      c. Stainless steel torsion spring.
      d. Similar to Moultrie “W41700” Self-closing gate hinge assembly.
   4. Gate latch:
      a. Cast aluminum.
      b. Spring-loaded pin latch.
         1) Stainless steel spring.
      c. Similar to Moultrie W41701.”
   5. Gate Stop: Similar to Moultrie W41702.”
   6. Gate Strike: Similar to Moultrie W41703.”

2.5 FABRICATION

A. General:
   1. Verify field conditions and dimensions prior to fabrication.
   2. For fabrication of items which will be exposed to view, use only materials which are smooth
      and free of surface blemishes including pitting, seam marks, roller marks, rolled trade
      names and roughness.
      a. Remove blemishes by grinding and buffing or by welding and grinding, prior to
         cleaning, treating and application of surface finishes.
   3. Form exposed work with smooth, short radius bends, accurate angles and straight edges.
      a. Ease exposed edges to a radius of approximately 1/32 IN.
      b. Form bent-metal corners to smallest radius possible without causing grain separation or
         otherwise impairing work.
      c. Drill or punch holes with smooth edges.
   4. Form exposed connections with flush, smooth, hairline joints, using stainless steel or
      aluminum splice locks to splice sections together or by welding.
      a. Ease the edges of top rail splices and expansion joints and remove all burrs left from
         cutting.
5. Provide for anchorage of type as required by field conditions.
   a. Drill or punch holes with smooth edges.

B. All railings are to be welded systems.
   1. Use wire welding for all joints.
   2. All welding to be continuous in accordance with AWS C5.5 and AWS D1.2.
      a. All welded railing joints shall have full penetration welds unless noted otherwise.
   3. All exposed welds to be ground smooth and flush to match and blend with adjoining surfaces.
      a. NAAMM AMP 521, Type 2.
   4. No ragged edges, surface defects, or undercutting of adjoining surfaces will be accepted.
   5. Finishing joints with filler is not acceptable.
   6. Provide flush weld fittings using locking weld connectors or coped drive-on connectors.

C. Fit exposed ends of guardrails and handrails with solid terminations.
   1. Return ends of handrail to wall, but do not attach to wall.
   2. Where guardrail terminates at a wall, provide a vertical post or end-loop 4 IN off the wall to center of vertical member.

D. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly of units at project site.

E. Expansion joints:
   1. Joints to be designed to allow expansion and contraction of railing and meet design loads required.
      a. Top rail splices and expansion joints shall be located within 8 IN of post or other support.
   2. Provide expansion joints in any continuous run exceeding 20 FT in length.
      1) Space expansion joints at not more than 40 FT OC.
      2) Where railings span building or tank expansion joints; provide a railing expansion joint in the span crossing the building or tank expansion joint.
      b. Provide minimum 0.10 IN of expansion joint for each 20 FT length of top rail for each 25 DEGF differential between installation temperature and maximum design temperature.
         1) Maximum expansion joint width at time of installation shall not exceed 3/8 IN.
            a) Provide additional expansion joints as required to limit expansion joint width.
      c. Provide slip-joint with internal sleeve.
         1) Extend slip joint min 2 IN beyond joint at maximum design width.
         2) Fasten internal sleeve securely to one side:
            a) Provide Allen-head set screw located in bottom of rail.
            b) Rivets or exposed screw heads are not acceptable.

F. Finish: Mill.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to installation, inspect and verify condition of substrate.
B. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
   1. Field welding aluminum is permitted when approved by Engineer.

3.2 INSTALLATION

A. Install handrails and guardrails to meet loading requirements of the Building Code.
B. Install products in accordance with manufacturer's instructions.
C. Set work accurately in location, alignment and elevation; plumb, level and true.
   1. Measure from established lines and items which are to be built into concrete, masonry or
      similar construction.

D. Align railings prior to securing in place to assure proper matching at butting and expansion
   joints and correct alignment throughout their length.
   1. Provide shims as required.

E. Install weeps to drain water from hollow sections of railing at exterior and high humidity
   conditions.
   1. Drill 1/4 IN weep hole in railings closed at bottom:
      a. 1 IN above walkway surface at bottom of posts set in concrete.
      b. 1 IN above solid aluminum rod at posts having base plate.
      c. At low point of intermediate rails.
   2. Do not drill weep holes: In bottom of base plate.

F. Install proper sized expansion joints based on temperature at time of installation and differential
   coefficient of expansion of materials in all railings as recommended by manufacturer.
   1. Lubricate expansion joint splice bar for smooth movement of railing sections.

G. Provide removable railing sections where necessary.

H. Attach handrails to walls or guardrail with brackets designed for condition:
   1. Provide brackets which provide a minimum 1-1/2 IN clearance between handrail and
      nearest obstruction.
      a. Handrails shall not project more than 4-1/2 IN into required stairway width.
   2. Anchor handrail brackets to concrete or masonry walls with stainless steel adhesive anchors
      with stainless steel hex head bolts.

I. Anchor railings to concrete with stainless steel adhesive anchors with stainless steel bolts, nuts
   and washers.
   1. Where exposed, bolts shall extend minimum 1/2 IN and maximum 3/4 IN above the top nut.
      a. If bolts are cut off to required height, threads must be dressed to allow nuts to be
         removed without damage to the bolt or the nut.
      b. Bevel the top of the bolt after cutting to provide a smooth surface.

J. Anchor railings to metal structure with stainless steel bolts, nuts and washers.

K. Install toeboards to fit tight to the walking surface.
   1. Attach to railing vertical post with manufacturer's standard mounting clamp:
      a. Adjustable.
      b. Designed to engage in extruded slot on back of toeboard.
   2. Provide splice bars, corner splices and brackets:
      a. Manufacturer's standard items as required for a complete installation.
   3. Notch toeboards at base plates or other obstructions.
   4. Bottom of toeboard shall not exceed 1/4 IN above walking surface.

L. Coat aluminum in contact with dissimilar metal or concrete in accordance with Specification
   Section 09 96 00.

M. Provide railings as required for stair construction.

N. Install guardrail gate plumb and level.
   1. Center gate in opening.
   2. Top of gate to match top of guardrail.
   3. Fasten hinges to gate and jamb post:
      a. Drill and tap into railing and gate vertical posts.
   4. Provide not less than two (2) hinges per gate.
   5. Install gate latch and stop on strike side of opening.
      a. Drill and tap into gate vertical post.
      b. Drill hole in railing vertical post to receive latch pin.
6. Adjust to provide smooth operation:

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

B. Qualifications:
   1. Manufacturer’s roof system engineer shall be a registered Professional Structural Engineer licensed in the State of Nebraska.

C. Completed roof system to be inspected by roof manufacturer’s authorized factory trained representative prior to issuance of roof warranty.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

B. Steep Slope: Having a pitch of 3:12 or greater.

C. Low Slope: Having a pitch less than 3:12 but greater than 1/4:12.

D. PVDF: Polyvinylidene fluoride.

1.4 SYSTEM DESCRIPTION

A. Prefinished, field-insulated, standing seam metal roof system, including but not limited to:
   1. Thermal barrier sheathing.
   2. Ice dam membrane.
   3. Vapor retarder.
   4. Roof insulation.
   5. Roof panel support and attachment system.

B. All flashing and miscellaneous trim required for a complete water and airtight system, including but not limited to:
   1. Flashing.
   2. Counterflashing.
   3. Sealants.

C. Prefinished Gutters and Downspouts.

D. Snow Retention System.
1.5 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Manufacturer data sheets on each component used in the roof system.
   3. Fabrication and/or layout Drawings:
      a. Manufacturer prepared computer generated Drawings showing anchorage, flashing, jointing and all other accessories required and all special detailing required by the system.
         1) Minimum plan scale:  1 IN = 8 FT.
         2) Minimum detail scale:  1-1/2 IN = 1 FT.
   4. Warranty: Sample language of manufacturer's warranty to be provided on this Project.
   5. Structural Engineer's sealed and signed calculations certifying that system structural components meet the requirements for lateral, upward and downward loads specified.

B. Informational Submittals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester-General Requirements.
   2. Final warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester -General Requirements.

1.7 WARRANTY

A. Provide 20 year complete system warranty, including material substrate for air and weather tightness of entire roof assembly signed by manufacturer.
   1. Warranty limits shall meet the minimum load capacity requirements of ASTM E1592.
   B. Provide manufacturer's 20 year warranty on panel finish against fading, chipping, cracking and peeling of the panel exterior finish and/or erosion of substrate metal.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   1. Metal Roofing System:
      a. Magnum Builders.

2.2 MATERIALS

A. Galvalume steel, ASTM A792, Class SS, Grade 50B.
B. Galvanized steel, ASTM A653, Class SS, G90.
C. Fasteners: 300 series stainless steel, ASTM F593.
D. Sealant: Manufacturer's standard non-curing butyl.
E. Wood: Fire Retardant Treated Material.
   1. Lumber (for framing, blocking, nailers, furring, grounds and similar members):
      a. NIST PS-20.
b. Species: As indicated in the appropriate AWPA standard.
   1) Provide species of FRTM as necessary to achieve UL rating listed.
   c. Grade:
      1) For nominal sizes up to and including 2 x 4: Standard and better.
      2) For nominal sizes up to 2 IN thick and wider than 4 IN: #2 and better.

2. Non-structural plywood:
   a. NIST PS-1.
   b. C-C plugged:
      1) Exposure: EXT.
      2) Touch sanded.

3. Pressure-treat material in accordance with AWPA U1.
   a. Maximum moisture content prior to treatment: 25 percent.
   b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
      1) Maximum moisture content after treatment:
         a) Lumber: 19 percent (KDAT).
         b) Plywood: 15 percent (KD-15).

4. Fire-retardant preservative:
   a. Provide protection against decay:
      1) EPA registered for use as a wood preservative.

5. UL Classified:
   a. FR-S, UL 723.
   b. Exterior: No increase in classification when subjected to the Standard Rain Test,
      ASTM D2898.
   c. Provide UL mark on each piece of FRTM.


F. Thermal Barrier Sheathing:
      a. Water and moisture-resistant treated gypsum core.
      b. Glass mat facing front and back.
   3. Class 'A' fire rated per UL 790.
   4. Flame spread 15 and smoke developed 0 when tested in accordance with ASTM E84 or
      UL 723.
   5. Thickness: 1/2 IN.
   6. Compatible with roofing vapor retarder, insulation and adhesives.
   7. Georgia-Pacific "DensDeck Roof Board".

G. Vapor Retarder:
   1. ASTM E1745, Class A rated.
   2. Fire retardant:
      b. Flame spread: ASTM E84, 5 maximum.
      c. Smoke developed: ASTM E84, 80 maximum.
   3. Vapor retarder tape: As recommended by vapor retarder manufacturer.

H. Roof Insulation:
   1. Rigid polyisocyanurate foam board.
      a. ASTM C1289, Class I, Type II.
      b. Compressive strength: 20 psi minimum.
   2. Thickness: 6 IN.

I. Ice Dam Membrane:
   3. Thickness: Minimum 40 mil.
2.3 ACCESSORIES

A. Gutters and Downspouts:
   1. Galvalume steel.
      a. Minimum thickness: 22 GA.
      b. All exposed surfaces to have finish and color to match roofing metal.
   2. Match existing at Solids Handling Building.
   3. Seamless except for expansion joints.
   4. Gutter straps and eave closure flashing: Match gutter material, finish and color.

B. Roof Penetration Flashing:
   1. Round penetrations:
      a. Premolded EPDM boot with metal collar.
      b. Buildex "DEK-TITE."

C. Equipment Curbs: See Division 23.

D. Foam and metal closures, sealant, gaskets, fasteners, washers, clips, angles, and all
   miscellaneous trims shall be provided by roofing manufacturer, fabricated for the specific
   condition as required.

E. Snow Retention System:
   1. Mechanical non-penetrating system for sloped metal roof systems to prevent ice and snow
      from sliding off roof.
      a. Provide splice fittings for a continuous installation.
   2. Snow retention system shall consist of aluminum extrusion secured to the standing seam
      with non-penetrating stainless steel set screws having rounded points.
   3. Aluminum:
      a. Finish: Manufacturer's standard finish.
      b. Extrusion to have receptacle in face to provide for insertion of prefinished sheet metal
         strip to match roofing color.
   4. Snow/Ice clips:
      a. Aluminum or stainless steel.
      b. Provide with rubber foot on end that sits on the metal roof pan.

2.4 FABRICATION

A. General:
   1. Fabricate with square, true corners, mitered and welded.
   2. Fabricate trim, flashings and closure pieces to match panel profile and finish.
   3. Hem all edges.
   4. Fabricate panels in full length with no end laps.

B. Standing Seam Metal Roof Panels: PVDF coated Galvalume steel.
   1. Profile: Match existing at Solids Handling Building.
   3. Finish:
      a. PVDF based.
      b. Meet or exceed requirements of AAMA 621.
      c. Color: Match existing at Solids Handling Building.
   4. Provide concealed fasteners where practicable.
      a. If exposed fasteners are required by the roof panel manufacturer, because of location,
         constructability issues or other critical design requirement, finish of fastener shall
         match roof panel finish.
      b. Exposed fasteners shall be approved by Engineer.
C. Intermediate Support System: Galvanized steel intermediate "Z" or "hat-shaped" or other miscellaneous support members as required to transfer roof panel loads into building roof framing members.
   1. Design in accordance with Building Code, ASCE 7, and loads shown on Drawings.

D. Roof panel anchor clips:
   1. Manufacturer's standard galvanized steel clip suitable for condition.

2.5 SOURCE QUALITY CONTROL

A. Roof assembly to be Class A roof covering assembly per UL 1256.

B. Fire Resistance/Wind Uplift Rating:
   1. UL 790, Class 1.
   2. UL 580, Class 90.

C. Support roofing panels on top of roof insulation using manufacturer-provided intermediate support system.
   1. Standing seam roof panel anchor clip attachment is to be determined by the Manufacturer’s Roof System Engineer.
      a. Provide attachment to roof structural frame or deck as required for loading criteria specified.
   2. Roof panel anchor clips shall be designed to allow thermal movement of the panels except where specific fixed points are indicated.
      a. Roof panel manufacturer shall be responsible for determining fixed point locations unless otherwise indicated.

2.6 MAINTENANCE MATERIALS

A. Provide Owner with 4 OZ of touch-up paint to match each different color used in the system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install products in accordance with manufacturer's instructions, SMACNA guidelines for a complete weathertight installation without waves, warps buckles or distortions.
      a. Provide all closures, trim, angles, plates, sealant, gaskets, fasteners, washers, etc., as necessary.
   2. Where mechanical fasteners penetrate roof deck, provide shortest fastener practical to provide required attachment with minimum protrusion into space below.
   3. Attachments shall allow for thermal expansion and contraction.
   4. Seal all joints as required for watertight installation.
   5. Touch-up paint all damaged surfaces.

B. Thermal Barrier Sheathing:
   1. Mechanically fasten thermal barrier sheathing to metal deck in accordance with manufacturer’s recommendations.

C. Vapor Retarder:
   1. Install over thermal barrier sheathing in accordance with manufacturer's recommendations.
   2. Lap joints minimum: 4 IN.
   3. Seal to perimeter, tape all joints and repair all tears.

D. Roof Insulation:
   1. Install in accordance with manufacturer’s recommendations.
   2. If multiple layers are provided to achieve total thickness as shown on Drawings, stagger joints minimum 12 IN in each direction.
E. Wood:
1. Anchor wood to concrete using post-installed anchors.
2. Anchor wood to metal using bolts and nuts.
3. Provide size and spacing of anchorage as required to meet loading criteria specified.
   a. Fasten blocking for perimeter flashing in accordance with ANSI/SPRI ES-1 and FM Global 1-49.
4. Provide flat washers under all bolt heads and nuts.
5. Fasten plywood in accordance with APA recommendations.
6. Correct or replace wood which shows bowing, warping or twisting to provide a straight, plumb and level substrate for applications of other materials.

F. Ice Dam Membrane:
1. Install per manufacturer’s recommendations.
2. Provide ice dam membrane from eave line to a point that is a minimum of 36 IN horizontally inside the interior face of the exterior wall.
3. Provide at all ridges, extending minimum 36 IN down the roof slope each side of the ridge line.

G. Standing Seam Roofing Panels:
1. Install in one (1) continuous length from ridge to eave.
   a. Exception: Panels at equipment curb openings.
2. Hand crimp battens at each clip.
3. Seam panels and battens together with portable electric seaming machine supplied by the manufacturer.

H. Snow Retention System:
1. Install starting 2 FT from the eave edge of the roof.
2. Install system in continuous lengths using manufacturer provided splice fittings.
3. Mount to metal roofing utilizing clamps fastened to standing seam with non-penetrating bullet-nosed set-screws.
   a. Fasteners shall be compatible with roof panel system and shall not void any roof warranties.
   b. Fasteners shall not damage panel finish.
4. Install metal color strip in face of extrusion.
   a. Color strip to match color of standing seam roofing.
5. Provide snow/ice clips in each standing seam panel laterally across the roof or as recommended by manufacturer.
   a. Provide single clip for seam spacing of less than 16 IN and two (2) clips for seam spacing 16 IN and greater.

I. Gutters:
1. Install gutters using gutter straps in accordance with SMACNA Table 1-8 and Figure 1-12 and per roofing manufacturer's recommendations.
   a. Provide expansion joints in gutters per SMACNA and at expansion joint locations shown on Drawings.
   b. Install gutters to provide positive drainage to downspout locations.
   c. Seal all joints in gutters to provide completely water tight system.

J. Downspouts:
1. Install downspouts in locations shown on the Drawings.
2. Provide downspout hanger straps to match existing.
3. Seal all joints in downspout for a complete watertight system.
   a. Angle bottom of downspout out away from building.
4. Fasten hanger straps to building wall with stainless steel screws and anchor sleeves appropriate for wall construction.
   a. Provide minimum of two (2) fasteners per strap.
5. Maximum spacing of hanger straps shall be 10 FT with minimum of two (2) hanger straps per vertical piece of downspout.

6. Spacing and location of hanger straps shall be consistent from downspout to downspout.

END OF SECTION
SECTION 07 62 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Qualifications:
   1. Sheet metal fabricator shall have minimum 10 years experience in fabrication of sheet metal items similar to items specified.
   2. Sheet metal installer shall have minimum five (5) years experience installing sheet metal items specified.

1.3 DEFINITIONS
A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.
B. PVDF: Polyvinylidene fluoride.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Fabrication and/or layout Drawings.
      a. Scaled drawing showing expansion joint locations, special conditions, profile, fastening and jointing details.
      1) Minimum plan scale: 1/8 IN = 1 FT.
      2) Minimum detail scale: 1-1/2 IN = 1 FT.
   4. Fabricator qualifications.
   5. Installer qualifications.
B. Samples:
   1. Finish and color samples for each product specified for Engineer preliminary color selection.
   2. For final color selection, provide two (2) 2 IN x 3 IN colored metal samples for each color selected during the preliminary color selection.
C. Informational Submittals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.
   2. Warranty: Manufacturer's sample warranty language.
1.5 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested.
1. Pre-finished sheet metal:
   a. Carlisle.
   b. Firestone Building Products.
   c. Petersen Aluminum Corp.
2. Butyl sealant:
   a. Pecora.
   b. Sika.
   c. Tremco.

2.2 MATERIALS
A. Sheet Metal:
      a. Type 316 or 316L.
B. Fasteners: Non-ferrous compatible with sheet metal.
C. Sealants:
   1. Non-curing Butyl Sealant:
      a. Pecora “BA-98”.
      b. Sika “SikaLastomer 511”.
      c. Tremco “TremPro JS-773”.
   2. Building sealants:
      a. See Specification Section 07 92 00.
D. Fasteners: Non-ferrous compatible with sheet metal.
E. Retainer Clips and Continuous Cleats: Galvanized steel or stainless steel.
F. Solder: ASTM B32.
G. Dissimilar Metal Protection: Comply with Specification Section 09 96 00.

2.3 FABRICATED ITEMS
A. General:
   1. Shop fabricate items to maximum extent possible.
      a. Fabricate true and sharp to profiles and sizes indicated on Drawings.
         1) Shop fabricate and weld or solder all corners.
   2. Pre-finished aluminum:
      a. Thickness: Minimum 0.050 IN.
      b. Texture: Smooth.
      c. Coated on exposed face with PVDF coating having a minimum 70 percent resin content and a minimum 1.0 mil dry film thickness.
         1) Meet requirements of AAMA 2605.
         2) Color: Match coping and fascia.
PART 3 - EXECUTION

3.1 PREPARATION

A. Provide items to be built into other construction to Contractor in time to allow their installation.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions, SMACNA, and as indicated on Drawings.

B. Weld aluminum to achieve weathertight joints and required details.
   1. Do not weld slip joints.
   2. Touch-up damaged prefinished items.

C. Set top edges of membrane flashing and sheet metal flashing into reglets wherever practicable.
   1. Surface applied terminations will be allowed only where specifically detailed or otherwise approved in writing by the Engineer.
   2. Provide counterflashings at all reglets.
   3. Seal reglets and counterflashings in accordance with Specification Section 07 92 00.

D. Fasten materials at intervals recommended by SMACNA.

E. Install slip joints to allow for thermal movement as recommended by SMACNA and manufacturer.
   1. Maximum spacing: 10 FT OC.
   2. Provide slip joint 24 IN from corners.
   3. Provide slip joint at each vertical expansion joint location in wall.
      a. Provide break in continuous cleat at each vertical expansion joint.
      b. The above expansion joints do not include brick veneer expansion joints.

F. Seal slip joints with two (2) beads of non-curing butyl sealant on each side of slip joint overlap.

G. Form flashings to provide spring action with exposed edges hemmed or folded to create tight junctures.

H. Provide dissimilar metals and materials protection where dissimilar metals come in contact or where sheet metal contacts mortar, concrete masonry or concrete.

I. Provide all miscellaneous sheet metal items not specifically covered elsewhere, as indicated or required to provide a weathertight installation.
   1. Provide all components necessary to create weather-tight junctures between roofing and sheet metal work.
SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Qualifications:
   1. Sealant applicator shall have minimum five (5) years experience using products specified on projects with similar scope.
C. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester – General Requirements for individual area classifications.

1.3 DEFINITIONS
A. Defect(ive): Failure of watertightness or airtightness.
B. Finish sealant: Sealant material per this Specification applied over face of compressible sealant or expanding foam sealant specified, to provide a finished, colored sealant joint.
C. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.
D. "Seal," "sealing" and "sealant": Joint sealant work.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Manufacturer's recommendations for joint cleaner, primer, backer rod, tooling and bond breaker.
   3. Certification from sealant manufacturer stating product being used is recommended for and is best suited for joint in which it is being applied.
   4. Certification of applicator qualification.
B. Test Results:
   1. Provide adhesion test results for each sealant sample including adhesion results compared to adhesion requirements.
   2. Manufacturer's authorized factory representative recommended remedial measures for all failing tests.
C. Samples:
   1. Cured sample of each color for Engineer's color selection.
   2. Color chart not acceptable.

D. Informational Submittals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

   A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

   B. Deliver material in manufacturer's original unopened containers with labels intact: Labels shall indicate contents and expiration date on material.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

   A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

   1. Compressible sealant:
      b. Emseal.
      c. Norton.

   2. Expanding foam sealant:
      a. Macklanburg Duncan.
      b. Convenience Products.
      c. FAI International, Inc.

   3. Polyether sealants:
      a. BASF.
      b. ChemLink, Inc.
      c. Tremco.

   4. Polysulfide rubber sealant:
      a. Pecora.
      b. BASF.
      c. PolySpec.

   5. Polyurea joint filler:
      a. Dayton Superior Specialty Chemical Corporation.
      b. Euclid Chemical Co.
      c. BASF.

   6. Polyurethane sealants:
      a. Pecora.
      b. Sika Chemical Corp.
      c. BASF.

   7. Silicone sealants:
      a. ChemLink.
      b. GE Construction Sealants.
      c. Dow Corning.

   8. Backer rod, compressible filler, primer, joint cleaners, bond breaker: As recommended by sealant manufacturer.

2.2 MATERIALS

   A. Sealants - General:
      1. Provide colors matching materials being sealed.
      2. Where compound is not exposed to view in finished work, provide manufacturer's color which has best performance.
3. Nonsagging sealant for vertical and overhead horizontal joints.
4. Sealants for horizontal joints: Self-leveling pedestrian/traffic grade.
5. Joint cleaner, primer, bond breaker: As recommended by sealant manufacturer.
6. Sealant backer rod and/or compressible filler:
   a. Closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible, nonabsorbent, non-bituminous material recommended by sealant manufacturer to:
      1) Control joint depth.
      2) Break bond of sealant at bottom of joint.
      3) Provide proper shape of sealant bead.
      4) Serve as expansion joint filler.
B. Compressible Sealant:
   1. Foamed polyurethane strip saturated with polymerized polybutylene waterproofing coated on front face with nonreactive release agent that will act as bond breaker for applied sealant.
      a. Polytite Manufacturing Corp. "Polytite-B."
   2. Fire rated where required.
   3. Adhesive: As recommended by sealant manufacturer.
C. Expanding Foam Sealant:
   1. One (1) or two (2) component fire rated moisture cured expanding urethane.
   2. Shall not contain formaldehyde.
   3. Density: Minimum 1.5 PCF.
   4. Closed cell content: Minimum 70 PCT.
   5. R-value: Minimum 5.0/IN.
   7. Smoke developed: Less than 25.
D. Polyether Sealant:
   1. Silyl-terminated polyether polymer.
   2. ASTM C920, Type S, Grade NS, Class 50, Use NT, M, A, and O.
      a. BASF MasterSeal 150.
      b. ChemLink DuraLink.
      c. Tremco Dymonic FC.
E. Polyurethane Sealant:
   1. One (1) or two (2) components.
   2. Paintable.
   3. Meet ASTM C920 Type S or Type M, Grade NS or P, Class 25, Use NT, T, M, A and O.
      b. BASF MasterSeal NP-1, NP-II, SL-1 SL-2.
      c. Tremco Dymonic or Dymeric, Vulkem 116,227,45,245.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before use of any sealant, investigate its compatibility with joint surfaces, fillers and other materials in joint system.
B. Use only compatible materials.
C. Where required by manufacturer, prime joint surfaces.
   1. Limit application to surfaces to receive sealant.
   2. Mask off adjacent surfaces.
D. Provide joint depth for joints receiving polyurea joint filler in accordance with manufacturer's recommendations.
3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions and UL requirements.
B. Clean all joints.
C. Make all joints water and airtight.
D. At changes in direction of joints, joint intersections and where sealant joints interface with other construction, install continuous sealant as necessary to ensure a weather-tight seal.
E. Make depth of sealing compounds, except expanding foam and polyurea sealant, not more than one-half width of joint, but in no case less than 1/4 IN nor more than 1/2 IN unless recommended otherwise by the manufacturer.
F. Provide correctly sized backer rod, compressible filler or compressible sealant in all joints to depth recommended by manufacturer:
   1. Take care to not puncture backer rod and compressible filler.
   2. Provide joint backer rod as recommended by the manufacturer for polyurea joint filler.
G. Apply bond breaker where required.
H. Tool sealants using sufficient pressure to fill all voids.
I. Upon completion, leave sealant with smooth, even, neat finish.
J. Where piping, conduit, ductwork, etc., penetrate wall, seal each side of wall opening.
K. Install compressible sealant to position at indicated depth.
   1. Size so that width of material is twice joint width.
   2. Take care to avoid contamination of sides of joint.
   3. Protect side walls of joint (to depth of finish sealant).
   4. Install with adhesive faces in contact with joint sides.
   5. Install finish sealant where indicated.
L. Install expanding foam sealant to minimum 4 IN depth or thickness of wall being penetrated if less than 4 IN.
   1. Hold material back from exposed face of wall as necessary to allow for installation of backer rod and finish sealant.
      a. Allow expanding foam sealant to completely cure prior to installing backer rod and finish sealant.
   2. Trim off excess material flush with surface of the wall if not providing finished sealant.

3.3 SEALANT WORK

A. General:
   1. Work includes but is not limited to: Sealing all joints which will permit penetration of dust, air, or moisture.
   2. Refer to SCHEDULE for materials to be used.
B. Concrete joints:
   1. Flooring joints.
   2. Isolation joints.
   3. Joints between paving or sidewalks and building.
   4. Construction, control and expansion joints.
D. Openings:
   1. Perimeters of door and window frames, louvers, grilles, etc.
   2. Door thresholds shall be set in a full bed of sealant.
E. Penetrations of walls, floors and decks.
F. Other joints where sealant, expanding foam sealant or compressible sealant is indicated.
3.4 FIELD QUALITY CONTROL

A. Adhesion Testing:
   1. Perform adhesion tests in accordance with ASTM C1521 per the following criteria:
      a. Building expansion joints: One (1) test per every 500 LF of joint sealed.
      b. All other type of joints except butt glazing joints: One (1) test per every 3000 LF of joint sealed.
      c. Manufacturer's authorized factory representative shall recommend, in writing, remedial measures for all failing tests.

3.5 SCHEDULE

A. Furnish sealant as indicated for the following areas:
   1. Exterior areas:
      a. Above grade: Polyether.
      2. Interior areas: Polyurethane.
   3. Exterior wall penetrations: Expanding urethane foam, with finish sealant.
      a. Finish sealant:
         1) Exterior side:
            a) Above grade: Polyether.
            b) Below grade: Polyurethane.
         2) Interior side: Polyurethane.

END OF SECTION
SECTION 08 15 00
FIBERGLASS REINFORCED PLASTIC (FRP) DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Qualifications:
   1. Manufacturer shall have been producing products specified for minimum of 10 years.
C. Doors and frames shall be fabricated and prepared for hardware by single manufacturer.

1.3 DEFINITIONS
A. AHC: Architectural Hardware Consultant, certified by DHI.
B. Borrowed Lite: Four-sided frame installed in an interior partition prepared for field installation of stationary (fixed) glazing.
C. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.
D. Safety Glazing: Glazing meeting the requirements of the Building Code and CPSC 16 CFR 1201.
E. Other terms as identified in CSPC 16 CFR 1201.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Schedule of doors and frames.
   5. Certification of installer's experience.
   6. Certification that doors and frames have been protected against chemical exposures listed.
   7. Finish Hardware:
      a. AHC Qualifications.
      b. Certification from AHC stating that all hardware has been reviewed and coordinated by AHC and verified to be compatible with doors and frames.
      c. Schedule of all hardware being used on each door.
      1) Number hardware sets and door references same as those indicated on Drawings.
      d. Technical data sheets on each hardware item proposed for use.
      e. Warranty information for all hardware devices having extended warranties.
8. Certification that insulating glass units meet requirements of IGCC and are certified by IGCC to ASTM E2190.

B. Samples:
   1. Provide one (1) 6 x 6 IN sample of frame and one (1) 6 x 6 IN sample of standard door and sample of fire rated door specified.
      a. Frame sample shall show corner construction.
      b. Door sample shall show core specified and reinforcing construction.

C. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

D. Informational Submittals:
   1. Certifications:
      a. Certification from AHC stating:
         1) All door hardware has been provided per approved Shop Drawings and has been installed in accordance with manufacturer's recommended installation instructions.
         2) All doors have been inspected and tested and found to be in proper working order.
         3) Fire-rated door assemblies have been inspected and tested in accordance with NFPA 80.
   2. Warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

B. Store doors and frames in a dry, weather protected area.
   1. Place units on wood skids providing a minimum 6 IN air space above the ground.
   2. Do not store units flat, set frames and doors on edge providing a minimum 1/2 IN air circulation space between each unit.
   3. Provide covering which will ensure air flow around each unit to prevent trapping moisture.
   4. If door wrapper becomes wet, remove immediately and provide dry protection equivalent to wrapper removed.

C. Storage recommendations by unit manufacturer shall take precedence over the above requirements.

1.6 WARRANTY

A. Warranty all FRP components to be free of defects in materials and workmanship for one (1) year and from degradation or failure due to corrosion for minimum of five (5) years from date of building acceptance.
   1. Warranty against door warpage of more than 1:100 when measured diagonally across the door.

B. Finish Hardware: Provide hardware manufacturers’ extended warranties.

C. Glass and Glazing.
   1. Provide manufacturer's written 10 year warranty to cover deterioration of glass, glass units, and coatings.
      a. Insulating glass units shall be warranted against failure of hermetic seal resulting in fogging or film formation on the interior glass surfaces.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. FRP Doors:
   a. Corrim Company.
   b. Chem-Pruf Door Co.
   c. Special-Lite, Inc.

2. Finish Hardware:
   a. Locksets and latchsets:
      1) Corbin/Russwin.
      2) Best Access Systems.
   b. Closers:
      1) LCN.
      2) Norton.
      3) Corbin/Russwin.
      4) Dorma.
   c. Hinges:
      1) Hager Hinge Co.
      2) McKinney Manufacturing Co.
      3) Stanley Works.
   d. Door stops and holders:
      1) Trimco.
      2) Rockwood.
      3) Ives.
   e. Overhead stops:
      1) Glynn-Johnson Corp.
      2) Rockwood.
      3) Trimco.
      4) Rixson.
   f. Weatherstripping and thresholds:
      1) Pemko Manufacturing Co.
      2) Reese Enterprises, Inc.
      3) Zero Weatherstripping, Inc.
      4) National Guard Products, Inc.
   g. Exit devices:
      1) Corbin/Russwin.
      2) Dorma.
      3) Precision.
      4) Sargent.
      5) Von Duprin, Inc.

3. Glass:
   a. Guardian Industries Corp.
   b. Insulite Glass Co.
   c. PPG.
   d. Viracon.

2.2 MATERIALS

A. Fiberglass Reinforced Plastic:
   1. Resin: Vinylester.
   2. Fiberglass content (by weight): Minimum 40 percent.
   3. UV stabilized.
B. Inserts, Bolts and Fasteners: Stainless steel.

C. Core:
   1. Closed cell polyurethane.

D. Finish Hardware:
   1. Fasteners: Stainless steel or aluminum.
   2. Closers: Corrosion Resistant.
      b. All other components and fasteners: Stainless steel.
      c. Closer arm bushing: Bronze.
   3. Kickplates: FRP.
   4. Thresholds: Aluminum.
   5. Overhead Stops: Stainless steel or aluminum.
   6. Keys: Brass or bronze.
   7. Weatherstripping and Smoke Seals: Polypropylene, neoprene, or EPDM.

E. Glass and Glazing.

F. General:
   1. ASTM C1036.
      a. Clear glass: Type I, Class 1, Quality Q3.
      b. Tinted glass: Type I, Class 2, Quality Q3.
      c. Thickness: 1/4 IN, unless noted otherwise.
      a. General use: Kind HS.
      b. Safety glazing: Kind FT.
      1) Meet requirements of ANSI Z97.1 and CSPC 16 CFR 1201.
      c. Condition:
         1) Clear vision glass: Condition A.

2.3 ACCESSORIES

A. Frame Anchors:
   1. Stainless steel machine screws and stainless steel expansion shield.
   2. Floor anchors: 12 GA steel, galvanized per ASTM A153/A153M, G60 coating.

B. Glass Panels:
   1. Fixed, applied stops on each face with snap-in retainer and trim fabricated from non-
      corrosive materials.
      a. No exposed fasteners on exterior of door allowed.
   2. Reinforce cut-out in door panel with minimum 1.5 IN SQ fiberglass tubing.

2.4 FABRICATION

A. General:
   1. Fabricate rigid, neat in appearance and free from defects.
   2. Form to sizes and profiles indicated on Drawings.
   3. Fit and assemble in shop wherever practical.
   4. Mark work that cannot be fully assembled in shop to assure proper assembly at site.
   5. For door frames, all surfaces, both exposed and concealed, shall be gel coated to prevent
      acid attack of the glass reinforcing.
   6. Fabricate doors and frames and borrowed lite frame to tolerance requirements of SDI 117.
   7. Fit doors to SDI clearances.

B. FRP Doors:
   1. General:
      a. Construction:
         1) 1-3/4 IN thick, minimum.
2) Face sheets, 0.125 IN thick, minimum.
3) Fabricate with flush top closure.
4) Fill and dress all joints.

b. Finish:
1) Two-part aliphatic polyurethane, low VOC, Industrial Coating.
2) Thickness: 5 mils.
3) Sheen: Gloss.
4) Color: White.

C. Frames:
1. General:
   a. Frame size to be 2 IN x 5-3/4 IN with equal rabbets on each side.
   b. One (1) piece, all joints filled with fiberglass compound, ground and sanded smooth
      and finished with gel coat.
   c. Minimum thickness: 0.1875 IN.
   d. Resin: vinyl ester.
   e. Fiberglass content (by weight): Minimum 30 percent, maximum 40 percent.
   f. UV stabilized.
2. FRP frames:
   a. Corner reinforcement: Minimum 4 x 4 x 0.25 IN FRP angle attached to top reinforcing
      bar with concealed stainless steel screws.
   b. Hinge reinforcement: Minimum 0.25 IN thick polymer plate attached to frame.
   c. Minimum 0.25 IN thick polymer plate reinforcement bonded and mechanically fastened
      to frame for strikes, closers and surface-mounted hardware.

D. Prepare for finish hardware in accordance with templates provided by hardware supplier and
   DHI/ANSI A115.1.
1. Locate finish hardware in accordance with SDI.

E. Finish Hardware:
1. Prepare for Phillips head machine screw installation.
2. Exposed screws to match hardware finish or, if exposed in surfaces of other work, to match
   finish of other work as closely as possible.
3. Provide concealed fasteners unless thru bolted.
4. Through bolt closers on all doors.
5. Furnish items of hardware for proper door swing.
6. Furnish lock devices which allow door to be opened from inside room without a key or any
   special knowledge.
7. Provide following ANSI/BHMA A156.18 finishes:
   a. Locksets, latchsets and strikes: 630.
   b. Door pulls, push bars, push plates: 630.
   c. Kickplates: FRP.
   1) Match door finish.
   d. Exit devices: 630 where available; 626 if 630 not available.
   1) Provide 630 finish on trim.
   e. Butt hinges: 630.
   f. Miscellaneous hardware: 630 where available, 626 if 630 not available.
   g. Door overhead stops: 630.
   h. Corrosion resistant closers: 630.
8. Mortise Locks and Latches:
   a. ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 1.
   1) Meet requirements of ADA.
   b. Antifriction two-piece mechanical latchbolt with stainless steel anti-friction insert.
   1) One-piece stainless steel deadbolt, minimum 1-1/4 IN x 9/16 IN thick with 1 IN
      throw.
   2) 2-3/4 IN backset.
3) Cylinder: Brass, 6 pin, with interchangeable core.
   a) Match existing keyway.

4) ADA compliant thumb turn lever.

4) Corrosion resistant, non-ferrous lock case.

5) Trim design: Corbin Russwin “NSF” cast lever and rose.

9. Door Closers:
   a. ANSI/BHMA A156.4, Grade 1.
   b. Size door closers to comply with ANSI recommendations for door size and location.
   c. Fabricate all closers with integral back check.
   d. Provide all weather fluid for all closers.
   e. Full cover.
      1) Manufacturer's standard plastic cover.
   f. Arms, brackets, and plates: As required for complete installation.
   g. Corrosion resistant closers: Norton 7500 SS Series.
   h. Provide manufacturer's standard 10 year warranty.

10. Hinges:
    a. Butt hinges:
       1) ANSI/BHMA A156.1.
          a) A5111: Stainless steel, full-mortise, anti-friction bearing, Grade 1.
          2) Ball bearing.
          3) Flat button tips.
          4) Non-removable pin (NRP).
          5) Butt hinges:
             a) Hager BB1199.
             b) McKinney T4B3386.
             6) Hinge size: 4.5 IN x 4.5 IN.

11. Overhead Door Holders/Stop:
    a. ANSI/BHMA A156.8.
    b. Provide 'hold-open' function on all stops unless noted otherwise.
    c. Surface mounted stops: Rockwood N14400 Series or Glynn Johnson 90 Series.
    d. Concealed stops: Rockwood N11000 Series or Glynn Johnson 100 Series.

12. Kickplates:
    a. ANSI/BHMA A156.6.
    b. 8 IN high x 2 IN less than door width.
    c. Beveled on all edges.
    d. Thickness: 0.125 IN.

13. Thresholds:
    a. ANSI/BHMA A156.21.
    b. Thermally broken unit.
    c. Height: 1/2 IN high maximum.
    d. Width: 4 IN.

14. Exit Devices:
    a. ANSI/BHMA A156.3, Grade 1.
    c. Pairs of doors: Surface vertical rods.
    d. Trim: Match lockset trim.
    e. Sargent "80 Series".

15. Weatherstripping:
    a. Weather seal at jambs and head:
       1) Self-adhesive strip: Reese #797.
       2) Color: Black.
    b. Sweep at bottom of doors:
       1) Reese 701.
       2) Color: Clear anodized.
16. Keying:
   a. Establish keying with Owner.
      1) Provide and set up complete visible card indexed system with key tags and control
         slips.
      2) Tag and identify keys.
      3) Provide two (2) keys for each lock or cylinder.
      4) Master key and key in groups as directed.
      5) Provide construction master keys for all exterior doors.
      6) Key to existing master key system.

F. Insulating Glass Units:
   1. ASTM E2190, Class A.
   2. Two (2) lites of glass separated by a hermetically sealed air space.
      a. Spacer: Stainless steel "warm edge" spacer.
         1) Thickness: 1/2 IN.
         2) Color: Black.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install doors and frames, in accordance with SDI and manufacturer's instructions.
B. Plumb, align, and brace securely until permanently anchored.
C. Immediately after erection, repair damaged areas of gel coat.
D. On doors not requiring weatherstripping, sound seals or smoke seals, install three (3) silencers
   on strike jamb of single door frame and two (2) on head of double door frame.
E. Number and location of anchors shall be in accordance with frame manufacturer's
   recommendation with minimum of three (3) anchors per jamb.
F. Protect frames during construction.
G. Finish Hardware:
   1. Install products in accordance with manufacturer's installation instructions.
      a. Perform installation by or under the direct supervision of an AHC.
   2. Provide all hardware in accordance with Building Code.
   3. Use SDI mounting heights for hardware.
   4. Provide overhead stop when corrosion resistant closer is specified.
   5. Provide weather seal, door sweep and threshold at all exterior doors.
      a. Set thresholds in a full bed of sealant.
      b. Mount door sweeps on exterior face of door.
   6. Mount kickplates on push side of doors.
H. Install glass and glazing in accordance with recommendations of manufacturer, GANA Glazing

3.2 FIELD QUALITY CONTROL

A. Provide for services of manufacturer's authorized representative to be present during and observe
   the installation of the first three (3) doors and frames.
   1. Manufacturer's representative shall instruct installer on proper methods for installing doors
      and frames, repairing damaged gel coating, repairing scratches in finish and filling and
      finishing all joints.
B. Finish Hardware:
   1. Adjust and check each operating item of hardware to assure proper operation or function.
   2. Lubricate moving parts with lubricant recommended by manufacturer.
3. During week prior to startup, make a final check and adjustment of all hardware items.
   a. Clean and lubricate as necessary to assure proper function and operation.
   b. Adjust door control devices to compensate for operation of heating and ventilating
      equipment.
4. Inspection and Testing:
   a. AHC shall inspect and test all door assemblies and provide written certification that
      door assemblies are in proper working order.
      1) Door assemblies required to swing in the direction of egress shall be inspected and
         tested in accordance with NFPA 101.
   b. Fire-rated door assemblies shall be inspected and tested in accordance with NFPA 80.
   c. Submit documentation and certification of testing in accordance with the certifications
      paragraph in the SUBMITTALS Article in PART 1 of this Specification Section.
SECTION 08 33 22
ALUMINUM ROLLING OVERHEAD DOORS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Qualifications:
   1. Installer to be licensed or approved in writing by door manufacturer.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Schedule of doors.
   4. Motor operator and accessories technical data including complete wiring and control diagram for motor operators and control stations.
   5. Certifications:
      a. Certification of Installer's qualifications.
B. Samples: Actual metal color samples of proposed finish to match existing.
C. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.
D. Informational Submittals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester Work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   1. Aluminum rolling overhead doors:
      a. The Cookson Company.
      c. Overhead Door Corp.
2.2 MATERIALS

A. Aluminum:

B. Steel: Hot-dipped Galvanized, ASTM A123.

2.3 ACCESSORIES

A. Motor Operator:
   1. Provide in accordance with Specification Section 26 05 00.
      a. Coordinate power requirements with Electrical Drawings.
   2. Instant reversing with electric reversing safety edge and weather seal on bottom of door and
      photoelectric sensor entrapment protection.
      a. Provide complete wiring connections from instant reversing safety edge and
         photoelectric entrainment protection to motor operator including all intermediate
         junction boxes, conduit, disconnects, wiring and low voltage wiring.
   3. Opening/Closing rate: Between 2/3 and 1 FPS.
   4. Internal motor brake.
   5. Oil tight three (3) pushbutton control(s).
      a. NEMA 4/13.

2.4 FABRICATION

A. Door Curtain:
   1. Insulated flat profile with interlocking face sheets:
      a. 2-5/8 IN high.
      b. Exterior face: 0.040 IN.
      c. Interior face: 0.024 IN.
      d. Galvanized endlocks.
      e. Core: Insulated.
         1) Closed cell polyurethane foam.
         a) CFC free.
   2. Weatherstripping:
      a. Exterior and interior guide sealing adjustable weatherstripping at jambs.
         1) Neoprene or vinyl.
      b. Lintel: Brush-type.
   3. Bottom bar:
      a. Aluminum or stainless steel.
      b. Reversing electric safety edge with weatherseal.
      c. Photo electric sensor entrapment protection.
   4. Finish:
      a. Powder coat:
         1) Factory prime and finish coats.
         2) Prime coat: Minimum 0.2 mil baked-on prime paint.
         3) Finish coat: Minimum 0.6 mil baked-on polyester powder coat.
         4) Color: Match existing facility white door color.

B. Hood:
   1. Minimum 0.040 IN aluminum or minimum 24 GA stainless steel.
   2. Air baffle weatherstripping extending full length of all exterior door hoods.

C. Guides: Aluminum.
   1. Mounting:
      a. Interior face of wall.
   2. Manufacturer's standard structural angle guide system for size of door specified.
      a. Furnish curtain wind locks as necessary for wind loading.
b. Cold-rolled guides are not acceptable.

3. Finish: Black powder coat.

D. Headplates:
   1. Galvanized steel plate mounted to guides.
   2. Sized to support counterbalance assembly, curtain, motor operator and hood.
   3. Finish: Black powder coat.

E. Counterbalance Assembly:
   1. Pipe barrel: Galvanized steel.
      a. Maximum deflection: 0.03 IN/FT.
   2. Torsion springs:
      a. Oil-tempered helical torsion springs on cast anchors.
      b. 100,000 cycle.
   3. Adjustable tension wheel.

F. Trim Pieces: Material and finish to match door curtain.

G. Wind Load: See Structural Drawings.

H. Operation:
   1. Motor operated with chain operator backup.
      a. Provide chain keeper on each operator.

I. Insulated door system: Overhead Door Corp. "625" Series.

2.5 SOURCE QUALITY CONTROL

A. Air Infiltration: 1.55 CFM/SF of opening maximum when tested in accordance with ASTM E283 with 25 mph wind load.

2.6 MAINTENANCE MATERIALS

A. Provide 2 OZ of touch-up paint properly labeled for each different color of door.
   1. Touch-up paint shall be formulated to be compatible with finish specified and shall be capable of being applied without special equipment or tools.

PART 3 - EXECUTION

3. INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Installation shall be done by manufacturer's authorized representative.

C. Provide all required trim, weatherstripping, closures etc., for complete weather tight installation.

D. Adjust for proper counter balance.

E. Seal along bottom of vertical track (guides), seal the vertical joint between the two (2) separate track angles (if not filled by welding) and seal all holes in vertical track (not being used for fasteners) to provide a completely weather tight track and door system.
   1. At fastener locations provide aluminum washers under bolt head to completely cover the slotted holes in the vertical guide.

F. Electrical disconnect and conduit and wiring from standard three (3) pushbutton control to motor operator is provided in the Electrical Design.

G. Provide aluminum or stainless steel bracing for motor operator to eliminate vibration.

H. Provide dissimilar materials protection on all surfaces coming in contact with dissimilar materials.
3.2 ADJUSTMENT

A. Prior to occupancy, adjust door for smooth operation.

END OF SECTION
SECTION 08 90 00
LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Color chart showing manufacturer's full line of colors including exotic and special colors for color selection by Engineer.
   4. Drawing showing location of each louver or vent, indicating size and arrangement of blank-off plates if required.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except as specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

   1. Louvers:
      a. Airolite Co.
      b. Construction Specialties, Inc.
      c. Ruskin Manufacturing.

2.2 MANUFACTURED UNITS

A. Louvers:
   1. 4 IN deep.
   2. Drainable with blades at 37-1/2 degrees.
   3. Continuous blade appearance.
   4. ASTM B221 extruded aluminum, alloy 6063T5, minimum 0.081 IN thick.
   5. Minimum free area: 8.58 SF for 4 x 4 FT louver.
   6. Maximum pressure drop: 0.10 IN of water at 700 fpm.
   7. Water penetration: 0.01 OZ/SF at 873 fpm.
8. AMCA certified.
9. Ruskin "ELF 375DX".
10. Screen:
      1) 18-16 mesh aluminum.
      2) Install in standard aluminum frame.
   b. Intake Louvers: Bird screen.
      1) 1/2 IN square mesh.
      2) 16 GA aluminum.
      3) Install in standard frame.

B. Anchors, Fasteners, Reinforcing: Aluminum or stainless steel.

C. Finish:
   1. Meet requirements of AAMA 2605.
      a. PVDF coating with minimum 70 percent resin content.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install anchoring and bracing accessories as required.
C. Seal around perimeter on exterior and interior.
   1. See Section 07 92 00.
D. Install 0.040 IN aluminum flashing at sill to match louver.
   1. See Section 07 62 00.

END OF SECTION
SECTION 09 96 00
HIGH PERFORMANCE INDUSTRIAL COATINGS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Qualifications:
   1. Applicators shall have minimum of 10 years of experience in application of similar products on similar project.
      a. Provide references for minimum of three (3) different projects completed in last five (5) years with similar scope of work.
      b. Include name and address of project, size of project in value (painting) and contact person.
C. Miscellaneous:
   1. Furnish coating through one (1) manufacturer unless noted otherwise.
D. Deviation from specified mil thickness or product type is not allowed without written authorization of Engineer.
E. Material shall not be thinned unless approved, in writing, by coating manufacturer's authorized representative.
F. See Specification Section 01 30 05 – Egg Shaped Anaerobic Digester - General Requirements for individual area classifications.

1.3 DEFINITIONS
A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.
B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the Specification Section where the product is specified or in Specification Section 01 61 03.
C. Corrosive Environment: For the purposes of this specification, the entire project site is considered a Corrosive Environment, unless defined as a Highly Corrosive Environment below.
D. Highly Corrosive Environment:
   1. For purposes of this Specification Section, highly corrosive environments include:
      a. Structures with the potential for accumulation of struvite, ammonia, or hydrogen sulfide.
      b. Areas within 10 FT of ESAD gas dome.
E. Holiday:
   1. A void, crack, thin spot, foreign inclusion, or contamination in the coating film that significantly lowers the dielectric strength of the coating.
2. May also be identified as a discontinuity or pinhole.

F. Immersion Service:
1. Any surface immersed in water or some other liquid.
2. Surface of any pipe, valve, or any other component of the piping system subject to frequent wetting.

G. High Performance Industrial Coatings (HPIC):
1. Epoxies, urethanes, vinyl ester, waterborne vinyl acrylic emulsions, acrylates, silicones, alkyds, acrylic emulsions and any other coating listed as a HPIC.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   b. Manufacturer's application instructions.
   c. Manufacturer's surface preparation instructions.
   d. If products being used are manufactured by Company other than listed in the MATERIALS Article of this Specification Section, provide complete individual data sheet comparison of proposed products with specified products including application procedure, coverage rates and verification that product is designed for intended use.
3. Applicator experience qualifications.
   a. No submittal information will be reviewed until Engineer has received and approved applicator qualifications.
   b. Coating manufacturer's recommendation on abrasive blasting.
   c. Manufacturer's recommendation for universal barrier coat.
   d. Manufacturer's recommendation for providing temporary or supplemental heat or dehumidification or other environmental control measures.
4. Manufacturer's statement regarding applicator instruction on product use.
   a. Coating manufacturer's authorized representative shall provide written statement attesting that applicator has been instructed on proper preparation, mixing and application procedures for coatings specified.
5. Certification that High Performance Coating Systems proposed for use have been reviewed and approved by Senior Corrosion Specification Specialist employed by the coating manufacturer.

B. Samples:
1. Manufacturer's full line of colors for Engineer's preliminary color selection.
2. After preliminary color selection by Engineer provide two (2) 3 x 5 IN samples of each final color selected.

C. Informational Submittals:
1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
2. Approval of application equipment.
3. Applicator's daily records:
   a. Submit daily records at end of each week in which coating work is performed unless requested otherwise by Engineer's on-site representative.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

B. Deliver in original containers, labeled as follows:
1. Name or type number of material.
2. Manufacturer's name and item stock number.
3. Contents, by volume, of major constituents.
4. Warning labels.
5. VOC content.

C. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 DEGF.

1.6 PROJECT CONDITIONS

A. Verify that atmosphere in area where coating is to take place is within coating manufacturer's acceptable temperature, humidity and sun exposure limits.

1. Provide temporary heating, shade and/or dehumidification as required to bring area within acceptable limits.
   a. Provide temporary dehumidification equipment properly sized to maintain humidity levels required by coating manufacturer.
   b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain temperature on a 24 HR basis.
      1) Vent exhaust gases to exterior environment.
      2) No exhaust gases shall be allowed to vent into the space being coated or any adjacent space.

2. Do not apply coatings in snow, rain, fog or mist.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except as specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval when Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. High Performance Industrial Coatings:
   a. PPG Industries.
   b. Sherwin Williams.
   c. Tnemec.

2.2 MATERIALS

A. General:

1. High Performance Industrial Coatings: Products listed are manufactured by Tnemec.
2. Products of other manufacturers will be considered for use provided that the product:
   a. Is of the same generic resin.
   b. Requires comparable surface preparation.
   c. Has comparable application requirements.
   d. Meets the same VOC levels or better.
   e. Provides the same finish and color options.
   f. Will withstand the atmospheric or immersion conditions of the location where it is to be applied.

3. Where manufacturer’s product data sheet indicates a minimum mil thickness per coat that is greater than specified herein, mil thickness for entire coating system shall be increased proportionately.

B. Coatings shall comply with the VOC limits of EPA.

C. For unspecified materials such as thinner, provide manufacturer's recommended products.
**D. High Performance Industrial Coatings:**

<table>
<thead>
<tr>
<th>GENERIC DESCRIPTION</th>
<th>PRODUCT</th>
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<tbody>
<tr>
<td>Polyamide Epoxy</td>
<td>Series 66HS Hi-Build Epoxoline</td>
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<tr>
<td>Zinc-Rich Urethane</td>
<td>Series 94-H2O Hydro-Zinc</td>
</tr>
<tr>
<td>Modified Polyamidoamine Epoxy</td>
<td>Series 135 Chembuild</td>
</tr>
<tr>
<td>Polyfunctional Hybrid Urethane</td>
<td>Series 740 UVX (Gloss)</td>
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<td></td>
<td>Series 750 UVX (Semi-Gloss)</td>
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### 2.3 COATING SYSTEMS

<table>
<thead>
<tr>
<th>Environment</th>
<th>Surface Preparation</th>
<th>Prime Coat</th>
<th>Intermediate Coats</th>
<th>Finish Coat</th>
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<tbody>
<tr>
<td><strong>Ferrous Metals (Structural &amp; Miscellaneous Metals)</strong></td>
<td></td>
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<tr>
<td>Interior atmospheric</td>
<td>SSPC SP-10/ NACE No. 2 min. 2 mil anchor profile</td>
<td>2.5 to 3.5 mil Series 94-H2O</td>
<td>3.0 to 4.0 mil Series 66HS</td>
<td>3.0 to 4.0 mil Series 66HS</td>
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<td>SSPC SP-6/ NACE No. 3</td>
<td>2.5 to 3.5 mil Series 94-H2O</td>
<td>3.0 to 5.0 mil Series 66HS</td>
<td>2.5 to 3.5 mil Series 740</td>
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<td>ESAD surfaces to receive insulation</td>
<td>SSPC SP-10/ NACE No. 2</td>
<td>3.0 to 4.0 mil Series 66HS</td>
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<td><strong>Galvanized Steel</strong></td>
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<td>4.0 to 6.0 mil Series 135</td>
<td>2.0 to 3.0 mil Series 66HS</td>
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<td>4.0 to 6.0 mil Series 135</td>
<td>2.5 to 3.5 mil Series 740</td>
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<td><strong>Non Ferrous Metals, including piping</strong></td>
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<td>Dissimilar Materials Protection</td>
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<td>4.5 to 5.5 mil Series 66HS</td>
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<tr>
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<td>3.0 to 4.0 mil Series 66HS</td>
<td>3.0 to 4.0 mil Series 66HS</td>
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<tr>
<td><strong>Ferrous Piping</strong></td>
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<td>Interior atmospheric</td>
<td>SSPC SP-6/ NACE No. 3</td>
<td>2.5 to 3.5 mil Series 94-H2O</td>
<td>3.0 to 4.0 mil Series 66HS</td>
<td>3.0 to 4.0 mil Series 66HS</td>
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<td>3.0 to 4.0 mil Series 66HS</td>
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<td>SSPC SP-10/ NACE No. 2</td>
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<td>3.0 to 4.0 mil Series 66HS</td>
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<td><strong>Ductile Iron Piping</strong></td>
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<td>3.0 to 4.0 mil Series 66HS</td>
<td>3.0 to 4.0 mil Series 66HS</td>
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</table>
3.1 ITEMS TO BE COATED

A. New piping, valves, fittings, hydrants and supports, as scheduled in Specification Section 40 05 00.

B. New pumps and motors.

C. Ferrous metal process equipment.

D. Structural steel.

E. Miscellaneous ferrous metal surfaces.

F. Miscellaneous galvanized steel surfaces:
   1. Pipe Bollards.
   2. Embed Plates.

3.2 ITEMS NOT TO BE COATED

A. General: Do not paint items listed in this Article.

B. Items with Approved Factory Finish:
   1. Electrical gear.
   2. Mechanical HVAC equipment.
   3. These items may require repair of damaged painted areas or painting of welded connections.

C. Moving parts of mechanical and electrical units where painting would interfere with the operation of the unit.

D. Code labels, equipment identification or rating plates and similar labels, tagging and identification.

E. Contact surfaces of friction-type structural connections.

F. Stainless Steel Surfaces.

G. Aluminum Surfaces, except:
   1. Where in contact with concrete.
   2. Where in contact with dissimilar metals.
H. Fiberglass Surfaces.

I. Interior of Pipe, Ductwork, and Conduits.
   1. See Division 23 for ductwork.
   2. See Division 40 for pipe linings.

J. Architectural Finishes:
   1. Exterior concrete indicated to receive another finish.
   2. Factory finished doors and frames.
   3. Finish hardware.
   4. Glass and glazing.
   5. Louvers.
   6. Pipe insulation and jacketing.
   7. Standing seam metal roof, fascia, trim, soffit and accessories.

3.3 PREPARATION

A. General:
   1. Prepare surfaces to be painted in accordance with coating manufacturer's instructions and
      this Specification Section unless noted otherwise in this Specification Section.
      a. Where discrepancy between coating manufacturer's instructions and this Specification
         Section exists, the more stringent preparation shall be provided unless approved
         otherwise, in writing, by the Engineer.
   2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent
      bonding of coating to surface.
   3. Adhere to manufacturer's recoat time surface preparation requirements.
      a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have
         exhibited surface chalking shall be prepared prior to additional coating in accordance
         with manufacturer's published recommendations.
         1) Minimum SSPC SP 7/NACE No. 4 unless otherwise approved by Engineer.

B. Protection:
   1. Protect surrounding surfaces not to be coated.
   2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar
      items; or provide ample in-place protection.
   3. Protect code labels, equipment identification or rating plates and similar labels, tagging and
      identification.

C. Prepare and paint before assembly all surfaces which are inaccessible after assembly.

D. Ferrous Metal:
   1. Prepare ductile iron pipe in accordance with pipe manufacturer's recommendations and
      NAPF.
      a. All piping, pumps, valves, fittings and any other component used in the water piping
         system that requires preparation for painting shall be prepared in accordance with
         requirements for immersion service.
      b. Prepare all areas requiring patch painting in accordance with recommendations of
         manufacturer and NAPF.
      c. Remove bituminous coating per piping manufacturer, paint manufacturer and NAPF
         recommendations.
         1) The most stringent recommendations shall apply.
   2. Complete fabrication, welding or burning before beginning surface preparation.
      a. Chip or grind off flux, spatter, slag or other laminations left from welding.
      b. Remove mill scale.
      c. Grind smooth rough welds and other sharp projections.
   3. Solvent clean in accordance with SSPC SP 1.
   4. Restore surface of field welds and adjacent areas to original surface preparation.
E. Galvanized Steel and Non-ferrous Metals:
   1. Solvent clean in accordance with SSPC SP 1 followed by brush-off blast clean in accordance with SSPC SP 16.
      a. Provide uniform 1 mil profile surface.

F. Preparation by Abrasive Blasting:
   1. Schedule the abrasive blasting operation so blasted surfaces will not be wet after blasting and before painting.
   2. Provide compressed air for blasting that is free of water and oil.
      a. Provide accessible separators and traps.
   3. Protect nameplates, valve stems, rotating equipment, motors and other items that may be damaged from blasting.
   4. All abrasive-blasted ferrous metal surfaces shall be inspected immediately prior to application of paint coatings.
      a. Inspection shall be performed to determine cleanliness and profile depth of blasted surfaces and to certify that surface has been prepared in accordance with these Specifications.
   5. Perform additional blasting and cleaning as required to achieve surface preparation required.
      a. Re-blast surfaces not meeting requirements of these Specifications.
      b. Prior to painting, re-blast surfaces allowed to set overnight and surfaces that show rust bloom.
      c. Surfaces allowed to set overnight or surfaces which show rust bloom prior to painting shall be re-inspected prior to paint application.
   6. Profile depth of blasted surface: Not less than 1 mil or greater than 2 mils unless required otherwise by coating manufacturer.
   7. Ensure abrasive blasting operation does not result in embedment of abrasive particles in paint film.
   8. Confine blast abrasives to area being blasted.
      a. Provide shields of polyethylene sheeting or other such barriers suitable to confine blast material.
      b. Plug pipes, holes, or openings before blasting and keep plugged until blast operation is complete and residue is removed.
      c. Protect equipment, valves, and similar items.
   9. Properly dispose of blasting material contaminated with debris from blasting operation.

3.4 APPLICATION

A. General:
   1. Thin, mix and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
      a. Application equipment must be inspected and approved in writing by coating manufacturer.
   2. Temperature and weather conditions:
      a. Do not paint surfaces when surface temperature is below 50 DegF unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and paint manufacturer's authorized representative.
      b. Avoid painting surfaces exposed to hot sun.
      c. Do not paint on damp surfaces.
   3. Apply materials under adequate illumination.
   4. Provide complete coverage to mil thickness specified.
      a. Thickness specified is dry mil thickness.
   5. Evenly spread to provide full, smooth coverage.
      a. All paint systems are "to cover."
         1) In situations of discrepancy between manufacturer's square footage coverage rates and mil thickness, mil thickness requirements govern.
         b. When color or undercoats show through, apply additional coats until paint film is of uniform finish and color.
c. Finished paint system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.

6. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.

7. Work each application of material into corners, crevices, joints, and other difficult to work areas.

8. Avoid degradation and contamination of blasted surfaces and avoid inter-coat contamination.
   a. Clean contaminated surfaces before applying next coat.

9. Smooth out runs or sags immediately, or remove and recoat entire surface.

10. Allow preceding coats to dry before recoating.
    a. Recoil within time limits specified by coating manufacturer.
    b. If recoat time limits have expired re-prepare surface in accordance with coating manufacturer's printed recommendations.

11. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.

12. Coat all aluminum in contact with dissimilar materials.

13. When coating rough surfaces which cannot be backrolled sufficiently, hand brush coating to work into all recesses.

14. Backroll surfaces if paint coatings are spray applied.

B. Employ services of coating manufacturer's qualified technical representative to ensure that field-applied coatings are compatible with factory-applied or existing coatings.
   1. Certify through material data sheets.
   2. Perform test patch.
      a. Prepare existing coating surface to receive specified coating system.
      b. Apply coating to a minimum 1 SQFT area and allow to cure in accordance with manufacturer's printed recommendations.
      c. Evaluate adhesion to existing coating: ASTM D6677 and ASTM D3359 (X-cut method).

3. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.
   a. Perform test patch as described above.

4. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using appropriate paint system listed in the MATERIALS Article, Paint Systems paragraph of this Specification Section.
   a. All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.

C. Prime Coat Application:
   1. Prime all surfaces indicated to be painted.
      a. Apply prime coat in accordance with coating manufacturer's written instructions and as written in this Specification Section.
   2. Prime ferrous metals embedded in concrete to minimum of 1 IN below exposed surfaces.
   3. Apply zinc-rich primers while under continuous agitation.
   4. Stripe coat bolts, welds, edges and difficult access areas per SSPC-PA Guide 11.
   5. Touch up damaged primer coats prior to applying finish coats.
      a. Restore primed surface equal to surface before damage.

D. Finish Coat Application:
   1. Apply finish coats in accordance with coating manufacturer's written instructions and in accordance with this Specification Section; manufacturer instructions take precedent over these Specifications.
   2. Touch up damaged finish coats using same application method and same material specified for finish coat.
      a. Prepare damaged area in accordance with the PREPARATION Article of this Specification Section.
3.5 FIELD QUALITY CONTROL

A. Application Deficiencies:
   1. Surfaces showing runs, laps, brush marks, telegraphing of surface imperfections or other
defects will not be accepted.
   2. Surfaces showing evidence of fading, chalking, blistering, delamination or other defects due
to improper surface preparation, environmental controls or application will not be accepted.
      a. Epoxy surfaces showing evidence of chalking or amine blush shall be prepared and
         recoated as follows:
            1) Solvent clean surfaces in accordance with SSPC SP1 and abrasive blast in
               accordance with SSPC SP7/NACE No. 4.
            2) Recoat with intermediate and finish coats in accordance with coating system
               specified herein.

B. Provide Protection for Painted Surfaces:
   1. Surfaces showing soiling, staining, streaking, chipping, scratches, or other defects will not
      be accepted.

C. Contractor Performed Testing:
   1. The Contractor shall provide ongoing testing and inspection, including but not limited to the
      following:
         a. Measurement and recording of environmental conditions as specified herein.
         b. Measurement and recording of substrate conditions as specified herein.
         c. Thickness Testing:
            1) Wet film thickness during application in accordance with ASTM D4414.
            2) Dry Film Thickness (DFT) in accordance with SSPC PA 2 and ASTM D7091.

D. Instrumentation:
   1. Provide instrumentation as necessary to measure and record atmospheric and substrate
      conditions, including but not limited to:
      a. Dry Film Thickness Gauge.
      b. Wet Film Thickness Gauge.
      c. Sling Psychrometer.
      d. Surface Temperature Gauge.
      e. Anemometer.
      f. Moisture Meter.

E. Maintain Daily Records:
   1. Record the following information during application:
      a. Date, starting time, end time, and all breaks taken by painters.
      b. Air temperature.
      c. Relative humidity.
      d. Dew point.
      e. Surface temperature of substrate.
      f. Provisions utilized to maintain work area within manufacturer's recommended
         application parameters including temporary heating, ventilation, cooling,
         dehumidification and provisions utilized to mitigate wind blown dust and debris from
         contaminating the wet paint film.
      g. For exterior painting:
         1) Sky condition.
         2) Wind speed and direction.
      h. Record environmental conditions, substrate moisture content and surface temperature
         information not less than once every 4 HRS during application.
         1) Record hourly when temperatures are below 50 DegF or above 100 DegF.
   2. Record the following information daily for the paint manufacturer's recommended curing
      period:
      a. Date and start time of cure period for each item or area.
b. For exterior painting:
   1) Sky conditions.
   2) Wind speed and direction.
   3) Air temperature.
      a) Dry Bulb.
      b) Wet Bulb.
   4) Relative humidity.
   5) Dew point.
   6) Surface temperatures.
   c. Record environmental conditions not less than once every 4 HRS.
      1) Record hourly when temperatures are below 50 DegF or above 100 DegF.
   d. Provisions utilized to protect each item or area and to maintain areas within
      manufacturer's recommended curing parameters.
   3. Format for daily record to be computer generated.

F. Measure wet coating with wet film thickness gages in accordance with ASTM D4414.
G. Measure coating dry film thickness in accordance with SSPC PA 2.
   1. Engineer may measure coating thickness at any time during project to assure conformance
      with these Specifications.
H. Measure surface temperature of items to be painted with surface temperature gage specifically
   designed for such.
I. Measure substrate humidity with humidity gage specifically designed for such.
J. Provide wet paint signs.

3.6 CLEANING
A. Clean Paint Spattered Surfaces: Use care not to damage finished surfaces.
B. Upon completion of painting, replace hardware, accessories, plates, fixtures, and similar items.
C. Remove surplus materials, scaffolding, and debris.

3.7 COLOR SCHEDULE
A. Pipe Bollards: 02SF Safety Yellow.
B. Piping and Pipe Banding Color Schedule (Colors based on Tnemec):
   1. Match existing plant piping and banding scheme.
   2. Refer to Specification Section 10 14 00 - Identification Devices.

END OF SECTION
SECTION 10 14 00
IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Catalog information for all identification systems.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   1. Miscellaneous Devices:
      a. W.H. Brady Co.
      b. Panduit.
      c. Seton.

2.2 MANUFACTURED UNITS
A. Type A1 - Round Metal Tags:
   1. Materials:
      a. Aluminum or stainless steel.
      b. Stainless steel shall be used in corrosive environments.
   2. Size:
      a. Diameter: 1-1/2 IN minimum.
      b. Thickness: 0.035 IN (20 GA) minimum.
   3. Fabrication:
      a. 3/16 IN minimum mounting hole.
      b. Legend: Stamped and filled with black coloring.
B. Type A2 - Rectangle Metal Tags:
2. Size:
   a. 3-1/2 IN x 1-1/2 IN minimum.
   b. Thickness: 0.036 IN (20 GA) minimum.
3. Fabrication:
   a. 3/16 IN minimum mounting hole.
   b. Legend: Stamped and filled with black coloring.

C. Type A3 - Metal Tape Tags:
1. Materials: Aluminum or stainless steel.
2. Size:
   a. Width 1/2 IN minimum.
   b. Length as required by text.
3. Fabrication:
   a. 3/16 IN minimum mounting hole.
   b. Legend: Embossed.

D. Type B1- Square Nonmetallic Tags:
2. Size:
   a. Surface: 2 x 2 IN minimum.
   b. Thickness: 100 mils.
3. Fabrication:
   a. 3/16 IN mounting hole with metal eyelet.
   b. Legend: Preprinted and permanently embedded and fade resistant.
4. Color:
   a. Background: Manufacturer standard or as specified.
   b. Lettering: Black.

E. Type B2 - Nonmetallic Signs:
1. Materials: Fiberglass reinforced or durable plastic.
2. Size:
   a. Surface: As required by text.
   b. Thickness: 60 mils minimum.
3. Fabrication:
   a. Rounded corners.
   b. Drilled holes in corners with grommets.
   c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability.
4. Color:
   a. Background: Manufacturer standard or as specified.
   b. Lettering: Black.

F. Type C - Laminated Name Plates:
1. Materials: Phenolic or DR (high impact) acrylic.
2. Size:
   a. Surface: As required by text.
   b. Thickness: 1/16 IN.
3. Fabrication:
   a. Outdoor rated and UV resistant when installed outdoors.
   b. Two (2) layers laminated.
   c. Legend: Engraved through top lamination into bottom lamination.
d. Two (2) drilled side holes, for screw mounting.

4. Color: Black top surface, white core, unless otherwise indicated.

G. Type D - Self-Adhesive Tape Tags and Signs:
1. Materials: Vinyl tape or vinyl cloth.
2. Size:
   a. Surface: As required by text.
   b. Thickness: 5 mils minimum.
3. Fabrication:
   a. Indoor/Outdoor grade.
   b. Weather and UV resistant inks.
   c. Permanent adhesive.
   d. Legend: Preprinted.
   e. Wire markers to be self-laminating.
4. Color: White with black lettering or as specified.

H. Type F - Underground Warning Tape:
2. Size:
   a. 6 IN wide (minimum).
   b. Thickness: 3.5 MILS.
3. Fabrication:
   a. Legend: Preprinted and permanently imbedded.
   b. Message continuous printed.
   c. Tensile strength: 1750 PSI.

I. Type G - Stenciling System:
1. Materials:
   a. Exterior type stenciling enamel.
   b. Either brushing grade or pressurized spray can form and grade.
2. Size: As required.
3. Fabrication:
   a. Legend: As required.
4. Color: Black or white for best contrast.

2.3 ACCESSORIES

A. Fasteners:
   1. Bead chain: #6 brass, aluminum or stainless steel.
   2. Plastic strap: Nylon, urethane or polypropylene.

2.4 MAINTENANCE MATERIALS

A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install identification devices at specified locations.
B. All identification devices to be printed by mechanical process, hand printing is not acceptable.
C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.

D. Attach tags with 1/8 IN round or flat head screws to equipment without sufficient surface or body area, or porous surfaces.
1. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.

E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing.
1. Several items of equipment mounted in housing to be individually tagged inside the compartment.

### 3.2 SCHEDULES

#### A. Process Systems:
1. General:
   a. Provide arrows and markers on piping.
      1) At 20 FT maximum centers along continuous lines.
      2) At changes in direction (route) or obstructions.
      3) At valves, risers, "T" joints, machinery or equipment.
      4) Where pipes pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
   b. Position markers on both sides of pipe with arrow markers pointing in flow direction.
      1) If flow is in both directions use double headed arrow markers.
   c. Apply tapes and stenciling in uniform manner parallel to piping.

2. Trenches with piping:
   a. Tag type: Type F - Underground Warning Tape.
   b. Location: Halfway between top of piping and finished grade.
   d. Natural gas or digester gas:
      1) Color: Yellow with black letters.
      2) Legend:
         a) First line: “CAUTION CAUTION CAUTION”
         b) Second line: “BURIED GAS LINE BELOW”
   e. Nonpotable water piping:
      1) Color: Green with black letters.
      2) Legend:
         a) First line: “CAUTION CAUTION CAUTION”
         b) Second line: “BURIED NONPOTABLE WATER LINE BELOW”

3. Yard valves, buried, with valve box and concrete pad:
   a. Tag type: Type A2 - Rectangle Metal Tags.
   b. Fastener: 3/16 IN x 7/8 IN plastic screw anchor with 1 IN #6 stainless steel pan head screw.
   c. Legend:
      1) Letter height: 1/4 IN minimum.
      2) Valve designation as indicated on the Drawings (e.g., “V-xxx”).

4. Valves:
   a. Tag type:
      1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
      2) Indoor noncorrosive:
         a) Type A1 - Round Metal Tags.
         b) Type B1 - Square Nonmetallic Tags.
      3) Indoor corrosive:
         a) Stainless steel Type A1 - Round Metal Tags.
         b) Type B1 - Square Nonmetallic Tags.
b. Fastener:
   1) Type A1: Chain of the same material.
   2) Type B1: Stainless steel chain.

c. Color: Per ASME A13.1 corresponding to the piping system.

d. Legend:
   1) Letter height: 1/4 IN minimum.
   2) Valve designation as indicated on the Drawings (e.g., “V-xxx”).

5. Process equipment (e.g., pumps, pump motors, boilers, etc.):
   a. Tag type:
      1) Type B2 - Nonmetallic Signs.
      2) Type D - Self-Adhesive Tape Tags and Signs.
      3) Type G - Stenciling System.
   b. Fastener:
      1) Self.
      2) Screws.
      3) Adhesive.
   c. Legend:
      1) Letter height: 1/2 IN minimum.
      2) Equipment designation as indicated on the Drawings (e.g., “Primary Sludge Pump P-xxx”).

6. Piping systems:
   a. Tag type:
      1) Outdoor locations: Type G - Stenciling System.
      2) Indoor locations:
         a) Type D - Self-Adhesive Tape Tags and Signs.
         b) Type G - Stenciling System.
   b. Fastener: Self.
   d. Legend:
      1) Letter height: Manufacturers standard for the pipe diameter.
      2) Mark piping in accordance with ASME A13.1.
      3) Use piping designation as indicated on the Drawings.
      4) Arrow: Single arrow.

7. Tanks (less than 1000 GAL) (e.g., break tanks, etc.):
   a. Tag type:
      1) Type D - Self-Adhesive Tape Tags and Signs.
      2) Type G - Stenciling System.
   b. Fastener: Self.
   c. Legend:
      1) Letter height: 2 IN minimum.
      2) Equipment designation as indicated on the Drawings (e.g., “Polymer Storage Tank Txxx”).

8. Equipment that starts automatically:
   a. Tag type:
      1) Type B2 - Nonmetallic Signs.
      2) Type D - Self-Adhesive Tape Tags and Signs.
   b. Fastener:
      1) Type B2 - Screw or adhesive.
      2) Type D - Self.
   c. Size: 5 IN x 7 IN
   d. Location: where equipment starts automatically.
   e. Legend:
      1) OSHA Warning Sign.
      2) Description of Warning: “THIS MACHINE STARTS AUTOMATICALLY”.
B. Instrumentation Systems:

1. Instrumentation Equipment (e.g., flow control valves, primary elements, etc.):
   a. Tag type:
      1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
      2) Indoor noncorrosive:
         a) Type A1 - Round Metal Tags.
         b) Type B1 - Square Nonmetallic Tags.
      3) Indoor corrosive:
         a) Stainless steel Type A1 - Round Metal Tags.
         b) Type B1 - Square Nonmetallic Tags.
   b. Fastener:
      1) Type A1: Chain of the same material.
      2) Type B1: Stainless steel chain.
   c. Legend:
      1) Letter height: 1/4 IN minimum.
      2) Equipment ISA designation as indicated on the Drawings (e.g., “FIT-xxx”).

2. Enclosure for instrumentation and control equipment, (e.g., PLC control panels, etc.):
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/2 IN minimum.
      2) Equipment name (e.g., "PLC CONTROL PANEL PCP-xxx").

3. Components inside equipment enclosure, (e.g., PLC’s, control relays, contactors, and timers):
   a. Tag type: Type D - Self-Adhesive Tape Tags.
   b. Fastener: Self.
   c. Legend:
      1) Letter height: 3/16 IN minimum.
      2) Description or function of component (e.g., "PLC-xxx" or “CR-xxx”).

4. Through enclosure door mounted components (e.g., selector switches, controller digital displays, etc.):
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/4 IN minimum.
      2) Component ISA tag number as indicated on the Drawings (e.g., “HS-xxx”).

C. HVAC Systems:

1. General:
   a. Provide arrows and markers on ducts.
      1) At 20 FT maximum centers along continuous lines.
      2) At changes in direction (route) or obstructions.
      3) At dampers, risers, branches, machinery or equipment.
      4) Where ducts pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
   b. Position markers on both sides of duct with arrow markers pointing in flow direction.
      1) If flow is in both directions use double headed arrow markers.
   c. Apply tapes and stenciling in uniform manner parallel to ducts.

2. HVAC Equipment (e.g., unit heaters, exhaust fans, air handlers, etc.):
   a. Tag type:
      1) Type B2 - Nonmetallic Signs.
      2) Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1 IN minimum.
      2) Equipment designation as indicated on the Drawings (e.g., "EF-xxx").
3. Ductwork:
   a. Tag type:
      1) Type D - Self-Adhesive Tape Tags and Signs.
      2) Type G - Stenciling System.
   b. Fastener: Self.
   c. Legend:
      1) Letter height: 1 IN minimum.
      2) Description of ductwork, (e.g., “AIR SUPPLY”).
      3) Arrows: Single arrow.

4. Enclosure for instrumentation and control equipment, (e.g., fan control panels, etc.):
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/2 IN minimum.
      2) Equipment designation as indicated on the Drawings (e.g., "FAN CONTROL PANEL FCP-xxx").

5. Wall mounted thermostats:
   a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
   b. Fastener: Self.
   c. Legend:
      1) Letter height: 3/16 IN minimum.
      2) Description of equipment controlled (e.g., “UH-xxx” or AHU-xxx”).

6. Components inside equipment enclosure, (e.g., controller’s, control relays, contactors, and timers):
   a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
   b. Fastener: Self.
   c. Legend:
      1) Letter height: 3/16 IN minimum.
      2) Description or function of component (e.g., "CR-xxx").

7. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/4 IN minimum.
      2) Component tag number as indicated on the Drawings or as defined by Contractor (e.g., “HS-xxx”).

D. Electrical Systems:
1. Trenches with ductbanks, direct-buried conduit, or direct-buried wire and cable.
   a. Tag type: Type F - Underground Warning Tape.
   c. Location:
      1) Where trench is 12 IN or more below finished grade: In trench 6 IN below finished grade.
      2) Where trench is less than 12 IN below finished grade: In trench 3 IN below finished grade.
   d. Electrical power (e.g., low and medium voltage):
      1) Color: Red with black letters.
      2) Legend:
         a) First line: “CAUTION CAUTION CAUTION”.
         b) Second line: “BURIED ELECTRIC LINE BELOW”.
   e. Communications (e.g., telephone, instrumentation, LAN, SCADA):
      1) Color: Orange with black letters.
      2) Legend:
         a) First line: “CAUTION CAUTION CAUTION”.

b) Second line: “BURIED COMMUNICATION LINE BELOW”.

2. Switchgear, switchboards and motor control centers:
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Main equipment legend:
      1) Letter height:
         a) First line: 1 IN minimum.
         b) Subsequent lines: 3/8 IN minimum.
      2) First line: Equipment name (e.g., "MAIN SWITCHBOARD MSBxxx").
      3) Second line:
         a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
         b) Include the building name or number if the source is in another building.
      4) Third line: System voltage and phase (e.g., “480/277 V, 3PH”).
      5) Fourth line: Date installed (e.g., “INSTALLED JULY 20xx”).
   d. Main and feeder device legend:
      1) Letter height: 3/8 IN minimum.
      2) Description of load (e.g., “MAIN DISCONNECT”, "PUMP Pxxx" or "PANELBOARD HPxxx").

3. Panelboards and transformers:
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height:
         a) First line: 3/8 IN minimum.
         b) Subsequent lines: 3/16 IN minimum.
      2) First line: Equipment name (e.g., "PANELBOARD LPxxx" or "TRANSFORMER Txxx").
      3) Second line (panelboards only): System voltage and phase (e.g., “208/120V, 3PH”).
      4) Third line:
         a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
         b) Include the building name or number if the source is in another building.
      5) Fourth line: Date installed (e.g., “INSTALLED JULY 20xx”).

4. Safety switches, separately mounted circuit breakers and motor starters, VFD’s, etc.:
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/4 IN minimum.

5. Enclosure for instrumentation and control equipment, (e.g., lighting control panels, etc.):
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/2 IN minimum.

6. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power
    transformers, control relays, contactors, timers, etc.):
   a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
   b. Fastener: Self.
   c. Legend:
      1) Letter height: 3/16 IN minimum.

7. Through enclosure door mounted equipment (e.g., selector switches, controller digital
    displays, etc.):
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
8. Conductors in control panels and in pull or junction boxes where multiple circuits exist.
   a. Tag type: Type D - Self-Adhesive Tape Tags.
   b. Fastener: Self.
   c. Tag conductor at both ends.
   d. Legend:
      1) Letter height: 1/8 IN minimum.
      2) Circuit number or wire number as scheduled on the Drawings or as furnished with
         the equipment.

9. Conductors in handholes and manholes.
   a. Tag type: Type A3 - Metal Tape Tags.
   b. Fastener: Nylon strap.
   c. Tag conductor at both ends.
   d. Legend:
      1) Letter height: 1/8 IN minimum.
      2) Circuit number or wire number as scheduled on the Drawings.

10. Grounding conductors associated with grounding electrode system in accordance with the
    following:
    a. Tag type: Type D - Self-Adhesive Tape Tags.
    b. Fastener: Self.
    c. Legend:
       1) Letter height: 1/8 IN minimum.
       2) Function of conductor (e.g., "MAIN BONDING JUMPER", "TO GROUND
          RING", "TO MAIN WATER PIPE").

11. Flash protection for switchboards, panelboards, industrial control panels and motor control
    centers:
    a. Tag type: Type D - Self-Adhesive Tape Signs.
    b. Fastener: Self.
    c. Legend: Per NFPA 70.

12. Entrances to electrical rooms:
    a. Tag type: Type B2 - Nonmetallic Signs.
    b. Fastener: Screw or adhesive.
    c. Size: 5 IN x 7 IN.
    d. Location: Each door to room.
    e. Legend:
       1) OSHA Danger Sign.
       2) Description of Danger: “HIGH VOLTAGE, AUTHORIZED PERSONNEL
          ONLY”.

13. Equipment where more than one (1) voltage source is present:
    a. Tag type:
       1) Type B2 - Nonmetallic Signs.
       2) Type D - Self-Adhesive Tape Signs.
    b. Fastener:
       1) Screw or adhesive.
       2) Self.
    c. Size: 1-3/4 IN x 2-1/2 IN.
    d. Location: Exterior face of enclosure or cubical.
    e. Legend:
       1) OSHA Danger Sign.
       2) Description of Danger: “MULTIPLE VOLTAGE SOURCES”.
3.3 HAZARD AND SAFETY SIGNS

A. Provide 10 Hazard and Safety Signs:
   1. Type B2.
   2. Inscription as directed by Owner.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Color charts for Engineer's color selection.
         1) Color selection shall be made from manufacturer's complete color line including all premium and special colors.
   3. Schedule of all signs indicating text and graphics.
   4. Layout Drawings of all signage showing size, letter style, text, border, finish, and installation detail.
      a. Provide Drawings for:
         1) Room identification signs.
         2) Aluminum letters.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   1. Room identification signs:
      a. ASE - Architectural Signs and Engraving.
      b. ASI Signage Innovations.
      c. Best Sign Systems.
   2. Aluminum letters:
      a. A R K Ramos Manufacturing Co., Inc.
      b. ASI Signage Innovations.
      c. Metallic Arts.
2.2 MATERIALS
   A. Room Identification Signs:
      1. Fiberglass suitable for raised lettering and Braille.

2.3 FABRICATION
   A. Room Identification Signs:
      1. General:
         a. Raised text, border and graphics.
            1) Minimum 1/32 IN relief.
            2) Nominal 1/4 IN border.
         b. Finish: Eggshell.
            1) Color: To be selected.
         c. Text:
            1) Typeface: Sans Serif.
            2) Size: Minimum 3/4 IN high.
         d. Text to match room identification names on Drawings.
   C. Aluminum Letters:
      1. General:
         a. Cast aluminum, machine cut or laser cut aluminum.
         b. Finish: Baked enamel.
         d. Mounting:
            1) 1 IN projected.
            2) Provide stainless steel mounting studs.
         e. Text as indicated in the SCHEDULES Article in PART 3 of this Specification Section.
      2. Letters:
         a. Style: Helvetica.
         b. Size: Upper case, 8 IN high.
         c. Depth: 3/8 IN.
      3. Provide true angles, crisp corners and straight edges with no burrs or pitting in the surface.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Room Identification Signs:
      1. Install signs using stainless steel screws:
         a. Provide four (4) screws per sign.
         b. Stainless steel screws shall be painted to match sign color.
   B. Aluminum Letters:
      1. Mount to walls with 1 IN projection in accordance with manufacturer's instructions.

3.2 SCHEDULES
   A. Room Identification Signs:
      1. Provide signage adjacent to each entrance door indicating room name as shown on Drawings.
   B. Aluminum Letters:
      1. ESAD #1 cradle: “ESAD 1.”
      2. ESAD #2 cradle: “ESAD 2.”
      3. Boiler Room: “ESAD BOILER ROOM.”

END OF SECTION
SECTION 10 44 33
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 DEFINITIONS
A. Authority Having Jurisdiction (AHJ): Building official, fire chief, fire marshal or other individual having statutory authority.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.
B. Deliver and install filled and charged extinguishers just prior to building occupancy.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   1. Fire extinguishers:
      a. J. L. Industries.
      b. Larsen's Manufacturing Co.
      c. Modern Metal Products.
   2. Fire extinguisher signs:
      a. Seton.

2.2 MANUFACTURED UNITS
A. Fire Extinguishers:
   1. Steel bodied, all metal top (head) and valves.
2. Multi-purpose dry chemical with hose and horn.
3. Provide UL rated multi-purpose chemical extinguishers located as necessary to meet the requirements of NFPA 10.
   a. Minimum extinguisher size: 4A-80BC.
   b. JL “Cosmic Extinguishers” or equal.

2.3 ACCESSORIES

A. Wall Brackets:
   1. Manufacturer’s stainless steel wall-mounted bracket type to fit specified extinguisher.
   2. Furnish bracket for each extinguisher.
   3. Bracket to be finished in red or black enamel.

B. Fire Extinguisher Signage:
   1. 60 mil plastic for indoor or outdoor use.
   2. Size: 15 IN wide by 12 IN high.
   3. Three-way viewable.
   4. SETON #84497.

C. Fasteners: Self-Tapping Concrete Anchors.
   1. 410 stainless steel.
   2. 1/4 IN DIA with 5/16 IN hex head.
   a. Minimum 1 IN embedment.
   3. ITW RedHead “Tapcon 410 SS.”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions and NFPA 10.
   1. Install units with extinguisher top not over 48 IN above floor.
   2. Install wall brackets to concrete substrate with self-tapping concrete anchors.

B. Verify all extinguisher mounting locations with the AHJ.

C. Provide "FIRE EXTINGUISHER" sign for each extinguisher location.
   1. Install signage to concrete substrate with self-tapping concrete anchors.

END OF SECTION
SECTION 22 20 00
PLUMBING FIXTURES AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Drains:
   a. Wade.
   b. Zurn.
   c. Smith.

2. Hose bibs:
   a. Nibco.
   b. Woodford.

3. Hydrants:
   a. Wade.
   b. Josam.
   c. Smith.

4. Hose racks:
2.2 MANUFACTURED UNITS

A. Drains:
   1. Floor drain:
      a. Bottom outlet.
      b. Clamping seepage flange.
      c. Seepage openings.
      d. Size as shown on Drawings.
      e. Type: Cast iron body.
         1) Unfinished areas: Sediment bucket, bucket shall support grate: Wade W-1200-TD.

B. Traps:
   1. Floor and equipment drains:
      a. Same material and coating as the piping system.
      b. 3 IN minimum seal.
   2. Ventilation housing drains: Extra-deep seal sufficient to maintain seal against static pressure maintained in fan housing.

C. Cleanouts:
   1. Cleanouts for cast iron pipe:
      a. Tapped extra heavy cast iron ferrule.
      b. Calked into cast iron fittings.
      c. Extra heavy brass neoprene seal screw plug with solid hexagonal nut.
   2. Cleanouts for steel pipe: Extra heavy brass screw plug in drainage fittings.
   3. Access housing with adjustable anchor flange and secured scoriated cast: Wade W-3800-MF.
   4. Cleanouts turning out through walls and up through floor shall be made by long sweep ells or "y" and 1/8 bends with plugs and face or deck plates to conform to architectural finish in room.
      a. Where definite finish is not indicated, wall plates shall be chrome-plated cast-brass and floor plates polished brass.
   5. Code:
      a. Provide cleanouts of same size as pipe up to 4 IN and not less than 4 IN for larger pipes.
      b. Close access openings for concealed cleanouts with flush floor or flush wall cover plates or flush ceiling access panels.
      c. Provide wall plates with chrome plated cast-brass round cleanout cover with flanged ring.
      d. Provide screws which match cover plate material.

D. Hose Bibb:
   1. 3/4 IN boiler drain with attached vacuum breaker-backflow preventer.
   2. Vacuum breaker: Non-removable, manual draining, meeting the requirements of the ASSE 1011.

E. Hydrants:
   1. Wall hydrant:
      a. Non-freeze.
      b. Integral vacuum breaker.
      c. Nylon seat.
      d. 3/4 IN hose connection.
      e. 3/4 IN inlet connection.
      f. Length as recommended by manufacturer for wall thickness.
      g. Type:
         1) Exposed: Wade 8600.
F. Hose Racks:
   1. Stainless steel.
   2. 3/4 IN hose capacity: 50 FT at each hose rack.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cross Connection: Do not install any plumbing components that will provide a cross connection between potable and non-potable or drainage systems.

B. Fixtures:
   1. Install fixtures in compliance with local Codes.

C. Drains:
   1. Install drains at locations indicated on Drawings and in compliance with local Codes.
   2. In uncovered concrete slabs:
      a. Install at the low points of surface areas to be drained or as indicated.
      b. Set tops of drains flush with the finished floor.
      c. Install drain flashing collar or a flange so that no leakage occurs between the drain and the adjoining surfaces.

D. Wall Hydrants:
   1. Install 24 IN above exterior grade.
   2. Support units from the structure and mount flush with structure face.
   3. Prior to final setting, fill the back of the face with a non-hardening silicone calk and press firmly in place to stop infiltration and water leakage.
   4. Install isolation valves in line to each wall hydrant.

E. Hose Racks:
   1. Provide at each hose bib and wall hydrant.
   2. Adjacent to hose bibbs, top of rack 36 IN above finished floor or grade.
   3. Concrete or masonry walls: Mount with 5/8 IN x 2-1/2 IN stainless steel expansion anchors.

F. Hose Bibbs:
   1. Install 36 IN above finished floor.
   2. In exterior locations, provide interior isolation valve.

G. Cleanouts:
   1. Install cleanouts:
      a. Above floor in each vertical riser that connects to horizontal branch below floor.
      b. At test tee to receive proper test plugs in each vertical riser at least every other floor.
      c. As required by local Code.

H. Wall Plates and Escutcheons: Install as specified in Specification Section 40 05 00 or this Specification Section.

3.2 FIELD QUALITY CONTROL

A. Test piping and fixtures for leaks per Specification Section 40 05 00.

END OF SECTION
DIVISION 23
HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)
SECTION 23 05 93
HVAC SYSTEMS: BALANCING AND TESTING

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Certifications:
      a. Letter stating the name and qualifications of the firm proposed.
      b. Evidence that relevant subcontractors have been notified of the requirement to coordinate balance and test elements in the work with the testing and balancing firm.
   4. Report forms:
      a. Procedures and forms to be used in calibrating of test instruments, balancing systems, and recording and reporting test data.
B. Informational Submittals:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Completed test reports and data forms upon completion of installation, balance and testing of HVAC systems.
      a. Insert recorded information on report forms required by specifications and approved for use on project.
      b. Additional written verification and other related information clearly identifying project, date and specifics of verification.
      c. Utilize report forms similar to those shown in Section V of AABC Standard.
      d. Provide forms typed and signed by the testing and balancing firm.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION
3.1 PREPARATION
A. Secure approved Shop Drawings of all HVAC equipment.
B. Procedures and Forms:
   1. Submit procedures and forms to be used in calibration of test instruments, balancing systems, and recording and reporting test data.
   2. Obtain approval before beginning balancing and testing.
C. Do not begin balancing and testing until HVAC systems are complete and in full working order.
   1. Place HVAC systems into full operation and continue their operation during each working day of balancing and testing.
D. Provide qualified heating and ventilating Engineer(s) to supervise and perform balancing and testing.
E. Review design Drawings, approved Shop Drawings and other related items to become thoroughly acquainted with the design of HVAC systems.
F. Check all installed systems against Contract Drawings and Shop Drawings to see that system is installed as required.
   1. Report deficiencies to the Engineer.
   2. Report deficiencies to Contractor for remedial action including providing corrective measures required in the function of any part of system to complete balancing.
G. Make necessary adjustments as required to balance the systems.

3.2 FIELD QUALITY CONTROL
A. Balance and Test Air Systems:
   1. Adjust equipment RPM to design requirements.
   3. Obtain design CFM at fans.
      a. Make pitot tube traverse of main supply and exhaust ducts within 5 percent.
   4. Test and record system static pressures, suction and discharge.
   5. Obtain design CFM for recirculated air.
   6. Obtain design CFM outside air.
   7. Test and record entering air temperatures, (DB, heating and cooling).
   8. Test and record leaving air temperatures, (DB, heating and cooling).
  10. Adjust dampers in supply, exhaust and return air ducts to design CFM.
  11. Identify and list size, type and manufacturer of diffusers, grilles, registers, and HVAC equipment.
      a. Use manufacturer's ratings on equipment to make required calculations.
  12. Adjust and assure that the operation of automatically operated dampers are as specified.
      a. Check and calibrate controls.
  13. Prepare and submit reports.
B. Balance and Test Water Systems:
   1. Phase 1:
      a. Complete air balance before beginning actual water balance.
      b. Open valves to full open position.
      1) Close coil bypass stop valves.
      2) Set mixing valve to full coil flow.
      c. Check operation of relief valves.
      d. Examine water in system and determine if water has been treated and cleaned.
      1) Clean strainers before and after balancing.
e. Check pump rotation.

f. Check expansion tanks to determine they are not air bound and system is completely full of water.

g. Check air vents at high points of water systems and determine all are installed and operating correctly.

h. Set temperature controls so coils are calling for full heating.
   1) This should close automatic bypass valves.
   2) Utilize same procedure when balancing chilled water coils, set on call for full cooling.

i. Check operation of automatic bypass valves.

2. Phase 2:

   a. Set pumps to proper flow delivery.
   b. Adjust and record waterflow at system entrance.
   c. Adjust and record waterflow through pumps.
   d. Check and record water entering temperatures and return water temperatures at system entrance.
      1) Set to correct design temperatures.
   e. Check water temperatures at inlet side of cooling and heating coils.
      1) Record rise or drop of temperatures from source.
   f. Proceed to balance each chilled water and hot water coil.
   g. Upon completion of flow readings and adjustments at coils, mark settings and record data.

3. Phase 3:

   a. After adjustments to coils are made, recheck settings at pumps and readjust if required.
   b. Install pressure gauges on coil, read pressure drop through coil at set flowrate.
      1) Set pressure drop across bypass valve to match coil full flow pressure drop to prevent unbalanced flow conditions when coils are on full bypass.
   c. Check and record the following items at each cooling heating element:
      1) Inlet water temperatures.
      2) Leaving water temperatures.
      3) Pressure drop of each coil.
      4) Pressure drop across bypass valve.
      5) Pump operating suction and discharge pressures and final TDH.
      6) Water metering device readings.
   d. List mechanical specifications of pumps.
   e. Record rated and actual running amperage of pump motor.
   f. Prepare and submit report.

   END OF SECTION
SECTION 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Miscellaneous:
   1. Controls to be in compliance with Specification Section 26 05 00 for NEMA and NFPA 70 enclosure class requirements.
   2. Components of systems shall be industrial duty suitable for moist, corrosive environments.

1.3 SYSTEM DESCRIPTION
A. Work shall be provided as an integrated operating system.
B. Provide a complete system of automatic temperature control, thermostats, relays, valves, damper operators and other associated controls and appurtenances required to maintain minimum conditions described in detail herein and on Drawings, together with thermometers, gages and other accessory equipment.
   1. Assemble control system with complete system of wiring and air piping to fulfill requirements of the Contract Documents.
C. Install system using competent mechanics under direct supervision of control manufacturer.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Wiring diagrams showing point to point termination with auxiliary interlocks for each item in each control loop.
   4. Pneumatic piping diagrams.
   5. Information on equipment proposed for use including corrosion protection.
   6. Instrument loop diagrams and word description of loop function for each individual unit controlled including auxiliary interlocks in full compliance with ISA S5.4.
      a. Show components in system and ensure diagrams are in full compliance with ISA S5.1 (Instrumentation Symbols and Identification) and other related ISA standards.
   7. Secure from equipment manufacturers, detailed and complete control and power wiring diagrams, word descriptions of controls provided as part of the HVAC equipment or equipment interfaced or interlocked thereto, and submit with equipment manufacturer's submittals.
      a. Provide the above information to control manufacturer.
1.5 SITE CONDITIONS

A. The environment and air streams may include varying concentrations of the following chemical components:
   1. H₂SO₄ - Sulfuric acid.
   2. NH₃ - Ammonia.
   3. Cl₂ - Chlorine.
   5. HCl - Hydrochloric acid.
   6. Condensation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Instrumentation and control systems:
   a. Honeywell.
   b. Johnson Control Co.

2.2 EQUIPMENT

A. Instrument Air Piping:
   1. Provide air piping for differential pressure switches:
      a. Provide hard stainless steel tubing, with compression fittings.
      1) Sized in accordance with manufacturer's recommendations, adequately strapped and supported.
   2. Provide compression fittings at connections to valves, damper motors, instruments, and other related items.

B. Dampers: Refer to Specification Section 23 31 00.

C. Damper Operators:
   1. Provide operators of proper size and number to secure true throttling or two-position action as required.
   2. Furnish damper operators for installation inside ductwork and attached to frame of damper, or installed outside ductwork and connected to extended shaft as required.
   3. Provide operators for outside air, spring-loaded with sufficient power to assure tight closing of dampers on fan shutdown or in the fail safe position indicated by "Sequence of Controls."
   4. Electric operators:
      a. Provide operators in NEMA 4X enclosure, Belimo ZS-300.
      b. Provide damper operators with integral spring return motor springs to make controls fail safe in position specified under "Sequence of Controls."
      c. Provide fully modulating operators from proportional electric controllers.
      d. Provide end switches or proportioning controllers permitting simultaneous operation or interlocking with other equipment.
      e. Provide separate electrical circuits for damper operators with no more than four (4) operators on a circuit.
5. Coordinate with dampers provided:
   a. Provide damper operators that are rated for the required torque.
   b. If single damper operator cannot meet torque requirement, provide sectional dampers
to match operator torque.
6. Ensure coordination to provide for the installation of tight closing dampers low leakage type
   (6 cfm per square foot at 4 IN WC pressure across damper) with compatible dampers,
damper operators and related controls.

D. Electric Control Instruments:
1. Provide stainless steel sensing elements type thermostats with liquid filled, compensated
   thermal systems so that equally spaced dial graduations are possible over entire range.
   a. Make thermal systems field detachable with averaging or plain bulbs as installation
      conditions dictate.
   b. Provide sensing elements minimum of 60 IN in length and suitable for operation from -
      30 to 300 DegF.
   c. Provide reverse acting on-off type thermostats for controlling ventilating fans.
   d. Provide multiple stage thermostats where designated in Paragraph "Sequence of
      Operation."
2. Provide transformers for supplying current to control equipment operating at less than 120
   V and where required by manufacturer's automatic control system design capable of
   supplying 125 percent of energy requirements of equipment connected for not less than 1
   HR.
   a. Enclose transformers in UL listed cabinets with conduit connections.
   b. Provide fused disconnect switches on both primary and secondary sides.
3. Provide low limit electric thermostats of two-position type with 20 FT bulb and manual
   reset.
   a. Shall be capable of opening thermostat circuit if any 1 FT section of bulb is subjected to
      a temperature below thermostat setting.
   b. Each thermostat shall have two (2) circuits, one (1) to shut down fan, another for alarm.
   c. Install all freeze-stats to override starter circuits regardless of position.
   d. For corrosive environments provide thermostats with stainless steel sensing elements.
      See 00E605 for space classifications.
      1) Ensure element is installed to sense coldest point should stratification occur.
4. Provide each thermostat with an accurate red-reading thermometer sensing temperature
   outside of enclosure.
5. Label thermostat with identification tag of HVAC equipment controlled using phenolic
   nameplate in accordance with Specification Section 10 14 00.

E. Differential Pressure Switches:
1. Weather proof.
2. Adjustable differential.
3. Provide stainless steel static pressure fitting, Dwyer A307-SS or equal.
4. Provide aluminum interconnecting tubing between switch and pressure fitting.
5. Provide switch according to the following table. Contractor shall be responsible for
   providing differential pressure switch appropriate for static pressure of given fan system.
6. Type: Dwyer 1800 or 1950 as required for space classification.

2.3 FABRICATION

A. Corrosion Protection:
1. Protect metal parts of controls, instrumentation and related items from corrosive atmosphere
   by either protective coatings or select materials.
   a. Aluminum and stainless steel require no further protection.
2. Provide NEMA 4X fiberglass control enclosures with tempered glass windows and vapor tight gaskets, illustrated in Hoffman Bulletin A-50, for protection of controls from corrosive environment.
   a. Install control instruments inside enclosure and extend remote stainless steel sensing elements through enclosure wall.
   b. Provide vaportight seals for penetrations of enclosure.
3. Provide in each enclosure industrial corrosion inhibitors, Hoffman Corrosion Inhibitors, as illustrated in Hoffman's technical Bulletin HCI.
4. Protect metal accessory items such as mounting brackets and fasteners not stainless steel, fiberglass or aluminum by epoxy or phenolic coatings.
5. Protect electric motor operator with corrosion inhibitors inside enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with requirements of Specification Section 26 05 19 and Specification Section 26 05 33.
B. Identification: See Specification Section 10 14 00.
C. Connect control devices to perform functions indicated and perform in required sequence.
D. Use remote element temperature transmitters for points of temperature transmitters for points of temperature measurement occurring in air ducts or shafts, or in mechanical piping system.
E. Use remote element pressure transmitters of panel-mounted pressure gages.
F. Where continuous indication of space temperature is on local control panels, install a thermostat and a temperature transmitter side by side.
   1. Pipe continuous indication signal to a receiver on panel.
   2. A resistance element or thermocouple signal may be used with continuous indicating meter, calibrated in degrees Fahrenheit.
G. In general, locate thermostats for room control immediately inside door, above light switch, unless shown otherwise.
   1. Where light switch is in an entryway to room, locate thermostat on wall within room so it is capable of sensing true space conditions.
   2. Prior to installation, coordinate thermostat location with Engineer.
H. Mount local control panels adjacent to equipment served.
I. Where a temperature indicating gage is used at the panel, a pressure gage indicating transmitter signal is not required.
J. Provide appropriate type continuous reading indicator for each controller, transmitter and transducer.
   1. Mount in-line or tapped on controller.
   2. Mount at local control panel.
K. Gages with flexible hose terminating with hypodermic needle may be used for checking control system.
   1. Do not substitute for in-line gages.
L. Locate panels so visual observation and adjustment can be accomplished from floor level.

END OF SECTION
SECTION 23 21 00
HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of the established standards of quality.
3. Certifications.
4. Test reports.
B. Operation and Maintenance Manuals:
1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
1. Automatic air vents:
   a. Armstrong Machine Works; Model No.21AR.
   b. Amtrol; Model No.720.
2. Combination strainer and air separator:
   a. Bell and Gossett; Rollairtrol.
3. Tank fittings:
   a. Bell and Gossett; Model ATFL.
4. Balancing valves and readout meters:
   a. Bell and Gossett; Circuit Setter Balance valves and Model R0-2 meter.
5. Flow measuring devices and meters:
   a. Aeroquip.
   b. Barco.
   c. Dieterich Standard Corp.
6. Heating water pumps:
   a. Bell and Gossett.

7. Expansion joints:
   a. Flexonics Div.
   b. Zallea Brothers, Inc.
   c. Pathway Bellows, Inc.

8. Flexible connections:
   a. Flexonics Div.
   b. Barco.
   c. Anaconda Metal Hose.

9. Three-way valves:
   a. Apollo.
   b. Bray.
   c. Dezurik.

### 2.2 EQUIPMENT

#### A. Automatic Air Relief Vents:
1. Type: Single-lever.
2. Material: Cast iron.
3. Vessel design limitations (PSIG): 150 at 250 DEGF minimum.
4. Relief tubing: K copper.
5. Size: As required.

#### B. Manual Air Relief Vents:
1. Type: Class 150 bronze gate with rising stem and solid wedge.
2. Material:
   b. Packing nut and packing gland: Bronze ASTM B62 or ASTM B584 alloy C84400.
   d. Hand wheel: Aluminum ASTM B85 Alloy A03800.
   e. Hand wheel nut: Zinc-plated steel with clear chromate.
3. Design limitations: 150 PSI steam at 406 DEGF minimum.
4. Relief tubing: K copper.
5. Size: As required.

#### C. Compression Tanks:
1. ASME code construction with gage glass and gage cocks.
2. Size: As recommended by manufacturer.

#### D. Combination Strainer and Air Separator:
1. ASME code constructed.
2. Type: Tangential flow.
3. Design pressure: 125 PSIG minimum at 350 DEGF.
4. Air collector tube:
   a. Stainless steel.
   b. 63 PCT open area design (minimum).
5. NPT vent connection.
6. NPT blowdown connection.
7. Tangential nozzles:
   a. NPT up to 3 IN DIA.
   b. Flanged, 4 IN and larger.
8. Strainer:
   a. Galvanized steel.
   b. Free area not less than five (5) times the cross sectional area of the connecting pipe.
   c. Removable.
9. GPM: As indicated.
E. Tank Fittings:
   1. Body: Cast iron.
   2. Tubes: Copper and copper plated.
   5. Design pressures: 125 PSI minimum.

F. Balancing Valve:
   1. Type: Calibrated balance valve.
   2. Connections:
      a. NPT up to 3 IN DIA.
      b. Flanged for 4 IN or larger.
   5. Integral seals.
   6. Preformed polyurethane insulation.
   7. Working pressure: 125 PSIG at 250 DEGF minimum.

G. Readout Meter for Balancing Valves.
   1. Type: Portable.
   2. Range: 0 to 100 FT of water.
   3. Increments: 0.5 FT.
   4. Accuracy: +0.5 PCT.
   5. Accessories:
      a. Carrying case.
      b. 10 FT hoses.
      c. Shut-off and vent valves.
      d. Balance valve calculator.

H. Water Flow Measuring Devices:
   1. Venturi type (non-corrosive areas).
      a. Material:
         1) Bronze to 3 IN DIA.
         2) Cast steel for 4 IN or larger.
      b. Connections:
         1) NPT to 3 IN or larger.
         2) Flanged for 4 IN or larger.
      c. Minimum length: 1.6 x pipe diameter.
      d. Accuracy: +1 PCT.
         1) Accuracy obtained with as little as five (5) pipe diameters of straight pipe upstream
            and two (2) pipe diameters downstream.
         e. Two (2) sensing taps, nipples, shut-off valves, and quick connect couplings.
   2. Pivot type (corrosive areas).
      b. Permanent pressure loss to system: 5 IN water of head on sizes over 1-1/2 IN,
         maximum.
      c. Impact port size:
         1) Pipes 2 to 5 IN: 0.125 IN ID minimum.
         2) Pipes 4 IN or larger: 0.281 IN ID minimum.
      d. Nominal 1/4 IN SAE flare safety shut-off instrument valves.
      e. Accuracy: +2 PCT of actual valve.
      f. Repeatability: +2 PCT of actual valve.
      g. Maximum temperature rating in water: 300 DEGF.
      h. Maximum pressure rating in water: 500 PSIG.
I. Readout Meter for Water Flow Measuring Devices:
   1. Type: Portable.
   2. Range: 0 to 100 IN of water.
   3. Accuracy: +2 PCT.
   4. Increments: 1 IN of water.
   5. Accessories:
      a. Carrying case.
      b. 10 FT hoses.
      c. Shut-off valves.
      d. Operating manual.
   6. Maximum operating temperature: 250 DEGF water at 250 PSIG.

J. Glycol Loop Pumps (65ESAD-HWP01 and 65ESAD-HWP02), Hot Water Pump (65ESAD-HWP05), Boiler Recirculation Pumps (65ESAD-HWP06 and 65ESAD-HWP07):
   1. Type: Centrifugal, single-stage, in-line as indicated on drawings.
   2. Material:
      a. Volute: Cast iron ASTM A159.
      b. Impeller:
         1) AA sizes: Brass, ASTM B36.
         2) A, F sizes: Cast bronze, ASTM B584.
      c. Pump shaft: Steel, SAE 1144.
      d. Seal assembly:
         1) Housing: Brass.
         2) Bellows: Buna-N.
         3) Ring: Carbon.
         4) Spring: 304 stainless steel.
         5) Seat: Ceramic.
         6) Seat gasket: Buna-N.
      e. Volute gasket: Cellulose fiber.
      f. Companion flanges:
         1) 1 to 1-1/2 IN: Formed steel.
         2) 2 IN and larger: Cast iron, ASTM A159.
      g. Shaft sleeve: Copper alloy 110 or aluminum bronze, ASTM B584.

K. Expansion Joints:
   1. For piping 2-1/2 IN or smaller:
      a. Type: Bellows.
      b. Material:
         1) Bellows: Two-ply stainless steel.
         2) Shrouds and end fittings: Carbon steel.
      c. Stroke: Contractor shall calculate required expansion and contraction for piping system layout.
      d. Maximum operating temperature: 750 DEGF.
      e. Maximum working pressure: 175 PSI.
      f. Maximum test pressure: 250 PSI.
      g. Fittings: NPT.
   2. For piping 3 IN or larger:
      a. Type: Controlled flexing bellows.
      b. Material:
         1) Bellows: Stainless steel.
         2) Carrier rings and fittings: Steel.
      c. Maximum transverse travel: 7-1/2 IN. Contractor shall calculate required expansion and contraction for piping system layout.
      d. Temperature limits: -20 to 850 DEGF.
      e. Allowable pressure: Vacuum to 300 PSI.
L. Pipe Guides:
   1. Type: System consisting of a spider which rigidly attaches to pipe and is housed in a sleeve which can be rigidly anchored.

M. Flexible Connectors:
   1. Type: Flexible corrugated single braid hose.
   3. Maximum working pressure: 150 PSIG.
   4. Maximum test pressure: 250 PSIG.
   5. Normal burst pressure: 650 PSIG minimum.
   6. Fittings:
      a. For sizes up to 2-1/2 IN DIA: NPT.
      b. For sizes 3 IN or larger: Flanged.

N. Three-way Valve (65ESAD-TCV01 and 65ESAD-TCV-02):
   1. Type: Diverting or mixing type as required for service.
   2. Valves shall have modulating plugs and contoured disc type inner valve construction to ensure modulation of flow and shut-off features as the application demands. Furnish valves with iron bodies with flanged ends.
   3. Rate valve at a maximum fluid pressure of 125 PSI, and a maximum fluid temperature of 350 DEGF.
   4. Flanged connections.
   5. Valve bodies suitable for 125 PSIG WP.

O. Hot water pumps to be sized for required flow and head of heating system.

P. Pressure Relief Valve
   1. Acceptable Manufacturer:
      a. Fisher 98 Series.
   2. Materials:
      a. Body: Cast iron.
      b. Spring: Steel.
      c. Trim: 416 stainless steel.
   3. Design Requirements:
      a. Pipe relief to discharge at non-hazardous location.

2.3 FABRICATION

2.4 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hydronic specialty items where indicated or required.

B. Install at high point in closed water systems and at high point of coil headers an automatic relief vent.
   1. Install shut-off valve ahead of each vent.
   2. Extend relief tubing from vent to drippan or drain.

C. Install flexible connectors at pump suction and discharge and where indicated.
D. Install pipe guides in accordance with EJMA Standards.
   1. Space at 4 and 14 pipe diameters from expansion joints.
   2. Install at expansion loops as indicated.

E. Provide pumps to operate at specified system fluid temperatures without vapor binding and
cavitation, are non-overloading in parallel or individual operation, and operate within 25 PCT of
midpoint of published maximum efficiency curve.

F. Install long radius reducing elbows or reducers between pump and piping. Support piping
adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted
pumps, install supports under elbows on pump suction and discharge line sizes 4 IN and over.

G. Install Pumps on Vibration Isolators.

H. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check
valve, balancing valve, and shut-off valve on pump discharge.

I. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent
to pump so no weight is carried on pump casings. Provide supports under elbows on pump
suction and discharge line sizes 4 IN and larger.

J. Provide air cock and drain connection on horizontal pump casings.

K. Provide drains for bases and seals.

L. Check, align, and certify alignment of base mounted pumps prior to start-up.

M. Lubricate pumps before start-up.

N. Install Work in accordance with local codes.

3.2 **FIELD QUALITY CONTROL**

   A. See Section 23 05 93.

**END OF SECTION**
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

B. Qualifications:
   1. Fabricator: Firms regularly engaged in the manufacture of the specific product, of type, size required, whose products have been in use in similar service for not less than three (3) years.
   2. Installers: Firm with at least five (5) years installation experience on products similar to that required for this Project.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Efficiency ratings per ASHRAE 52 for factory built and assembled filter units.
   4. Scaled Ductwork Drawings (1/4 IN equals 1 FT) showing duct and accessory layout and support.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

C. Informational Submittal:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Documentation of qualifications for fabricators and installers.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Transverse joints (factory fabricated aluminum):
   a. Ductmate Industries, Inc.

2. Turning vanes:
   a. Ductmate Industries, Inc.
   b. Duro Dyne.
   c. SEMCO Incorporated.

3. Flexible duct connections:
   a. Vent Fabrics.
   b. Duro Dyne.

4. Flexible connector thrust restraint:
   a. Mason WB.

5. Access doors in ductwork:
   a. Vent Fabrics.
   b. American Warming.

6. Backdraft dampers:
   a. Air Balance.
   b. Ruskin.
   c. American Warming.

7. Grilles and registers:
   a. Anemostat.
   b. Carnes.
   c. Titus.

8. Air filters:
   b. Farr.
   c. Continental.

9. Manual (volume) dampers:
   a. Air Balance.
   b. Ruskin.
   c. American Warming.

10. Duct sealers:
    a. Durkee-Atwood.
    b. Unitec McGill.
    c. Benjamin Foster.
    d. Design Polymeric.

11. Temperature control and automatic dampers:
    a. Air Balance.
    b. Ruskin.
    c. American Warming.

2.2 COMPONENTS

A. Duct and Fittings (Metallic):
   1. Materials:
      a. 3003 H-14 aluminum alloy:
         1) Comply with ASTM B209.
   2. Fabrication (aluminum):
      a. Minimum sheet material thickness:
         1) Ducts with largest side or diameter to 30 IN: 0.05 IN thick.
2) Ducts with largest side or diameter greater than 30 IN: 0.08 IN thick.
b. Utilize SMACNA HVAC Duct Construction Standards for minimum of 2 IN water
gage static pressure for the minimum sheet material thickness specified herein.
1) Heavier gage sheet material may be used with associated reinforcement as an
alternate to minimum thickness specified.
2) Lighter gage sheet material with associated reinforcement shall not be used as an
alternate to minimum thickness specified.
c. Longitudinal seams:
1) 0.050 Material:
   a) Pittsburgh seam.
   b) Continuously welded.
2) 0.080 Material: Continuously welded.
d. Continuously weld seams on factory assembled units.
e. Transverse joints (Alternate A):
1) SMACNA T-22 companion flange.
2) Gasketed.
3) Rigidity class:
   a) Ducts with largest side or diameter to 30 IN: SMACNA Class D (1-1/2 x 1-
1/2 x 1/8 IN angles).
   b) Ducts with largest side or diameter greater than 30 to 54 IN: SMACNA Class
H (2-1/2 x 2-1/2 x 3/16 IN angles).
f. Transverse joints (Alternate B):
1) Materials and fabrication:
   a) Angles: Aluminum.
      (1) Ductmate 35.
   b) Corners: Aluminum.
      (1) Ductmate DC 35.
   c) Snap cleats: Aluminized or stainless steel.
   d) Gaskets: Closed cell neoprene.
   e) Bolts: Stainless steel.
   f) Sheet metal screws: Self-drilling stainless steel with unthreaded section under
head.
   2) Fabrication:
      a) Rigidity class: SMACNA Class H.
      b) 3/8 IN DIA x 1 IN bolts.

B. Supports and Hangers:
1. Materials (for aluminum duct):
   a. Support angles: Aluminum or stainless steel, minimum 1-1/2 by 1-1/2 by 1/4 angle.
   b. Hanger rods: Stainless steel.
   c. Anchors: Stainless steel wedge type.
2. Fabrication: Trapeze type units.
3. Strap hangers are not allowed.

C. Turning Vanes:
1. Materials: Same as duct.
2. Fabrication:
   a. Fabricate double vane units.
   b. Pressure drop through elbows: Maximum 20 PCT of velocity pressure.

D. Flexible Connections:
2. Fabrication: Withstand 4.5 IN water column, positive and negative pressure.

E. Access Doors:
1. Materials:
   a. Inner panel, out panel and frame: Same as duct.
b. Gaskets: Closed cell neoprene.
c. Insulation: 1 LB density fiberglass.
d. Hinges: Stainless steel.
e. Latches:
   1) Aluminum-zinc alloy.
   2) Outside lever handle.
   3) Adjustable spacer.
   4) Beveled inside flange.
   5) Studs:
      a) Minimum 3/8 IN DIA stud for doors up to 24 IN wide x 48 IN high.
      b) Minimum 1/2 IN DIA stud for doors larger than 24 x 48 IN.

2. Fabrication:
   a. Provide four-side continuous gaskets.
   b. Utilize continuous piano hinges.
   c. Latches required:
      1) 12 IN in any direction: One (1).
      2) Up to 18 x 18 IN: Two (2).
      3) Up to 24 x 48 IN: Two (2) with inside handles.
      4) Up to 24 x 72 IN: Three (3) with inside handles.
      5) Minimum door size: 12 x 12 IN.

F. Volume Extractors:
   1. Materials (for aluminum duct):
      a. Mounting bracket: 0.071 IN aluminum.
      b. Movement bar: 0.080 IN aluminum.
      c. Blades: 0.050 IN aluminum.

2. Fabrication:
   a. Gang operated parallel blade, fully adjustable.
   b. Minimum two (2) manually operated adjustment arms.
   c. Rotating shaft: Minimum 3/8 IN SQ.

G. Flexible Duct:
   1. Material: Continuous steel supporting spiral covered with 100 PCT continuous filament fiberglass with nonporous fiberglass/vinyl liner and reinforced Mylar/neoprene outer cover.
   2. UL listed, Class 1 with flame spread of 25 or less and smoke development rating not to exceed 50.

H. Drain Pan:
   1. Materials: Aluminum.
   2. Fabrication: 0.080 IN.

I. Acoustical Liners:
   1. Materials:
      a. Thickness: 1 IN.
      b. 3 LBS/CF density fiberglass.
      c. UL listed, Class 1, non-combustible.

J. Backdraft Dampers:
   1. Material:
      a. 6063 T5 aluminum.
   2. Fabrication:
      a. Frame thickness: 0.125 IN minimum.
      b. Blade thickness: 0.070 IN minimum.
      c. Linkage: 1/2 IN tie bars.
      d. Bearings: Synthetic.
K. Fire Dampers:
   1. Materials:
      a. Frame, blades, enclosure: Galvanized steel.
   2. Fabrication:
      b. Blades:
         1) Curtain type.
         2) 24 GA, G60.
      c. Enclosure: 20 GA, G60.
      d. Fusible link: 212 DEGF, UL listed.
      e. Fire rating: 1-1/2 HR per UL 555.
      f. Mounting: Vertical or horizontal.
      g. Design with blade package out of air stream.

L. Combination Fire and Smoke Dampers:
   1. Materials:
      a. Frame, blades, enclosure: Galvanized.
   2. Fabrication:
      a. Frame: 5 IN x 16 GA.
      b. Blades:
         1) 6 IN wide.
         2) 16 GA.
      c. Bearings: Stainless steel sleeve pressed into frame.
      d. Jamb seals:
         1) Flexible metal.
         2) Compression type.
         3) Stainless steel.
      e. Sleeve: Factory-supplied 20 GA.
      f. Fusible link: 212 DEGF, UL listed.
      g. Fire rating:
         1) Per UL 555.
         2) For rating see Drawings.
      h. Leakage rate: Class III per UL 555S.
   3. Mounting: Vertical or horizontal.
   5. Factory installed.
   6. 120 V, 60 HZ.
   7. UL listed.

M. Volume Dampers and Flow Equalizers for Round Neck Diffusers:
   1. Material: Aluminum.
   2. Fabrication:
      a. Design for neck velocity: 2500 FT/MIN.
      b. Center rod operator accessible through diffuser without removing diffuser.
      c. Furnish with screws, duct collars, transitions and air pattern deflectors as required.

N. Air Grille and Register Assembly:
   1. Materials:
      b. Gaskets: Sponge rubber.
   2. Fabrication:
      a. Supply registers: Two (2) sets individually adjustable louvers.
      b. Exhaust and return registers: 45-degree deflection front blades.
      c. Dampers: Key-operated opposed blade.
      d. Screws, duct collars, and transitions as required.
      e. Finish:
         1) Manufacturer's standard factory applied finish.
2) Color: White.

O. Air Filter Enclosure:

1. Housing:
   a. Factory fabricated.
   b. 16 GA galvanized steel.
   c. Bracing to eliminate racking.
   d. Two-side access doors.

2. Access doors:
   a. 16 GA galvanized steel.
   b. Replaceable positive sealing latches.
   c. Replaceable hinges.
   d. Neoprene door gasket.
   e. Holding frame to door gasket: Polyurethane foam.

3. Tracks:
   a. Field adjustable.
   b. Anodized extruded aluminum.
   c. Polypropylene seal between holding frame and track.

4. Holding frame:
   a. Galvanized steel.
   b. Multiple fastener lances.
   c. Polyurethane foam gasket.
   (1) Internally.
   (2) Frame sides.
   d. Accommodate nominal 24 x 24 IN or 12 x 24 IN filters without modifications to frame
   or housing.

P. Air Filters:

1. Materials:
   a. Holding frame: Aluminum.

2. Fabrication:
   a. Factory built and assembled unit.
   b. Efficiency rating as per ASHRAE 52.
   c. 2 IN thickness minimum.
   d. Efficiency: 20 PCT.
   e. Air velocity: 450 FPM maximum.
   f. Clean pressure drop: 0.2 IN WG maximum.
   g. Size, capacity, and type: As indicated on Drawings.

Q. Temperature Control, Automatic and Manually (Volume) Operated Dampers:

1. Material:
   b. Seal blade edge: Extruded vinyl.

2. Fabrication:
   a. Frame thickness: 0.125 IN minimum.
   b. Provide flanged connections.
   c. Blades:
      (1) Two-position damper: Parallel blade.
      (2) Mixing and volume damper: Opposed blade.
      (3) Airfoil shape.
      (4) Maximum 6 IN width.
   d. Linkage: Concealed in frame.
   e. Axles: 1/2 IN plated steel hex.
   f. Bearings: Molded synthetic.
   g. Seals:
      (1) Jamb: Flexible compression type.
   h. Control shaft: Removable, 1/2 IN DIA.
i. Air leakage (4 FT SQ damper) at 4 IN WG pressure: 99 cfm maximum.

j. Motors for motor operated damper: See Specification Section 23 09 00.

k. Provide outboard support for operator linkage where damper motor is to be installed outside of duct.

l. Provide stainless steel locking quadrants for manual (volume) dampers.
m. Provide fold out operator mounting bracket where damper motor is to be installed on face of damper or inside duct.

n. Finish: 215 R1 anodized.

R. Duct sealer:
1. NFPA rating of "Non-Combustible".
2. Flame spread rating: 25 or lower, in dry condition.
3. Smoke developed rating: 50 or lower, in dry condition.
4. Resistant to water and water vapors.
5. Comply with UL 181.
6. Pressure rupture rating: 16 IN WG, minimum.

S. Louvers: See Specification Section 08 90 00.

2.3 MAINTENANCE MATERIALS

A. Extra Materials:
1. Furnish Owner with the following extra materials:
   a. Two complete filter media changes for each filter unit.
   b. Filter media used during construction is in addition to this requirement.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 01 61 03.

B. Metal Ductwork:
1. Install with longitudinal seams sealed for zero leakage.
   a. For welded seams, submit sample for approval by Engineer.
2. Install gaskets at each transverse joint and fasten sections together with bolts.
   a. Tighten for zero leakage.
3. Install supports and hangers with anchors in accordance with SMACNA HVAC Duct Construction Standards.
4. Install turning vanes in square elbows:
   a. Unsupported vane length not to exceed 48 IN.
   b. Position vanes at proper angle to meet specified pressure drop.
5. Install flexible connections at fans:
   a. Locate as close as possible to fan.
   b. Allow 1 IN of slack to prevent vibration transmission.
   c. Install thrust restraints across connectors.
6. Install access doors where indicated on Drawings and at smoke and fire damper in accordance with NFPA requirements.
7. Volume extractors:
   a. Install at supply registers, grilles, diffusers and supply branch connections from ducts.
   b. Provide branch duct extensions into main duct above and below extractor when branch duct is narrower than main duct.

C. Flexible Ductwork:
1. Install in concealed areas between: low velocity duct work and diffusers, return air grilles or exhaust outlets and ducts.
2. Use low loss fittings for connection to duct.
3. Connect to metal duct collars by means of non-combustible synthetic rubber sealing compound and stainless steel drawband.
D. Drain Pans:
   1. Install at fan coil cooling coils, control valves above finished ceilings and at other sources of moisture.
   2. Install metal tubing at drain and terminate above floor drain, equipment drain and as shown on Drawings.

E. Dampers:
   1. Install where required by code.
   2. Install fire and smoke dampers in ductwork passing through 1 HR or higher fire-rated construction.
      a. Install in wall and floor openings utilizing steel sleeves, angles and other materials following practices required to provide installation in accordance with local Building Codes.

F. Diffusers:
   1. Install where shown on Drawings of size and capacities scheduled on Drawings.
   2. Install painted lay-in type in lay-in ceilings.
   3. Install prime painted diffusers in areas where duct work is concealed.
   4. Install anodized diffusers in exposed duct work.

G. Air Grille and Register Assemblies:
   1. Install where shown on Drawings of size and capacities scheduled on Drawings.
   2. Install prime painted grilles and registers in areas where duct work is concealed.
      a. Field paint to match adjacent surface finish.

H. Roof-mounted Intake Hoods: Install where shown on Drawings.

I. Air Filters:
   1. Install where shown on Drawings of size and capacity scheduled on Drawings.
   2. Do not operate equipment during construction without filters.

END OF SECTION
SECTION 23 34 00
HVAC: FANS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Miscellaneous:
   1. Gage thickness specified herein shall be manufacturer’s standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
   2. Corrosion protection of equipment to be as specified herein.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Wiring diagrams.
      c. Control diagrams.
      d. Manufacturer's catalog cuts and technical data.
      e. Corrosion-protection information.
      f. Fan curves.
      g. Sound data.
      h. Vibration isolation.
      i. Performance data on all equipment.
   3. Certifications:
      a. Provide certification of thickness of corrosion-protection coating.
      b. Fan systems have been tested in accordance with AMCA Standard 210 or 260, and are licensed to bear the AMCA Certified Ratings Seal.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except as specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Vibration isolation assemblies:
   a. Mason.
   b. Vibration Mounting and Controls Co.
   c. Vibro-Acoustics.

2. Corrosion-protective coatings:
   a. Heresite and Chemical Co.; "Heresite."
   b. Aero-Marine Engineering, Inc.
   c. Luvata ElectroFin.

3. Wall-mounted centrifugal exhaust fans:
   a. Loren Cook.
   b. PennBarry Ventilator Co., Inc.

2.2 GENERAL

A. All Manufactured Units:
   1. Comply with Specification Section 01 61 03.
   2. Factory wired and assembled.
   3. Use fasteners made of same material as unit.
   4. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
      a. Type: As per ASHRAE HVAC Applications Handbook.

B. All manufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.

   1. Type:
      a. Corrosion-resistant materials:
         1) Aluminum.
         2) Stainless steel.
         3) FRP.
      b. Corrosion-resistant coating:
         1) Phenolic-based coating or Epoxy-based coating.
         2) 3 mil minimum dry thickness, air-dried coating, for surfaces exposed to temperatures less than 150 DEGF.
         3) 5 mil baked-on coating for heat transfer surfaces and surfaces exposed to temperatures greater than 150 DEGF.
         4) Factory applied.
         5) Provide factory certification of application.

2.3 MANUFACTURED UNITS

A. Wall-Mounted Centrifugal Exhaust Fans:
   1. AMCA certified.
   2. Non-overloading horsepower capabilities.
   3. Materials:
      a. Housing: Spun aluminum.
      b. Wheel: Aluminum.
      c. Drive shaft: Stainless steel.
      d. Minimum 10 GA motor mounting plate.
   5. Statically and dynamically balanced wheel.
   6. Bearings:
      a. Cast iron pillow blocks.
b. Concentric bearing locking collar for drive shafts 1 IN and larger.
   1) SKF "ConCentra."
   2) Dodge "D Lock."
   c. Regreaseable.
   d. 200,000 HR average life.
7. Weather tight compartment for motor and drives.
   a. Separated from airstream.
8. Motor:
   a. See Specification Section 01 61 03.
   b. Belt Drive Units:
      1) Driver and driven sheaves:
         a) Keyed hub type.
         b) Drive sheaves: Fixed pitch diameter.
         c) Driver:
            (1) Shipped with variable pitch diameter sheave.
            (2) Fixed pitch diameter size based on approved test and balance reports.
         d) V-belt drives sized for 150 PCT motor horsepower.
      2) Automatic drive belt tensioner.
   c. Direct Drive Units:
   d. Vibration isolated motor assembly.
   e. Integral attachment collar.
9. Accessories:
   a. Aluminum birdscreen.
   b. Backdraft damper: See Specification Section 23 31 00.
   c. Extended grease lines and fittings.
10. Spark-resistent construction for classified areas:
    a. Type A: All parts in air stream are aluminum or non-ferrous construction.
    b. Type B: Aluminum wheel and an aluminum rub ring where the fan shaft passes
       through the housing.
    c. Type C: Aluminum inlet cone and an aluminum rub ring where the fan shaft passes
       through the housing.
11. Size and capacity as determined by system designer.

2.4 SOURCE QUALITY CONTROL
A. Factory Performance test for any fan having a flow rate greater than 1,000 CFM and/or a total
   static pressure rating equal to or greater than 1.5 IN WC.
   1. Pursuant to AMCA Publication 203 or 210 with no plus tolerances on Power and no minus
      tolerances on flow or pressure.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Install in accordance with Specification Section 01 61 03.
B. Install fixed pitched drive sheave after sheave has been sized based on accepted test and balance
   report.
C. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings
   lubricated and fan has been test run under observation.

3.2 FIELD QUALITY CONTROL
A. Comply with Specification Section 23 05 93.
3.3 ADJUSTING

A. Install new filters on units which have been running prior to acceptance of Project.

END OF SECTION
SECTION 23 80 00
HVAC: EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Miscellaneous:
   1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
   2. Corrosion protection of equipment to be as specified herein.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Manufacturer's installation instructions.
      c. Wiring diagrams.
      d. Control diagrams.
      e. Manufacturer's catalog cuts and technical data.
      g. Fan curves.
      h. Sound data.
      i. Vibration isolation.
      j. Control description.
      k. Performance data on all equipment.
   3. Certifications:
      a. Provide certification of thickness of corrosion-protection coating.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Vibration isolation assemblies:
   a. Mason.
   b. Vibration Mounting and Controls Co.
   c. Vibro-Acoustics.

2. Corrosion-protective coatings:
   a. Heresite and Chemical Co.; "Heresite."
   b. Aero-Marine Engineering, Inc.
   c. Luvata ElectroFin.

3. Cooling coils - direct expansion:
   a. Carrier.
   b. Daikin Applied.
   c. AAON.

4. Heating and cooling coils - water:
   a. Carrier.
   b. Daikin Applied.
   c. AAON.

5. Heating coil - electric:
   a. Carrier.
   b. Daikin Applied.
   c. AAON.

6. Unit heater - electric:
   a. Brasch.
   b. Chromalox.
   c. QMark.

7. Unit heaters - water:
   a. Modine Manufacturing Co.
   b. Armstrong-Hunt Inc.

8. Make-up air units, direct fired, gas:
   a. Hastings.
   b. Titan.
   c. AAON.

9. Make-up air units, water:
   a. Hastings.
   b. Daikin Applied.
   c. AAON.

10. Ductless split air conditioning system:
   a. Carrier.
   b. Daikin.
   c. Bryant.

11. Positive pressurization unit:
   a. Purafil.

2.2 GENERAL

A. All Manufactured Units:
   1. Comply with Specification Section 01 61 03.
   2. Factory wired and assembled.
   3. Use fasteners made of same material as unit.
4. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
   a. Type: As per, ASHRAE HVAC Applications Handbook.

B. Indicated manufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.
   1. Type:
      a. Corrosion-resistant materials:
         1) Aluminum.
         2) Stainless steel.
         3) FRP.
      b. Corrosion-resistant coating:
         1) Phenolic-based coating:
         2) 3 mil minimum dry thickness, air-dried coating, for surfaces exposed to temperatures less than 150 DEGF.
         3) 5 mil baked-on coating for heat transfer surfaces and surfaces exposed to temperatures greater than 150 DEGF.
         4) Factory applied.
         5) Provide factory certification of application.

2.3 MANUFACTURED UNITS

A. Equipment Coils:
   1. Cooling coils - direct expansion:
      a. Corrosion resistant on units indicated as corrosion resistant.
      b. ARI certified.
      c. Material:
         1) Aluminum.
         2) Copper with aluminum fins for use in administration units only.
      d. Fin spacing: Minimum 80 fins per foot.
      e. Minimum standard operating limit: 250 psi.
      f. Size and capacity as scheduled.
   2. Heating coils - water:
      a. Corrosion resistant on units indicated as corrosion resistant.
      b. ARI certified.
      c. Material:
         1) Aluminum.
         2) Copper with aluminum fins for use in administration units only.
      d. Fin spacing: Minimum 80 fins per foot.
      e. Minimum standard operating limit: 200 psi.
      f. Equip with vent, drain and condensate connections.
   3. Heating coil - electric:
      a. Corrosion resistant on units indicated as corrosion resistant.
      b. ARI certified.
      c. 80-PCT nickel, 20-PCT chromium elements.
      d. Maximum heating density: 35 watts/SQ IN.
      e. Built-in thermal protection.
      f. Airflow switch.
      g. Built-in circuit fusing.
      h. Control voltage transformer.
      i. Terminal block.
      j. Magnetic contactor.
      k. Fused disconnect switch.
      l. Step controller as required by instrumentation.
      m. Single point electrical connection.

B. Unit Heater - Electric:
   1. Type: Horizontal.
2. UL listed for non-rated areas.
3. Material:
   b. Heating elements: Copper-clad steel.
4. Fan motors:
   a. See Specification Section 01 61 03.
   b. Built-in automatic reset overload protection.
5. Dynamically balanced fan.
7. Accessories:
   a. Mounting bracket.
   b. 40 to 90 DEGF, 5 DEGF differential wall-mounted thermostat.

C. Unit Heater - Electric:
1. UL listed for Class 1, Group D, Division 1 areas.
2. Material:
3. Fan motor:
   a. See Specification Section 01 61 03.
   b. Built-in overload protection.
5. Integral line voltage terminal block.
6. Accessories: Mounting bracket.

D. Make-Up Air Units, Glycol:
1. Corrosion Resistant.
2. ARI certified.
4. Materials:
   a. Cabinet: Galvanized steel.
   b. Scroll housing: Galvanized steel.
5. Blower section:
   a. Blower wheels:
      1) Statically and dynamically balanced.
      2) Forwardly curved double width, double inlet.
      3) Mounted on solid turned ground steel shaft.
   b. Bearings:
      1) Self-aligning grease lubricated ball type.
      2) Extended lubrication lines with external grease fittings.
      3) Average life rating: 200,000 HRS.
   c. Blower scrolls, bearings and adjustable base to be mounted on reinforced angle iron frame.
   d. Internal spring isolation.
   e. Driver and driven sheaves:
      1) Keyed hub type.
      2) Drive sheaves: Fixed pitch diameter.
      3) Driver: Variable pitch diameter sheave.
      4) V-belt drives sized for 150 PCT motor horsepower.
   f. Motors: See Specification Section 01 61 03.
   g. Insulated cabinet.
6. Heating(cooling) section:
   a. Coils: See paragraph(s) in Article 2.3, Equipment Coils.
   b. Insulated cabinet.
7. Drain pan: Double pan construction, insulated.
8. Accessories:
   a. Factory-built heavy-duty filter section with access doors.
   b. Filters: See Specification Section 23 31 00.
   c. Combination Angular filter and mixing box with parallel acting blade dampers.
   d. Face and bypass damper section with opposed blade dampers.
   e. Inlet hood with birdscreen.
   f. Prefabricated insulated roof curb.

E. Ductless Split Air Conditioning System:
1. Outdoor Unit:
   a. Casing and frame:
      1) Installation: Base equipped with lifting brackets with lifting holes.
      2) Removable end panel for access to components and connections.
   b. Compressors:
      1) Inverter compressor, with 5 year non-prorated warranty.
      2) Suction and discharge service valves.
      3) Thermal overload protection.
   c. Condenser coils:
      1) Nominal 3/8 IN OD seamless copper mechanically bonded to corrugated aluminum fins.
      2) Factory leak tested at 315 psig under water.
   d. Condenser fans:
      1) Direct drive: See Specification Section 01 61 03.
      2) Propeller type.
   e. Expansion valve.
   f. Low ambient cooling capability to -20 DEGF.
2. Indoor unit:
   a. Materials:
      1) Pan insulation: Foam-in-place insulation.
      2) Casing insulation: 1 IN, 3/4 LB fiberglass blanket.
   b. Casing:
      1) Removable access panel.
   c. Evaporator fans:
      1) Backward curved.
      2) Statically and dynamically balanced.
   d. Filter section:
      1) Filters: See Specification Section 23 31 00.
      2) Access doors for filter removal.
   e. Evaporator coils: See paragraph(s) in Article 2.3, Equipment Coils.
   f. Evaporator coil circuiting:
      1) Adjustable thermal expansion valve per circuit with external equalizer.
   g. Drain pan:
      1) Mastic-coated.
      2) Threaded drain connections.
3. Refrigerant line set between condensing unit and fan coil.
4. Remote controller with wall bracket.

F. Positive Pressurization Unit:
1. Self contained.
2. Pressurization air as scheduled.
3. Total delivered air with recirculation as scheduled.
4. Vertical configuration.
5. Four (4) stages of air purification.
b. Second stage: Media modules filled with 50 LBS of media.

c. Third stage: Same as second.

d. Fourth stage: JFL-90, 90 PCT removal.

6. Materials:
   a. Unit: 14 GA cold rolled steel.
   c. Stage supports: Aluminum track with sealing material.

7. Blower:
   a. Location: Between second and third stage.
   b. Wheel: Backward curved, aluminum.
   c. VFD drive.
   d. Motor: See Specification Section 01 61 03.

8. Module media:
   a. Pelletized.
   b. Activated alumina impregnated with a minimum of 12 PCT sodium permanganate.
   c. 100 LB of media shall remove 14 LB hydrogen sulfide; 14 PCT minimum by weight.
   d. Inorganic.
   e. Non-toxic.
   f. Non-flammable.
   g. Shall not support bacterial or fungal growth.

9. Media performance certification (manufacturer's responsibility):
   a. Performed by laboratory of Owner's (Engineer's) choice.
   b. Test procedure: Pass moist (85 PCT RH) air containing 10 (plus or minus 1) ppm hydrogen sulfide gas at a rate of 2900 ml per minute through a 1.0 IN diameter by 6.0 IN deep uniformly packed bed.
   c. Test shall run continuous for 48 HRS.
   d. During test down stream concentration of hydrogen sulfide shall never exceed 0.05 ppm.

10. Gages:
    a. Outside air flow.
    b. Room pressure.
    c. Pressure differential across first stage.
    d. Pressure differential across final stage.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with Specification Section 01 61 03.

B. Install fixed pitched drive sheave after sheave has been sized based on accepted test and balance report.

3.2 FIELD QUALITY CONTROL

A. Comply with Specification Section 23 05 93.

3.3 ADJUSTING

A. Install new filters on units which have been running prior to acceptance of Project.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Where UL test procedures have been established for the product type, use UL or ETL approved electrical equipment and provide with the UL or ETL label.

1.3 DEFINITIONS
A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
   1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
   2. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.
   3. Corrosive area: Areas identified where there is a varying degree of spillage or splashing of corrosive materials such as wastewater.
   4. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
   5. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
      c. Include data sheets that include manufacturer's name and product model number.
         1) Clearly identify all optional accessories.
      d. Acknowledgement that products are UL or ETL listed or are constructed utilizing UL or ETL recognized components.
      e. Manufacturer's delivery, storage, handling and installation instructions.
      f. Product installation details.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.
B. Protect nameplates on electrical equipment to prevent defacing.

1.6 AREA DESIGNATIONS

A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.

B. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements for individual area classifications.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

B. Provide all components of a similar type by one (1) manufacturer.

2.2 MATERIALS

A. Electrical Equipment Support Pedestals and/or Racks:

1. Approved manufacturers:
   a. Modular strut:
      1) Unistrut Building Systems.
      2) Eaton B-Line.
      3) Thomas & Betts Superstrut.

2. Material requirements:
   a. Modular strut:
      1) Galvanized steel: ASTM A123/123M or ASTM A153/A153M.
      2) Stainless steel: AISI Type 316.
      3) PVC coated galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.
      4) Aluminum: AA Type 6063-T6.

   b. Mounting hardware:
      1) Galvanized steel.
      2) Stainless steel.

B. Field Touch-Up of Galvanized Surfaces:

1. Zinc-rich primer.
   a. One (1) coat, 3.0 mils, ZRC by ZRC Products.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and wire all equipment and perform all tests necessary to ensure that equipment is ready and safe for energization.

B. Install equipment in accordance with the requirements of:

1. NFPA 70.
2. IEEE C2.
3. The manufacturer's instructions.

C. Install equipment plumb, square and true with construction features and securely fastened.

D. Install electrical equipment, including pull and junction boxes, minimum of 6 IN from process, gas, air and water piping and equipment.
E. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.

F. Device Mounting Schedule:
1. General mounting heights are as indicated below:
   a. Light switch (to center): 48 IN.
   b. Receptacle on exterior wall of building (to center): 18 IN.
   c. Receptacle in non-architecturally finished areas (to center): 48 IN.
   d. Safety switch (to center of operating handle): 54 IN.
   e. Separately mounted motor starter (to center of operating handle): 54 IN.
   f. Pushbutton or selector switch control station (to center): 48 IN.
   g. Panelboard (to top): 72 IN.

G. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.

H. Provide electrical equipment support system per the following area designations:
1. Dry areas:
   a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
   b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
2. Wet areas:
   a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts and hardware.
   b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
3. Corrosive areas:
   a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts and hardware.
   b. PVC coated steel system consisting of PVC coated steel channels and fittings with stainless steel nuts and hardware.

I. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer:
1. Do not cut, or weld to, building structural members.
2. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

J. Provide corrosion resistant spacers to maintain 1/4 IN separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Digesters, etc.

K. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.

L. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.

M. Do not use materials that may cause the walls or roof of a building to discolor or rust.

N. Identify electrical equipment and components in accordance with Specification Section 10 14 00.

3.2 FIELD QUALITY CONTROL

A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.
1. See Specification Section 01 73 20 for openings and penetrations in structures.
B. Replace equipment and systems found inoperative or defective and re-test.


D. The protective coating integrity of support structures and equipment enclosures shall be maintained.
   1. Repair galvanized components utilizing a zinc rich paint.
   2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
   3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
   4. Repair surfaces which will be inaccessible after installation prior to installation.

E. Replace nameplates damaged during installation.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 DEFINITIONS

A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

B. Instrumentation Cable:

1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.

2. The following are specific types of instrumentation cables:

   a. Analog signal cable:

      1) Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 Vdc) signals, using No. 16 AWG and smaller conductors.

      2) Commonly used types are defined in the following:

         a) TSP: Twisted shielded pair.
         b) TST: Twisted shielded triad.

   b. Digital signal cable: Used for the transmission of digital signals between computers, PLC’s, RTU’s, etc.

C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG and larger.

D. Shielded VFD Cable: Multi-conductor, insulated, with shield, drain wire and building wires, No. 12 and larger.

E. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, No. 12 or No. 10 AWG.

F. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.

2. Product technical data including:

   a. Acknowledgement that products submitted meet requirements of the established standards of quality.

   b. Provide submittal data for all products specified in PART 2 of this Specification Section except:

      1) Wire connectors.
      2) Insulating tape.
      3) Cable lubricant.
1.5 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Building wire, power and control cable:
   a. Aetna Insulated Wire.
   b. General Cable.
   c. Southwire Company.

2. Shielded VFD cable:
   a. Belden Inc.
   b. General Cable.
   c. Priority Wire and Cable (Prysmian).

3. Analog instrumentation cable:
   a. Belden Inc.
   b. General Cable.

4. Wire connectors:
   a. Burndy Corporation.
   b. Buchanan.
   c. Ideal.

5. Insulating and color coding tape:
   a. 3M Co.
   b. Plymouth Bishop Tapes.
   c. Red Seal Electric Co.

2.2 MANUFACTURED UNITS
A. Building Wire:
   1. Conductor shall be copper with 600 V rated insulation.
   2. Conductors shall be stranded, except for conductors used in lighting and receptacle circuits which may be stranded or solid.
   3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
   4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.
   5. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.

B. Power Cable:
   1. Conductor shall be copper with 600 V rated insulation.
   2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
   3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 and UL 1277 for type THHN/THWN.
   4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
   5. Number of conductors as required, including a bare ground conductor.
   6. Individual conductor color coding:
      b. See PART 3 of this Specification Section for additional requirements.
   7. Conform to NFPA 70 Type TC.
C. Control Cable:
   1. Conductor shall be copper with 600 V rated insulation.
   2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and
      UL label.
   3. Conform to NEMA/ICEA WC 57/S-73-532 and UL 83 and UL 1277 for type
      THHN/THWN insulation with an overall PVC jacket.
   4. Conform to NEMA/ICEA WC 57/S-73-532 and UL 44 and UL 1277 for type XHHW-2
      insulation with an overall PVC jacket.
   5. Number of conductors as required, provided with or without bare ground conductor of the
      same AWG size.
      a. When a bare ground conductor is not provided, an additional insulated conductor shall
         be provided and used as the ground conductor (e.g., 6/c No. 14 w/g and 7/c No. 14 are
         equal).
   6. Individual conductor color coding:
      a. ICEA S-58-679, Method 1, Table E-2.
      b. See PART 3 of this Specification Section for additional requirements.
   7. Conform to NFPA 70 Type TC.

D. Electrical Equipment Control Wire:
   1. Conductor shall be copper with 600 V rated insulation.
   2. Conductors shall be stranded.
   3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and
      UL label.
   4. Conform to UL 44 for Type SIS insulation.
   5. Conform to UL 83 for Type MTW insulation.

E. Shielded VFD Cable:
   1. Conductor shall be copper, stranded with 600 V rated insulation.
   2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and
      UL label.
   3. Cables No. 1 AWG and less:
      a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type RHW-2
         or XHHW-2 insulation with an overall PVC jacket.
      b. Shielding: 85 percent tinned copper braid, full size tinned copper drain wire and 100
         percent foil shield.
      c. Number of conductors: 3 PH and 1 full size ground.
   4. Cables No. 12 through 750 kcmil:
      a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 type XHHW-2 insulation.
      b. Shielding: Continuous corrugated copper-free aluminum sheath covered with a PVC
         jacket or 5 mil copper tape, longitudinally applied with a minimum overlap of 15
         percent.
      c. Number of conductors: 3 PH and 3 equally spaced ground conductors.
   5. Individual conductor color coding:
      b. See PART 3 of this Specification Section for additional requirements.
   6. When installed exposed outdoors, UL listed and marked as sunlight resistant.
   7. For continuously corrugated cable, use manufacturer approved fittings.
   8. Conform to NFPA 70, Type TC.

F. Instrumentation Cable:
   1. Surface mark with manufacturer's name or trademark, conductor size, insulation type and
      UL label.
   2. Analog cable:
      a. Tinned copper conductors.
      b. 300 V or 600 V PVC insulation with PVC jacket.
      c. Twisted with 100 percent foil shield coverage with drain wire.
      d. Six (6) twists per foot minimum.
3. Digital cable:
   a. As recommended by equipment (e.g., PLC, RTU) manufacturer.
   b. Horizontal voice and data cable:
      1) Category 6 per TIA/EIA/ANSI 568.
      2) Cable shall be label-verified.
      3) Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
      4) Conductors: No. 24 AWG solid untinned copper.
      5) Rated CMP per NFPA 70.
   c. Conform to NFPA 262 and NFPA 70 Type ITC.

G. Fiber Optic Cable:
1. Design and fabrication - Multi-mode:
   a. Type:
      1) Indoor: Tight buffered or loose tube with a dry gel water blocking system.
      2) Outdoor: Loose tube with a wet or dry gel water blocking system.
   b. Fiber size: 62.5/125 micrometer (core diameter/cladding diameter).
   c. Glass fiber core.
   d. Step index.
   e. Maximum attenuation:
      1) At 850 nm: 3.75 dB/km.
      2) At 1300 nm: 1.5dB/km.
   f. Minimum bandwidth:
      1) At 850 nm: 160 MHz/km.
      2) At 1300 nm: 500 MHz/km.
   g. Maximum tensile load:
      1) Installation: 225 LBS.
      2) Long term: 67 LBS.
   h. Cable jacket material:
      1) In rigid steel conduit: PVC, or polyethylene.
      2) In plenum or riser: Flame retardant material, PVC not allowed.
         a) Plenum applications: Cable materials shall pass NFPA 262 requirements.
         b) Riser applications: Cable materials shall pass UL 1666 requirements.
      3) In cable tray: Polyethylene or equivalent; PVC not allowed.
         a) Meet vertical flame tray test requirements of NFPA 262.
   i. Cables shall be listed and marked in accordance with the requirements of NFPA 70.
   j. Optical fiber cable type utilized shall be in accordance with NFPA 70.
   k. Utilize LC type connectors:
      1) Tip material: Ceramic or ceramic/glass composite.
      2) Utilize connectors which do not require adhesive, epoxy, or polish.

H. Wire Connectors:
1. Twist/screw on type:
   a. Insulated pressure or spring type solderless connector.
   b. 600 V rated.
   c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
   d. Phase and neutral conductors: Conform to UL 486C.
2. Compression and mechanical screw type:
   a. 600 V rated.
   b. Ground conductors: Conform to UL 467.
   c. Phase and neutral conductors: Conform to UL 486A.
3. Terminal block type:
   a. High density, screw-post barrier-type with white center marker strip.
b. 600 V and ampere rating as required, for power circuits.
c. 600 V, 20 ampere rated for control circuits.
d. 300 V, 15 ampere rated for instrumentation circuits.
e. Conform to NEMA ICS 4 and UL 486A.

I. Insulating and Color Coding Tape:
   1. Pressure sensitive vinyl.
   2. Premium grade.
   3. Heat, cold, moisture, and sunlight resistant.
   4. Thickness, depending on use conditions: 7, 8.5, or 10 mil.
   5. For cold weather or outdoor location, tape must also be all-weather.
   6. Color:
      a. Insulating tape: Black.
      b. Color coding tape: Fade-resistant color as specified herein.
   7. Comply with UL 510.

J. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Permitted Usage of Insulation Types:
   1. Type XHHW-2:
      a. Building wire and power and control cable in architectural and non-architectural finished areas.
      b. Building wire and power and control cable in conduit below grade.
   2. Type THHN/THWN and THHN/THWN-2:
      a. Building wire and power and control cable No. 8 AWG and smaller in architectural and non-architectural finished areas.
   3. Type SIS and MTW:
      a. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers.

B. Shielded VFD Cable:
   1. For wiring between a VFD and motor when routing in cable trays or conduit other than RGS or RAC.

C. Conductor Size Limitations:
   1. Feeder and branch power conductors shall not be smaller than No. 12 AWG.
   2. Control conductors shall not be smaller than No. 14 AWG.
   3. Instrumentation conductors shall not be smaller than No. 18 AWG.

D. Color Code All Wiring as Follows:
   1. Building wire:

<table>
<thead>
<tr>
<th></th>
<th>240/120 V, 208/120 V</th>
<th>480 V, 480/277 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>Black</td>
<td>Brown</td>
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<tr>
<td>Phase 2</td>
<td>Red</td>
<td>Orange</td>
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<tr>
<td>Phase 3</td>
<td>Blue</td>
<td>Yellow</td>
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<tr>
<td>Neutral</td>
<td>White</td>
<td>White or Gray</td>
</tr>
<tr>
<td>Ground</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
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HDR Project # 10045587  City of Fremont, Nebraska
Egg-Shaped Anaerobic Digester - ESAD -
WIRE AND CABLE: 600 VOLT AND BELOW
26 05 19 - 5
a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors shall be identified by a continuous colored outer finish along its entire length.

b. Conductors larger than No. 6 AWG:
   1) Insulated phase and neutral conductors shall be identified by one (1) of the following methods:
      a) Continuous colored outer finish along its entire length.
      b) 3 IN of colored tape applied at the termination.
   2) Insulated grounding conductor shall be identified by one (1) of the following methods:
      a) Continuous green outer finish along its entire length.
      b) Stripping the insulation from the entire exposed length.
      c) Using green tape to cover the entire exposed length.
   3) The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.

2. Power cables ICEA S-58-679, Method 4 with:
   a. Phase and neutral conductors identified with 3 IN of colored tape, per the Table herein, applied at the terminations.
   b. Ground conductor: Bare.

3. Shielded VFD cable ICEA S-58-679, Method 4 with:
   a. Phase conductors identified with 3 IN of colored tape, per the Table herein, applied at the terminations.
   b. Ground conductor: Green color insulation or bare.

4. Control cables ICEA S-58-679, Method 1, Table E-2:
   a. When a bare ground is not provided, one (1) of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.
   b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 IN of colored tape, per the Table herein, applied at the terminations.

E. Install all wiring in raceway.

F. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:
   1. Where field conditions dictate and written permission is obtained from the Engineer.
   2. Control circuits shall be isolated from feeder and branch power and instrumentation circuits but combining of control circuits is permitted.
      a. The combinations shall comply with the following:
         1) 12 Vdc, 24 Vdc and 48 Vdc may be combined.
         2) 125 Vdc shall be isolated from all other AC and DC circuits.
         3) AC control circuits shall be isolated from all DC circuits.
   3. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.
      a. The combinations shall comply with the following:
         1) Analog signal circuits may be combined.
         2) Digital signal circuits may be combined but isolated from analog signal circuits.
   4. Multiple branch circuits for lighting, receptacle and other 120 Vac circuits are allowed to be combined into a common raceway.
      a. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NFPA 70, including but not limited to:
         1) Up sizing conductor size for required ampacity de-ratings for the number of current carrying conductors in the raceway.
         2) Up sizing raceway size for the size and quantity of conductors.
G. Ground the drain wire of shielded instrumentation cables at one (1) end only.
   1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g.,
      field mounted instrument).

H. Splices and terminations for the following circuit types shall be made in the indicated enclosure
   type using the indicated method.
   1. Feeder and branch power circuits:
      a. Device outlet boxes:
         1) Twist/screw on type connectors.
      b. Junction and pull boxes:
         1) Twist/screw on type connectors for use on No. 8 and smaller wire.
         2) Compression, mechanical screw or terminal block or terminal strip type connectors
            for use on No. 6 AWG and larger wire.
      c. Motor terminal boxes:
         1) Twist/screw on type connectors for use on No. 10 AWG and smaller wire.
         2) Insulated mechanical screw type connectors for use on No. 8 AWG and larger
            wire.
      d. Manholes or handholes:
         1) Twist/screw on type connectors pre-filled with epoxy for use on No. 8 AWG and
            smaller wire.
         2) Watertight compression or mechanical screw type connectors for use on No. 6
            AWG and larger wire.
   2. Control circuits:
      b. Manholes or handholes: Twist/screw on type connectors pre-filled with epoxy.
      c. Control panels and motor control centers: Terminal block or strips provided within the
         equipment or field installed within the equipment by the Contractor.
   3. Instrumentation circuits can be spliced where field conditions dictate and written permission
      is obtained from the Engineer.
      a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
      b. Junction and pull boxes: Terminal block type connector.
      c. Control panels and motor control centers: Terminal block or strip provided within the
         equipment or field installed within the equipment by the Contractor.
   4. Non-insulated compression and mechanical screw type connectors shall be insulated with
      tape or hot or cold shrink type insulation to the insulation level of the conductors.

I. Insulating Tape Usage:
   1. For insulating connections of No. 8 AWG wire and smaller: 7 mil vinyl tape.
   2. For insulating splices and taps of No. 6 AWG wire or larger: 10 mil vinyl tape.
   3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all
      weather vinyl tape.

J. Color Coding Tape Usage: For color coding of conductors.

K. Fiber Optic Cable:
   1. Unless indicated otherwise, install all fiber optic cable in conduit.
      a. In cable trays, the cable(s) shall be installed in an innerduct that is placed in the tray for
         protection of the cable.
   2. Splicing:
      a. Optical fibers shall not be spliced.
   3. Utilize dust tight wall-mounted interconnect center to provide the following:
      a. Interconnect fiber optic cable to jumper cable assemblies for connection to the opto-
         electronic interface.
4. Where exposed to contact with electric light or power conductors, the noncurrent carrying metallic members (if applicable) of optical fiber cables entering buildings shall be grounded as close to the point of entrance as practicable in accordance with NFPA 70.

5. Install cables in accordance with the requirements of NFPA 70.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Assure ground continuity is continuous throughout the entire Project.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification Section except:
         1) Grounding clamps, terminals and connectors.
         2) Exothermic welding system.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

   1. Ground rods and bars and grounding clamps, connectors and terminals:
      a. Erico Products, Inc.
      b. Harger Lightning & Grounding.
      c. Thompson Lightning Protection.

   2. Exothermic weld connections:
      b. Harger Lightning & Grounding - Ultraweld.
      c. Thomas & Betts - Furseweld.

2.2 COMPONENTS
A. Wire and Cable:
2. Insulated conductors: Color coded green, per Specification Section 26 05 19.

B. Conduit: As specified in Specification Section 26 05 33.

C. Ground Bars:
   1. Solid copper:
      a. 1/4 IN thick.
      b. 2 or 4 IN wide.
      c. 24 IN long minimum in main service entrance electrical rooms, 12 IN long elsewhere.
   2. Predrilled grounding lug mounting holes.
   3. Stainless steel or galvanized steel mounting brackets.
   4. Insulated standoffs.

D. Ground Rods:
   1. 3/4 IN x 10 FT.
   2. Copper-clad:
      a. 10 mil minimum uniform coating of electrolytic copper molecularly bonded to a rigid
         steel core.
      b. Corrosion resistant bond between the copper and steel.
      c. Hard drawn for a scar-resistant surface.

E. Grounding Clamps, Connectors and Terminals:
   1. Mechanical type:
      b. High copper alloy content.
   2. Compression type for interior locations:
      b. High copper alloy content.
      c. Non-reversible.
      d. Terminals for connection to bus bars shall have two bolt holes.
   3. Compression type suitable for direct burial in earth or concrete:
      b. High copper alloy content.
      c. Non-reversible.
      d. Factory filled with oxide inhibiting compound.

F. Exothermic Weld Connections:
   1. Copper oxide reduction by aluminum process.
   2. Molds properly sized for each application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install products in accordance with manufacturer's instructions.
   2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250.
   3. Remove paint, rust, or other non-conducting material from contact surfaces before making
      ground connections.
   4. Where ground conductors pass through floor slabs or building walls provide nonmetallic
      sleeves and install per Specification Section 01 73 20.
   5. Do not splice grounding conductors except at ground rods.
   6. Install ground rods and grounding conductors in undisturbed, firm soil.
      a. Provide excavation required for installation of ground rods and ground conductors.
      b. Use driving studs or other suitable means to prevent damage to threaded ends of
         sectional rods.
      c. Connect conductors to ground rods with compressor type connectors or exothermic
         weld.
d. Provide sufficient slack in grounding conductor to prevent conductor breakage during backfill or due to ground movement.
e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.

B. Grounding Electrode System:
1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.
2. Grounding conductor terminations:
   a. Ground bars mounted on wall, use compression type terminal and bolt it to the ground bar with two bolts.
   b. Ground bars in electrical equipment, use compression type terminal and bolt it to the ground bar.
   c. Piping systems use mechanical type connections.
   d. Building steel, below grade and encased in concrete, use compression type connector or exothermic weld.
   e. At all above grade terminations, the conductors shall be labeled per Specification Section 10 14 00.
3. Ground ring grounding system:
   a. Ground ring consists of ground rods and a grounding conductor looped around the structure.
   b. Placed at a minimum of 10 FT from the structure foundation and 2 FT-6 IN below grade.
   c. Provide a minimum of four (4) ground rods placed at the corners of the structure and additional rods so that the maximum distance between ground rods does not exceed 50 FT.
   d. Building/Structure grounding:
      1) Bond building/structure metal support columns to the ground ring at all corners of the structure.
e. Grounding conductor: Bare conductor, size as required.

C. Supplemental Grounding Electrode:
1. Provide the following grounding in addition to the equipment ground conductor supplied with the feeder conductors.
2. Equipment support rack and pedestals mounted outdoors:
   a. Connect metallic structure to a ground rod.
   b. Grounding conductor: #6 AWG minimum.

D. Low Voltage Transformer Separately Derived Grounding System:
1. Ground separately mounted step-down transformers XO terminal to one of the following:
   a. Closest building steel using mechanical type terminal bolted to the steel, compression type connection or exothermic weld.
   b. Closest water pipe using a mechanical type connection.
2. Ground step-down transformer integrally mounted in motor control center to motor control center ground bus.

E. Raceway Bonding/Grounding:
1. All metallic conduit shall be installed so that it is electrically continuous.
2. All conduits to contain a grounding conductor with insulation identical to the phase conductors, unless otherwise indicated on the Drawings.
3. NFPA 70 required grounding bushings shall be of the insulating type.
4. Provide double locknuts at all panels.
5. Bond all conduit, at entrance and exit of equipment, to the equipment ground bus or lug.
6. Provide bonding jumpers if conduits are installed in concentric knockouts.
7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.

F. Equipment Grounding:
   1. All utilization equipment shall be grounded with an equipment ground conductor.

G. Manhole and Handhole Grounding:
   1. Provide a ground rod and ground bar, when indicated or as needed, in each manhole and handhole with exposed metal parts.
   a. Expose a minimum of 4 IN of the rod above the floor for field connections to the rod.
   2. Connect all exposed metal parts (e.g., conduits and cable racks) to the ground rod.

3.2 FIELD QUALITY CONTROL

A. Leave grounding system uncovered until observed by Owner.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

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A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification Section except:
         1) Conduit fittings.
         2) Support systems.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
1. Rigid metallic conduits:
   a. Allied Tube and Conduit Corporation.
   b. Western Tube and Conduit Corporation.
   c. Wheatland Tube Company.
2. Rigid aluminum conduits:
   a. EASCO Aluminum.
   b. Indalex.
   c. VAW of American, Inc.
3. PVC coated rigid metallic conduits:
   a. Thomas & Betts Ocal.
   b. Rob-Roy Ind.
4. Rigid nonmetallic conduit:
   a. Prime Conduit (Carlon).
   b. Cantex.
5. Fiberglass conduit:
   a. Champion Fiberglass.
   b. United Fiberglass of America, Inc.

6. Flexible conduit:
   a. Electri-Flex.
   b. Flexible Metal Hose Company.
   c. Triangle PWC Inc.

7. Wireway:
   b. Wiegmann.
   c. Square D.

8. Conduit fittings and accessories:
   a. Carlon.
   b. Crouse-Hinds.
   c. OZ Gedney Company.

9. Support systems:
   b. Eaton B-Line.
   c. Thomas & Betts Superstrut.

10. Outlet, pull and junction boxes:
    b. O-Z/Gedney.
    c. Thomas & Betts Steel City.

2.2 RIGID METALLIC CONDUITS

A. Rigid Galvanized Steel Conduit (RGS):
   1. Mild steel with continuous welded seam.
   2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
   3. Threads galvanized after cutting.
   4. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
   5. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6.

B. PVC-Coated Rigid Steel Conduit (PVC-RGS):
   1. Nominal 40 mil Polyvinyl Chloride Exterior Coating:
      a. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to
         NEMA/ANSI C80.1.
      b. The bond between the PVC coating and the conduit surface: Greater than the tensile
         strength of the coating.
   2. Nominal 2 mil, minimum, urethane interior coating.
   3. Urethane coating on threads.
   4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
   5. Female Ends:
      a. Have a plastic sleeve extending a minimum of 1 pipe diameter or 2 IN, whichever is
         less beyond the opening.
      b. The inside diameter of the sleeve shall be the same as the outside diameter of the
         conduit to be used with it.
   6. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6, NEMA RN 1.

C. Rigid Aluminum Conduit (RAC):
   1. AA Type 6063 aluminum alloy, T-1 temper.
   2. Maximum copper content of 0.10 percent.
   3. Extruded, seamless.
2.3 RIGID NONMETALLIC CONDUIT

A. Schedules 40 (PVC-40) and 80 (PVC-80):
   1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
   2. Rated for direct sunlight exposure.
   3. Fire retardant and low smoke emission.
   4. Shall be suitable for use with 90 DEGC wire and shall be marked "maximum 90 DEGC".
   5. Standards: NFPA 70 Type PVC, NEMA TC 2, UL 651.

B. Fiberglass:
   1. Epoxy based resin system using an anhydride curing agent.
   2. Continuous E-glass roving.
   3. Winding angle approximately 54.75 degrees.
   4. Smooth internal walls with all fibers imbedded in the epoxy.
   5. Above grade rated: Halogen free additive for flame spread and smoke control.
   6. Ultraviolet inhibitor: Carbon black.
   7. Two (2) step curing process.
   8. Tensile strength: 11,000 PSI per ASTM D2105.
   10. Wall thickness:
        a. Standard: 3/4 IN to 4 IN nominal size.
        b. Medium: 5 in to 6 IN nominal size.
        c. Extra Heavy for “bullet proof” and Class 1, Division 2 areas: 3/4 IN to 6 IN nominal size.
   11. Integral bell and spigot.
   12. Conduits and fittings to be joined with an interference joint and epoxy adhesive creating a concrete and water tight connection.

2.4 FLEXIBLE CONDUIT

A. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
   1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
   2. Extruded PVC outer jacket positively locked to the steel core.
   3. Liquid and vaportight.
   4. Standard: NFPA 70 Type LFMC, UL 360.

2.5 WIREWAY

A. General:
   1. Suitable for lay-in conductors.
   2. Designed for continuous grounding.
   3. Covers:
        a. Hinged or removable in accessible areas.
        b. Non-removable when passing through partitions.
   4. Finish: Rust inhibiting primer and manufacturers standard paint inside and out except for stainless steel type.
   5. Standards: UL 870, NEMA 250.

B. Watertight (NEMA 4X rated) Wireway:
   1. 14 GA Type 304 or 316 stainless steel bodies and covers without knockouts and 10 GA stainless steel flanges.
   2. Cover: Fully gasketed and held in place with captive clamp type latches.
   3. Flanges: Fully gasketed and bolted.
C. Dusttight (NEMA 12 rated) Wireway:
   1. 14 GA steel bodies and covers without knockouts and 10 GA steel flanges.
   2. Cover: Fully gasketed and held in place with captive clamp type latches.
   3. Flanges: Fully gasketed and bolted.

2.6 CONDUIT FITTINGS AND ACCESSORIES

A. Fittings for Use with RGS and RAC:
   1. General:
   2. Locknuts:
      a. Threaded steel or malleable iron.
      b. Gasketed or non-gasketed.
      c. Grounding or non-grounding type.
   3. Bushings:
      a. Threaded, insulated metallic.
      b. Grounding or non-grounding type.
   4. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
   5. Couplings:
      a. Threaded straight type: Same material and finish as the conduit with which they are
         used on.
      b. Threadless type: Gland compression or self-threading type, concrete tight.
   6. Conduit bodies (ells and tees):
      a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
      b. Standard and mogul size.
      c. Cover:
         1) Clip-on type with stainless steel screws.
         2) Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free
            aluminum.
   7. Conduit bodies (round):
      a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
      b. Cover: Threaded screw on type, gasketed, galvanized steel, zinc plated cast iron or cast
         copper free aluminum.
   8. Sealing fittings:
      a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
      b. Standard and mogul size.
      c. With or without drain and breather.
      d. Fiber and sealing compound: UL listed for use with the sealing fitting.
   9. Hazardous location flexible coupling (HAZ-FLEX):
      a. Liquid tight and arc resistant.
      b. Electrically conductive so no bonding jumper is required.
   10. Expansion couplings:
      a. 2 IN nominal straight-line conduit movement in either direction.
      b. Galvanized steel with insulated bushing.
      c. Gasketed for wet locations.
      d. Internally or externally grounded.
12. Expansion/deflection couplings:
   a. 3/4 IN nominal straight-line conduit movement in either direction.
   b. 30-degree nominal deflection from the normal in all directions.
   c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps.
   d. Internally or externally grounded.
   e. Watertight, raintight and concrete tight.


B. Fittings for Use with PVC-RGS:
   1. The same material and construction as those fittings listed under paragraph "Fittings for Use
      with RGS and RAC" and coated as defined under paragraph "PVC Coated Rigid Steel
      Conduit (PVC-RGS)."

C. Fittings for Use with FLEX-LT:
   1. Connector:
      a. Straight or angle type.
      b. Metal construction, insulated and gasketed.
      c. Composed of locknut, grounding ferrule and gland compression nut.
      d. Liquid tight.
   2. Standards: UL 467, UL 514B.

D. Fittings for Use with Rigid Nonmetallic PVC Conduit:
   1. Coupling, adapters and conduit bodies:
      a. Same material, thickness, and construction as the conduits with which they are used.
      b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.
      c. Bore smooth and free of blisters, nicks or other imperfections which could damage the
         conductor.
   2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the
      conduit and fittings.
   3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.

E. Fittings for Use with Rigid Nonmetallic Fiberglass Conduit:
   1. Coupling and adapters shall be of the same material, thickness, and construction as the
      conduit.
   2. Epoxy adhesive for joining conduits and fittings shall be supplied by the same manufacturer
      as the conduit and fittings and shall provide a concrete and water tight connection.

F. Weather and Corrosion Protection Tape:
   1. PVC based tape, 10 mils thick.
   2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
   3. Used with appropriate pipe primer.

2.7 ALL RACEWAY AND FITTINGS

A. Mark Products:
   1. Identify the nominal trade size on the product.
   2. Stamp with the name or trademark of the manufacturer.

2.8 OUTLET BOXES

A. Cast Outlet Boxes:
   1. Zinc plated cast iron or die-cast copper free aluminum with manufacturers standard finish.
   2. Threaded hubs and grounding screw.
   3. Styles:
      a. "FS" or "FD".
      b. "Bell".
      c. Single or multiple gang and tandem.
      d. "EDS" or "EFS" for hazardous locations.
   4. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
2.9 PULL AND JUNCTION BOXES

A. NEMA 4X Rated (metallic):
   1. Body and cover: 14 GA Type 304 or 316 stainless steel.
   2. Seams continuously welded and ground smooth.
   3. No knockouts.
   4. External mounting flanges.
   5. Hinged door and stainless steel screws and clamps.
   6. Door with oil-resistant gasket.

B. NEMA 7 Rated:
   1. Cast gray iron alloy or copper-free aluminum with manufacturers standard finish.
   2. Drilled and tapped openings or tapered threaded hub.
   3. Cover bolted-down with stainless steel bolts or threaded cover with neoprene gasket.
   4. External mounting flanges.
   5. Grounding lug.
   6. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.

C. NEMA 12 Rated:
   a. 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
   b. Type 5052 H-32 aluminum, unpainted.
   2. Seams continuously welded and ground smooth.
   3. No knockouts.
   4. External mounting flanges.
   5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
   6. Flat door with oil resistant gasket.

D. Miscellaneous Accessories:
   1. Rigid handles for covers larger than 9 SF or heavier than 25 LBS.
   2. Split covers when heavier than 25 LBS.
   3. Weldnuts for mounting optional panels and terminal kits.
   4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.

E. Standards: NEMA 250, UL 50.

2.10 SUPPORT SYSTEMS

A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:
   1. Material requirements.
      a. Galvanized steel: ASTM A123/A123M or ASTM A153/A153M.
      b. Stainless steel: AISI Type 316.
      c. PVC coat galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.

B. Single Conduit and Outlet Box Support Fasteners:
   1. Material requirements:
      a. Zinc plated steel.
      b. Stainless steel.
      c. Malleable iron.
      d. PVC coat malleable iron or steel: 20 mil PVC coating.
      e. Steel protected with zinc phosphate and oil finish.

2.11 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS

A. Sleeves, smoke and fire stop fitting through walls and floors:
   1. See Specification Section 01 73 20.
PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION - GENERAL

A. Shall be in accordance with the requirements of:
   1. NFPA 70.
   2. Manufacturer instructions.

B. Size of Raceways:
   1. Size in accordance with NFPA 70.
   2. Unless specifically indicated otherwise, the minimum raceway size shall be:
      a. Conduit: 3/4 IN.
      b. Wireway: 2-1/2 IN x 2-1/2 IN.

C. Field Bending and Cutting of Conduits:
   1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for
      the purpose and the conduit material to make all field bends and cuts.
   2. Do not reduce the internal diameter of the conduit when making conduit bends.
   3. Prepare tools and equipment to prevent damage to the PVC coating.
   4. Degrease threads after threading and apply a zinc rich paint.
   5. Debur interior and exterior after cutting.

D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize
   compound.

E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and
   accessories shall be maintained.
   1. Repair galvanized components utilizing a zinc rich paint.
   2. Repair painted components utilizing touch up paint provided by or approved by the
      manufacturer.
   3. Repair PVC coated components utilizing a patching compound, of the same material as the
      coating, provided by the manufacturer of the conduit; or a self-adhesive, highly
      conformable, cross-linked silicone composition strip, followed by a protective coating of
      vinyl tape.
      a. Total nominal thickness: 40 mil.
   4. Repair surfaces which will be inaccessible after installation prior to installation.

F. Remove moisture and debris from conduit before wire is pulled into place.
   1. Pull mandrel with diameter nominally 1/4 IN smaller than the interior of the conduit, to
      remove obstructions.
   2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
   3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.

G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

H. Where portions of a raceway are subject to different temperatures and where condensation is
   known to be a problem, as in cold storage areas of buildings or where passing from the interior
   to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to
   colder section of the raceway.

I. Fill openings in walls, floors, and ceilings and finish flush with surface.
   1. See Specification Section 01 73 20.

3.2 RACEWAY ROUTING

A. Raceways shall be routed in the field.
   1. Conduit and fittings shall be installed, as required, for a complete system that has a neat
      appearance and is in compliance with all applicable codes.
   2. Run in straight lines parallel to or at right angles to building lines.
   3. Do not route conduits:
      a. Through areas of high ambient temperature or radiant heat.
b. In suspended concrete slabs.

4. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.

5. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 degrees of bends in the conduit run or in long straight runs to limit pulling tensions.

B. All rigid conduits within a structure shall be installed exposed except as follows:

1. Embedded in floor slabs or buried under floor serving equipment in non-architecturally finished areas that are not located on or near a wall or column and the ceiling height is greater than 12 FT.

C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 FT:

1. Between instrumentation and telecommunication: 1 IN.

2. Between instrumentation and 125 V, 48 V and 24 Vdc: 2 IN.

3. Between instrumentation and 600 V and less AC power or control: 6 IN.

4. Between telecommunication and 125 V, 48 V and 24 Vdc: 2 IN.

5. Between telecommunication and 600 V and less AC power or control: 6 IN.

6. Between 125 V, 48 V and 24 Vdc and 600 V and less AC power or control: 2 IN.

7. Between process, gas, air and water pipes: 6 IN.

D. Conduits shall be installed to eliminate moisture pockets.

1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.

E. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.

F. Provide all required openings in walls, floors, and ceilings for conduit penetration.

1. See Specification Section 01 73 20.

3.3 RACEWAY APPLICATIONS

A. Permitted Raceway Types Per Wire or Cable Types:

1. Power wire or cables: All raceway types.

2. Control wire or cables: All raceway types.

3. Instrumentation cables: Metallic raceway except nonmetallic may be used underground.

4. Motor leads from a VFD: RGS, RAC or shielded VFD cables in all other raceways.

5. Telecommunication cables: All raceway types.

B. Permitted Raceway Types Per Area Designations:

1. Dry areas:

   a. RGS.

   b. RAC.

2. Wet areas:

   a. RAC.

3. Corrosive areas:

   a. RAC.

4. NFPA 70 hazardous areas:

   a. PVC-RGS when required by other area designations.

   b. RAC when required by other area designations.

C. Permitted Raceway Types Per Routing Locations:

1. In concrete block or brick walls:

   a. PVC-40.

2. Embedded in poured concrete walls and floors:

   a. PVC-40.

   b. Fiberglass (above grade rated).

   c. PVC-RGS when emerging from concrete into areas designated as wet, corrosive or highly corrosive.
3. Beneath floor slab-on-grade:
   a. PVC-40.
   b. Fiberglass (above or below grade rated).

4. Through floor penetrations, see Specification Section 01 73 20:
   a. Fiberglass (above grade rated) in areas designated as wet, or corrosive.
   b. PVC-RGS in areas designated as wet or corrosive.

5. Direct buried conduits and ductbanks:
   a. PVC-80.
   b. Fiberglass (above or below grade rated).
   c. 90 degree elbows for transitions to above grade:
      1) PVC-RGS.
   d. Long sweeping bends greater than 15 degrees:
      1) PVC-RGS.
   2) Fiberglass (above or below grade rated).

6. Concrete encased ductbanks:
   a. PVC-40.
   b. Fiberglass (above or below grade rated).
   c. 90 degree elbows for transitions to above grade:
      1) PVC-RGS.
   d. Long sweeping bends greater than 15 degrees:
      1) Fiberglass (above or below grade rated).

D. FLEX-LT conduits shall be install as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.

1. The maximum length shall not exceed:
   a. 6 FT to light fixtures.
   b. 3 FT to motors.
   c. 2 FT to all other equipment.

E. HAZ-FLEX coupling shall be installed as the final conduit to motors, electrically operated valves, instrumentation primary elements and electrical equipment that is liable to vibrate.

1. The maximum length shall not exceed:
   a. 3 FT to motors.
   b. 2 FT to all other equipment.

F. NEMA 4X Rated Wireway:
   1. Surface mounted in areas designated as wet and or corrosive.

G. NEMA 12 Rated Wireway:
   1. Surface mounted in areas designated as dry in architecturally and non-architecturally finished areas.

3.4 CONDUIT FITTINGS AND ACCESSORIES

A. Conduit Seals:
   1. Installed in conduit systems located in hazardous areas as required by the NFPA 70.
   2. Filler plug and drain shall be accessible.
   3. Pour the conduit seals in a two-step process.
      a. Pour the seal and leave cover off.
      b. After seal is dry, inspect for proper sealing, install cover and mark (for example, paint or permanent marker) as complete.

B. Rigid nonmetallic conduit and fittings shall be joined utilizing solvent cement.

1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.
C.  Install Expansion Fittings:
   1.  Where conduits are exposed to the sun and conduit run is greater than 200 FT.

D.  Install Expansion/Deflection Fittings:
   1.  Where conduits enter a structure.
      a.  Except electrical manholes and handholes.
      b.  Except where the ductbank is tied to the structure with rebar.
   2.  Where conduits span structural expansions joints.

E.  Threaded connections shall be made wrench-tight.

F.  Conduit joints shall be watertight:
   1.  Where subjected to possible submersion.
   2.  In areas classified as wet.

G.  Terminate Conduits:
   1.  In metallic outlet boxes:
      a.  RAC:
          1)  Conduit hub and locknut.
          2)  Insulated bushing and two (2) locknuts.
          3)  Use grounding type locknut or bushing when required by NFPA 70.
      2.  In NEMA 1 rated enclosures:
          a.  RAC:
              1)  Conduit hub and locknut.
              2)  Insulated bushing and two (2) locknuts.
              3)  Use grounding type locknut or bushing when required by NFPA 70.
          b.  EMT:  Compression type connector and locknut.
      3.  In NEMA 12 rated enclosures:
          a.  Watertight, insulated and gasketed hub and locknut.
          b.  Use grounding type locknut or bushing when required by NFPA 70.
      4.  In NEMA 4X rated enclosures:
          a.  Into an integral threaded hub.
          6.  When stubbed up through the floor into floor mount equipment:
              a.  With an insulated grounding bushing on metallic conduits.
              b.  With end bells on nonmetallic conduits.

H.  Threadless couplings shall only be used to join new conduit to existing conduit when the 
     existing conduit end is not threaded and it is not practical or possible to cut threads on the 
     existing conduit with a pipe threader.

3.5  CONDUIT SUPPORT

   A.  Permitted multi-conduit surface or trapeze type support system per area designations and conduit 
        types:
      1.  Dry or wet and/or hazardous areas:
          a.  Aluminum system consisting of:  Aluminum channels, fittings and conduit clamps with 
              stainless steel nuts and hardware.
      2.  Corrosive areas:
          a.  Aluminum system consisting of:  Aluminum channels, fittings and conduit clamps with 
              stainless steel nuts and hardware.
          b.  PVC coated steel system consisting of:  PVC coated galvanized steel channels and 
              fittings and conduit clamps with stainless steel nuts and hardware.
      3.  Conduit type shall be compatible with the support system material.
          a.  Stainless steel system may be used with PVC-RGS and RAC.
          b.  PVC coated galvanized steel system may be used with PVC-RGS and RAC.
          c.  Aluminum system may be used with RAC and PVC-RGS.
d. Fiberglass system may be used with PVC-40 and PVC-80 and PVC-RGS and Fiberglass.

B. Permitted single conduit support fasteners per area designations and conduit types:
   1. Dry or wet and/or hazardous areas:
      b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
   2. Corrosive areas:
      a. Material: Stainless steel and PVC coat malleable iron or steel.
      b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
   3. Conduit type shall be compatible with the support fastener material.
      a. Zinc plated steel, steel protected with zinc phosphate and oil finish and malleable iron fasteners may be used with RGS.
      b. Stainless steel system may be used with RGS, PVC-RGS and RAC.
      c. PVC coated fasteners may be used with PVC-RGS and RAC and PVC-40 and PVC-80.
      d. Nonmetallic fasteners may be used with PVC-40, PVC-80 and fiberglass.

C. Conduit Support General Requirements:
   1. Maximum spacing between conduit supports per NFPA 70.
   2. Support conduit from the building structure.
   3. Do not support conduit from process, gas, air or water piping; or from other conduits.
   4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 LBS.
      a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
      b. Conduit hangers:
         1) Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.
         c. Do not use suspended ceiling support systems to support raceways.
         d. Hangers in metal roof decks:
            1) Utilize fender washers.
            2) Not extend above top of ribs.
            3) Not interfere with vapor barrier, insulation, or roofing.
      5. Conduit support system fasteners:
         a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
         b. Do not use concrete nails and powder-driven fasteners.

3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION

A. General:
   1. Install products in accordance with manufacturer's instructions.
   2. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
   3. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.

B. Outlet Boxes:
   1. Permitted uses of cast outlet boxes:
      a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet, corrosive, and hazardous areas.
      b. Pull and junction box surface mounted in non-architecturally finished dry, wet, and corrosive areas.
   2. Set device outlet boxes plumb and vertical to the floor.
   3. Outlet boxes recessed in walls:
      a. Install with appropriate stud wall support brackets or adjustable bar hangers so that they are flush with the face of the wall.
b. Locate in ungrouted cell of concrete block with bottom edge of box flush with bottom edge of block and flush with the face of the block.

4. Place barriers between switches in boxes with 277 V switches on opposite phases.

5. Back-to-back are not permitted.

6. When an outlet box is connected to a PVC coated conduit, the box shall also be PVC coated.

7. Pull and Junction Boxes:

1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.

a. Make covers of boxes accessible.

2. Permitted uses of NEMA 4X metallic enclosure:

a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.

3. Permitted uses of NEMA 7 enclosure:

a. Pull or junction box surface mounted in areas designated as Class I hazardous.

1) Provide PVC coating in corrosive areas when PVC coated conduit is used.

4. Permitted uses of NEMA 12 enclosure:

a. Pull or junction box surface mounted in areas designated as dry.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination:
   1. Coordinate all interfacing work with WWTP contractor.

1.3 DEFINITIONS
A. Direct-Buried Conduit(s):
   1. Individual (single) underground conduit.
   2. Multiple underground conduits, arranged in one or more planes, in a common trench.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.

1.5 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
1. Prefabricated composite handholes:
   a. Quazite Composolite.
   b. Armorcast Products Company.
   c. Synertech.
2. Precast manholes and handholes:
   a. Utility Vault Co.
   b. Oldcastle Precast, Inc.
   c. Lister Industries.
3. Manhole and handhole and ductbank accessories:
   a. Neenah.
   b. Unistrut.
   c. Condux International, Inc.
2.2 MANHOLES AND HANDHOLES

A. Prefabricated Composite Material Handholes:
   1. Handhole body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
   3. Open bottom.
   4. Stackable design as required for specified depth.
   5. Cover:
      a. Engraved legend of "ELECTRIC" or "COMMUNICATIONS".
      b. Non-gasketed bolt down with stainless steel penta head bolts.
      c. Lay-in non-bolt down, when cover is over 100 LBS.
      d. One or multiple sections so the maximum weight of a section is 125 LBS.
   6. Cover lifting hook: 24 IN minimum in length.

B. Precast Manholes and Handholes:
   1. Fiberglass reinforced polymer concrete or steel reinforced cement concrete structures:
   2. AASHTO live load rating: H-20 for full deliberate vehicle traffic.
   4. Solid bottom with a 12 IN x 12 IN or 12 IN DIA French drain in the bottom of each manhole.
   5. Cover extension rings as required.
   6. Cable pulling eyes opposite all conduit entrances.
      a. Coordinate exact location with Installation Contractor.

2.3 CONCRETE MANHOLE AND HANDHOLE ACCESSORIES

A. Cover and Frame:
   2. AASHTO live load rating: H-20.
   3. Diameter: 30 IN.
   4. Cast the legend "ELECTRICAL" or "COMMUNICATIONS" into manhole and handhole covers.

B. Cable Racks and Hooks:
   1. Material: Heavy-duty nonmetallic (glass reinforced nylon).
   2. Hook loading capacity: 400 LBS minimum.
   3. Rack loading capacity: Four (4) hooks maximum.
   4. Hook deflection: 0.25 IN maximum.
   5. Hooks: Length, as required, with positive locking device to prevent upward movement.

C. Cable Pulling Irons:
   1. 7/8 IN DIA hot-dipped galvanized steel.
   2. 6000 LB minimum pulling load.

2.4 UNDERGROUND CONDUIT AND ACCESSORIES

A. Conduit: See Specification Section 26 05 33.

B. Duct Spacers/Supports:
   1. High density polyethylene or high impact polystyrene.
   2. Interlocking.
   3. Provide 2 IN minimum spacing between conduits.
   4. Accessories, as required:
      a. Hold down bars.
      b. Ductbank strapping.
PART 3 - EXECUTION

3.1 GENERAL

A. Manhole and Handhole Locations:
   1. As required for pulling distances.
   2. As required to keep pulling tensions under allowable cable tensions.
   3. As required for number of bends in ductbank routing.
   4. Shall not be installed in a swale or ditch.
   5. Determine the exact locations after careful consideration has been given to the location of other utilities, grading, and paving.

B. Install products in accordance with manufacturer's instructions.

C. Install manholes and handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.

3.2 MANHOLES AND HANDHOLES

A. Prefabricated Composite Material Handholes:
   1. For use in areas subjected to occasional non-deliberate vehicular traffic.
   2. Place handhole on a foundation of compacted 1/4 to 1/2 IN crushed rock or gravel a minimum of 8 IN thick and 6 IN larger than handholes footprint on all sides.
   3. Provide concrete encasement ring around handhole per manufacturers installation instructions (minimum of 10 IN wide x 12 IN deep).
   4. Install so that the surrounding grade is 1 IN lower than the top of the handhole.
   5. Size: As required for the number and size of conduits.
   6. Provide cable rails and pulling eyes as needed.

B. Precast Manholes and Handholes:
   1. For use in vehicular and non-vehicular traffic areas.
   2. Construction:
      a. Grout or seal all joints, per manufacturer's instructions.
      b. Support cables on walls by cable racks:
         1) Provide a minimum of two (2) racks, install symmetrically on each wall of manholes and handholes.
            a) Provide additional cable racks, as required, so that both ends of cable splices will be supported horizontally.
         2) Equip cable racks with adjustable hooks: Quantity of cable hooks as required by the number of conductors to be supported.
      c. In each manhole and handhole, drive 3/4 IN x 10 FT long copper clad ground rod into the earth with approximately 6 IN exposed above finished floor.
         1) Drill opening in floor for ground rod.
         2) Connect all metallic components to ground rod by means of #8 AWG minimum copper wire and approved grounding clamps.
         3) Utilize a ground bar in the manhole or handhole if the quantity of ground wires exceeds three (3).
            a) Connect ground bar to ground rod with a #2/0 AWG minimum copper wire.
      3. Place manhole or handhole on a foundation of compacted 1/4 to 1/2 IN crushed rock or gravel a minimum of 8 IN thick and 6 IN larger than manholes or handholes footprint on all sides.
      4. Install so that the top of cover is 1 IN above finished grade.
         a. Where existing grades are higher than finished grades, install sufficient number of courses of curved segmented concrete block between top of handhole and manhole frame to temporarily elevate manhole cover to existing grade level.
      5. After installation is complete, backfill and compact soil around manholes and handholes.
   6. Handhole size:
      a. As required for the number and size of conduits entering.
      b. Minimum floor dimension of 4 FT x 4 FT and minimum depth of 4 FT.
7. Manhole size:
   a. As required for the number and size of conduits entering.
   b. Minimum floor dimension of 6 FT x 6 FT and a minimum depth of 6 FT.

3.3 UNDERGROUND CONDUITS

A. General Installation Requirements:
1. Ductbank types per location:
   a. Direct-buried conduit(s):
      1) All other conduits;
      2) Area/Roadway lighting.
2. Do not place concrete or soil until conduits have been observed by the Engineer.
3. Ductbanks shall be sloped a minimum of 4 IN per 100 FT.
   a. Low points shall be at manholes or handholes.
4. During construction and after conduit installation is complete, plug the ends of all conduits.
5. Provide conduit supports and spacers.
   a. Place supports and spacers for rigid nonmetallic conduit on maximum centers as indicated for the following trade sizes:
      1) 1 IN and less: 3 FT.
      2) 1-1/4 to 3 IN: 5 FT.
      3) 3-1/2 to 6 IN: 7 FT.
   b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for the following trade sizes:
      1) 1 IN and less: 10 FT.
      2) 1-1/4 to 2-1/2 IN: 14 FT.
      3) 3 IN and larger: 20 FT.
   c. Securely anchor conduits to supports and spacers to prevent movement during placement of concrete or soil.
6. Stagger conduit joints at intervals of 6 IN vertically.
7. Make conduit joints watertight and in accordance with manufacturer's recommendations.
8. Accomplish changes in direction of runs exceeding a total of 15 degrees by long sweep bends having a minimum radius of 25 FT.
   a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.
9. Furnish manufactured bends at end of runs.
   a. Minimum radius of 18 IN for conduits less than 3 IN trade size and 36 IN for conduits 3 IN trade size and larger.
10. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.
11. After the conduit run has been completed:
   a. Prove joint integrity and test for out-of-round duct by pulling a test mandrel through each conduit.
      1) Test mandrel:
         a) Length: Not less than 12 IN.
         b) Diameter: Approximately 1/4 IN less than the inside diameter of the conduit.
      b. Clean the conduit by pulling a heavy duty wire brush mandrel followed by a rubber duct swab through each conduit.
12. Pneumatic rodding may be used to draw in lead wire.
   a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
   b. Extend cord 3 FT beyond ends of conduit.
13. Transition from rigid nonmetallic conduit to rigid metallic conduit, per Specification Section 26 05 33, prior to entering a structure or going above ground.
   a. Except rigid nonmetallic conduit may be extended directly to manholes, handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
   b. Terminate rigid PVC conduits with end bells.
c. Terminate steel conduits with insulated bushings.

14. Place warning tape in trench directly over ductbanks, direct-buried conduit, and direct-buried wire and cable in accordance with Specification Section 10 14 00.

15. Placement of conduits stubbing into handholes and manholes shall be located to allow for proper bending radiiuses of the cables.

B. Direct-Buried Conduit(s):

1. Install so that the top of the uppermost conduit, at any point:
   a. Is not less than 36 IN below grade.
   b. Is below pavement sub-grading.

2. Provide a uniform minimum clearance of 2 IN between conduits or as required in Specification Section 26 05 33 for different cabling types.
   a. Maintain the separation of multiple planes of conduits by one of the following methods:
      1) Install multilevel conduits with the use of conduit supports and separators to maintain the required separations, and backfill with flowable fill (100 PSI) or concrete per Specification Section 31 23 33.
      2) Install the multilevel conduits one level at a time.
         a) Each level is backfilled with the appropriate amount of soil and compaction, per Specification Section 31 23 33, to maintain the required separations.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification:
         c. See Section 26 05 00 for additional requirements.
   3. Fabrication and/or layout Drawings.
      a. Electrical wiring/connection diagrams.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Digital metering devices:
   3. Eaton.
   4. Square D Company.

2.2 DIGITAL METERING DEVICES

A. General:

   1. Direct reading metered or calculated values.
   2. Microprocessor based.
   3. Integral LED or LCD display.
   4. Current and potential transformers as required.
   5. Integral fusing.
   6. Operating temperature: 0 DEGF to 150 DEGF.
7. Standards:
   a. NEMA/ANSI C12.20.
   b. UL 508.

B. Type 'C' High Range Meter:
1. Display the following minimum electrical parameters (accuracy):
   a. RMS current per phase (+0.2 PCT full scale).
   b. RMS voltage line-to-line and line-to-neutral (+0.2 PCT full scale).
   c. Real power (W): 3 PH total (+0.4 PCT full scale).
   d. Apparent power (VA): 3 PH total (+0.4 PCT full scale).
   e. Reactive power (VAR): 3 PH total (+0.4 PCT full scale).
   f. Power factor (+1.0 PCT).
   g. Frequency (+0.04 PCT).
   h. PCT current individual harmonic and total harmonic distortion (50th).
   i. PCT voltage individual harmonic and total harmonic distortion (50th).
   j. Watt-hours (0.5 PCT).
   k. VAR-hours (1.0 PCT).
   l. VA-hours (0.5 PCT).
   m. Ampere demand (+0.2 PCT full scale).
   n. Watt demand (+0.4 PCT full scale).
   o. VAR demand (+0.4 PCT full scale).
   p. VA demand (+0.4 PCT full scale).
2. NEMA/ANSI C12.20, Class 0.2 revenue accuracy.
3. Communication ports and protocols: Ethernet TCP/IP.
4. Supply voltage: 120 Vac.

2.3 ACCESSORIES
A. Power Management and Control Software:
1. Manufacturer’s standard, see Part 3 for minimum functionality.

B. Separately Mounted Enclosure:
1. NEMA 12 rated for indoor locations.
2. NEMA 4 rated for outdoor locations.
3. Hinged front opening door with padlockable latch.
4. Input/output terminal blocks and wiring.
5. Separate control voltage source disconnect switch and wiring.
6. 600 Volt rated power voltage terminal blocks and wiring.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
1. Provide all equipment as necessary to provide a complete and functioning system.

B. Meter Type Application:
1. Type C meters: Connected to 480 V main breakers.

C. Communication Configuration:
1. The main breaker meter shall be connected to the nearest plant control system Ethernet switch.

D. Computer Screen Configuration:
1. Each Type C meter shall have a data screen with the following minimum data as applicable
   for the capabilities of that type of meter:
   a. Voltage line-to-line for each phase and an average.
   b. Voltage line-to-neutral for each phase and an average.
3.2 TRAINING

A. A qualified factory-trained manufacturer's representative shall provide the Owner with 4 HRS of on-site training in the operation and maintenance of the metering system and its components.

END OF SECTION
SECTION 26 09 16
CONTROL EQUIPMENT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SYSTEM DESCRIPTION
A. This Specification specifies components used within other equipment as referenced in other technical specifications.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification:
         1) When components are used within equipment specified in another Section, submittal data for components specified herein shall be included with the submittal for the equipment the components are used in.
      c. Industrial Control Panel bill of material.
      d. Control Station bill of material.
   3. Fabrication and/or layout Drawings.
      a. Industrial Control Panel:
         1) Interior and exterior layout.
         2) Wiring/connection diagrams.
         3) Short circuit rating.
         4) Copy of the UL 508A label.
      b. Operator Control Station:
         1) Interior (if applicable) and exterior layout.
         2) Wiring/connection diagrams.
      c. Associate Industrial Control Panel and Operator Control Stations with associated equipment name and tagging.

1.5 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Pilot devices, relays, contactors, and termination equipment:
   a. Allen-Bradley.
   b. Eaton.
   c. Schneider Electric.

2. Photocells and time clocks:
   a. Grasslin.
   b. Tork.
   c. Intermatic.

3. Alarm devices:
   a. Edwards Signaling.
   b. Federal Signal Corp.

4. Enclosures:
   b. Eaton B-Line.
   c. Stahlin.

2.2 PILOT DEVICES

A. General Requirements:
   2. Heavy-duty NEMA 4/13 watertight/oiltight.
   3. Heavy-duty NEMA 4/4X corrosion resistant.
   4. Heavy-duty factory sealed, explosion-proof and dust ignition-proof (Class I and II).
   5. Mounting hole: 30.5 mm.
   6. Contact blocks: 10 amp, NEMA A600 rated, number as required to fulfill functions shown or specified.

B. Selector Switches:
   1. Two, three- or four-position rotary switch as required to fulfill functions shown or specified.
   2. Maintained contact type.
   3. Knob or lever type operators.

C. Pushbuttons:
   1. Non-illuminated type:
      a. Protective boot.
      b. Momentary contact.
      c. Standard flush and mushroom operators.
      d. Green colored buttons for START or ON and red color for STOP or OFF.
      e. Emergency stop pushbuttons: Mushroom head operator and maintained contact.

D. Indicating Lights:
   1. Allowing replacement of bulb without removal from control panel.
   2. Lamp: LED, 120 V or 24 V as required.
   3. Full voltage type.
   5. Glass lens.
   6. Color code lights as follows:
      a. Green: ON or running; valve open.
      b. Amber: Standby; auto mode; ready.
      c. Red: OFF or stopped; valve open closed.
2.3 RELAYS

A. General Requirements:

B. Control Relays:
   1. General purpose (ice cube) type:
      a. Plug-in housing.
      b. Clear polycarbonate dust cover with clip fastener.
      c. Coil voltage: 120 Vac or as required.
      d. Contacts:
         1) 10 amp continuous.
         2) Silver cadmium oxide.
         3) Minimum of 3 SPDT contacts.
      e. Sockets: DIN rail mounted.
      f. Internal neon or LED indicator is lit when coil is energized.
      g. Manual operator switch.

   2. Industrial type:
      a. Coil voltage: 120 Vac or as required.
      b. Contacts:
         1) 10 amp, NEMA A600 rated.
         2) Double break, silver alloy.
         3) Convertible from normally open to normally closed or vice versa, without removing any wiring.
         4) Expandable from 2 poles to 12 poles.
      c. Provide contacts for all required control plus two spares.

C. Time Delay Relays:
   1. General purpose type:
      a. Timing modes: On and Off delay, interval, one shot and repeat cycle.
      b. Plug-in housing.
      c. Polycarbonate dust cover with clip fastener.
      d. Coil voltage: 120 Vac or as required.
      e. Contacts:
         1) 10 amp continuous.
         2) Silver cadmium oxide.
         3) Two normally open and two normally closed DPDT contacts.
      g. External timing adjustment knob.
      h. Timing ranges: 0.05 seconds to 16.65 HRS.
      i. Repeat accuracy: +1 PCT.

   2. Solid State industrial type:
      a. Timing modes: On and Off delay and repeat cycle.
      b. Industrial housing.
      c. Coil voltage: 120 Vac or as required.
      d. Contacts:
         1) 5 amp, NEMA B150 rated.
         2) Silver alloy.
         3) Convertible On Delay and Off Delay contacts.
         4) One normally open and one normally closed timed contacts.
         5) One normally open and one normally closed instantaneous contacts.
      e. Furnish with "on" and "timing out" indicators.
      f. External timing adjustment knob.
      g. Timing ranges: 0.05 seconds to 10 HRS.
      h. Repeat accuracy: +1 PCT.

   3. Mechanical industrial type:
b. Coil voltage: 120 Vac or as required.
c. Contacts:
   1) 10 amp, NEMA A600 rated.
   2) Double break, silver alloy.
   3) Convertible On Delay and Off Delay contacts.
   4) Convertible normally open and normally closed timed contacts.
   5) Convertible normally open instantaneous contacts.
d. External timing adjustment knob.
e. Timing ranges: 0.2 - 60 seconds or 5 - 180 seconds.
f. Repeat accuracy: Greater than +10 PCT.

2.4 CONTACTORS
A. General Requirements:
B. Lighting and Remote Control Switches:
   1. Electrically operated, electrically held.
   2. Coil voltage: 120 Vac or as required.
   4. Rated for ballasted lighting, tungsten and general use loads.
   5. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as specified.
C. Definite Purpose:
   1. Coil voltage: 120 Vac or as required.
   3. Resistive load and horsepower rated.
   4. Number of poles, continuous ampere rating and voltage, as required.

2.5 PHOTOCELLS AND TIME CLOCKS
A. Photocells:
   1. Weatherproof enclosure.
   2. Adjustable turn-on range, initially set at 1.0 footcandles.
      a. Turn-off level approximately three times turn-on.
   3. Provide time delay device to eliminate nuisance switching.
   4. Voltage, amperage and/or wattage ratings as required for the application.
B. General Requirements for Time Clocks:
   1. Separate manual on-off operation without disturbing automatic settings.
   2. Enclosure:
      a. Stand alone or DIN rail for mounting in control panel.
      b. NEMA 4.
   3. Voltage, amperage and/or wattage ratings as required for the application.

2.6 ALARM DEVICES
A. Alarm Horns:
   1. Vibrating horn type.
   2. PLC compatible as required.
   3. Heavy-duty die cast housing with corrosion resistant finish.
   4. Adjustable volume: 78 to 103 dB at 10 FT.
   5. Voltage: 120 Vac or as required.
   6. Enclosures/mountings:
      a. NEMA 4X panel mounting in wet areas.
      b. Surface mounting in dry areas.
      c. NEMA 4X surface mounting in wet areas.
      d. NEMA 4X, hazardous location surface mounting in wet and hazardous areas.
      1) Fixed volume: 97 dB at 10 FT.
B. Alarm Lights:
   1. Panel mounted:
      a. Strobe type.
      b. Shatter resistant polycarbonate lens and base.
      c. NEMA 4X enclosure.
      d. PLC compatible.
      e. Voltage: 120 Vac.
   2. Wall mounted:
      a. Heavy-duty strobe type.
      b. Weatherproof shatter resistant polycarbonate lens and cast base.
      c. Optically designed fresnel lens with color.
      d. Immune to shock and vibration, no moving parts.
      e. Xenon flash tube providing a minimum of 65 single flashes per minute.
      f. Mounting: Wall or corner wall brackets.
   3. Hazardous and corrosive locations:
      a. Heavy-duty strobe type.
      b. Weatherproof and rated for the indicated hazardous location.
      c. Body: Zinc plated cast iron or cast copper free aluminum and/or coated with 20 mils of PVC.
      d. High impact glass dome with guard.
      e. Shatter resistant polycarbonate lens with color as required.
      f. Immune to shock and vibration, no moving parts.
      g. Xenon flash tube providing a minimum of 65 single flashes per minute.
      h. Mounting: Wall bracket or pendant.

2.7 MISCELLANEOUS DEVICES
A. Run Time Meters:
   1. Six-digit wheels including a 1/10 digit.
   2. Non-reset type.
   3. Time range in hours.
   4. Automatic recycle at zero.
   5. Accuracy: 1 PCT.
   6. Sealed against dirt and moisture.
   7. Tamperproof.

2.8 TERMINATION EQUIPMENT
A. General Requirements:
   1. Modular type with screw compression clamp.
   4. Thermoplastic insulation rated for -40 to +90 DEGC.
   5. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
   6. End sections and end stops at each end of terminal strip.
   7. Machine-printed terminal markers on both sides of block.
   8. Spacing: 6 mm.
   9. Wire size: 22-12 AWG.
   10. Rated voltage: 600 V.
   11. DIN rail mounting.

B. Standard-Type Block:
   1. Rated current: 30 A.
   2. Color: Gray body.

C. Bladed-Type Disconnect Block:
   1. Terminal block with knife blade disconnect which connects or isolated the two sides of the block.
2. Rated current: 10 A.
3. Color:
   a. Panel control voltage leaves enclosure - normal: Gray body, orange switch.
   b. Foreign voltage entering enclosure: Orange body, orange switch.

D. Grounded-Type Block:
1. Electrically grounded to mounting rail.
2. Terminal ground wires and analog cable shields.
3. Color: Green and yellow body.

E. Fuse Holders:
1. Blocks can be ganged for multi-pole operation.
2. Spacing: 9.1 mm.
3. Wire size: 30-12 AWG.
4. Rated voltage: 300 V.
5. Rated current: 12 A.
8. DIN rail mounting.

2.9 ENCLOSURES

A. Industrial Control Panels:
1. NEMA 4X rated:
   a. Body and cover: 14 GA Type 304 or 316 stainless steel.
   b. Seams continuously welded and ground smooth.
   c. No knockouts.
   d. External mounting flanges.
   e. Hinged door and stainless steel screws and clamps.
   f. Door with oil-resistant gasket.
2. NEMA 7 rated:
   a. Cast gray iron alloy or copper-free aluminum.
   b. Drilled and tapped openings or tapered threaded hub.
   c. Cover bolted-down with stainless steel bolts or threaded cover with neoprene gasket.
   d. External mounting flanges.
   e. Grounding lug.
   f. Accessories: 40 MIL PVC exterior coating and 2 MIL urethane interior coating.
3. NEMA 12 enclosure:
   a. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
   b. No knockouts.
   c. External mounting flanges.
   d. Non-hinged stainless steel cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
   e. Flat door with oil resistant gasket.
4. Control panel miscellaneous accessories:
   a. Back plane mounting panels: Steel with white enamel finish or Type 304 stainless steel.
   b. Interiors shall be white or light gray in color.
   c. Wire management duct:
      1) Bodies: PVC with side holes.
      2) Cover: PVC snap-on.
      3) Size as required.
   d. Rigid handles for covers larger than 9 SF or heavier than 25 LBS.
   e. Split covers when heavier than 25 LBS.
   f. Floor stand kits made of same material as the enclosure.
   g. Weldnuts for mounting optional panels and terminal kits.

B. Operator Control Stations:
   1. NEMA 4/13 rated:
      a. Die cast aluminum body with manufacturers standard finish.
      b. Gasketed die cast aluminum cover with manufacturers standard finish.
      c. Number of device mounting holes as required.
   2. NEMA 4X rated:
      a. Type 304 or 316 stainless steel body.
      b. Gasketed Type 304 or 316 stainless steel cover.
      c. Number of device mounting holes as required.
   3. NEMA 7 rated:
      a. Zinc plated cast iron or die-cast copper free aluminum, with threaded hubs, grounding screw and with manufacturers standard finish.
      b. "EDS" or "EFS" style.
      c. Single or multiple gang or tandem.
      d. Accessories: 40 MIL PVC exterior coating and two (2) MIL urethane interior coating.

2.10 FABRICATION
   A. Supplier of Industrial Control Panels shall build control panel under the provisions of UL 508A.
      1. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
   B. Control Panels:
      1. Size as required to mount the equipment.
      2. Permitted uses of NEMA 4X enclosure:
         a. Surface mounted in areas designated as wet and/or corrosive or highly corrosive.
      3. Permitted uses of NEMA 7 enclosure:
         a. Surface mounted in areas designated as Class I hazardous.
      4. Permitted uses of NEMA 12 enclosure:
         a. Surface mounted in areas designated as dry and/or dusty non-architecturally finished areas.
   C. Operator Control Stations:
      1. Permitted uses of NEMA 4/13 enclosure:
         a. Surface mounted in areas designated as dry and/or dusty architecturally or non-architecturally finished areas and wet.
      2. Permitted uses of NEMA 4X enclosure:
         a. Surface mounted in areas designated as wet and/or corrosive or highly corrosive.
      3. Permitted uses of NEMA 7 enclosure:
         a. Surface mounted in areas designated as Class I hazardous with PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.

3.2 FIELD QUALITY CONTROL
   A. Industrial Control Panel(s) and Operator Control Station Functional Test:
      1. The test is to prove the correct interaction of all sensing, processing and action devices.
      2. Develop a test plan and parameters for the purpose of evaluating the performance of the system.
         a. Plan shall have witness signature lines for the contractor and owner and submitted when system pass the test.
3. Perform the following tests:
   a. Verify functionality of all control states.
   b. Verify the correct operation of all interlock safety devices for fail-safe functions.
   c. Verify the correct operation of all sensing devices, alarms and indicating devices.

3.3 TRAINING

A. A qualified supplier representative shall provide the Owner with 4 HRS of on-site training in the operation and maintenance of the Industrial Control Panel(s) and its components.

END OF SECTION
SECTION 26 22 13
DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05-Egg Shaped Anaerobic Digester-General Requirements.
   2. Product technical data:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification Section.
   3. Fabrication and/or layout Drawings.
      a. Nameplate Drawing.
   4. Certifications:
      a. Sound level certifications.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Dry type transformers:
   a. Eaton.
   b. General Electric Company.
   c. Square D Company.

2.2 GENERAL PURPOSE DRY-TYPE TRANSFORMERS
A. Ventilated or non-ventilated, air cooled, two (2) winding type.
B. Cores:
   1. High grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses.
2. Magnetic flux densities are to be kept well below the saturation point.

C. Coils: Continuous wound with electrical grade aluminum.

D. Ventilated Units:
   1. Core and coils assembly impregnated with non-hygroscopic, thermosetting varnish and
cured to reduce hot spots and seal out moisture and completely isolated from the enclosure
by means of vibration dampening pads.
   2. Dripproof, NEMA 1, steel enclosure finished with a weather-resistant enamel and
ventilation openings protected from falling dirt.

E. Furnish Taps for Transformers as follows:
   1. 1 PH, 2 kVA and below: None.
   2. 1 PH, 3 to 25 kVA: Two (2) 5 PCT FCBN.
   3. 1 PH, 25 kVA and above: Two (2) 2.5 PCT FCAN and four (4) 2.5 PCT FCBN.
   4. 3 PH, 3 to 15 kVA: Two (2) 5 PCT FCBN.
   5. 3 PH, 15 kVA and above: Two (2) 2.5 PCT FCAN and four (4) 2.5 PCT FCBN.

F. Sound Levels:
   1. Manufacturer shall guarantee not to exceed the following:
      a. Up to 9 kVA: 40 dB.
      b. 10 to 50 kVA: 45 dB.
      c. 51 to 150 kVA: 50 dB.
      d. 151 to 300 kVA: 55 dB.

G. Efficiency (minimum):
   1. Ventilated:
      a. 1 PH, 15 - 333 kVA: DOE 2016 Efficiency.
      b. 3 PH, 15 - 1000 kVA: DOE 2016 Efficiency.

H. Insulating Material (600 V and below):
   1. 3 to 15 kVA units: 185 DEGC insulation system with a 115 DEGC rise.
   2. 15 kVA and above units: 220 DEGC insulation system with a 150 DEGC rise.

I. Ratings: 60 Hz, voltage, KVA and phase, as required.

J. Finish: Rust inhibited primer and manufacturers standard paint inside and out.


PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Indoor Locations:
   1. Provide ventilated type for 15 kVA units and above.
   2. Provide non-ventilated type for 9 kVA units and below.
   3. Mount 9 kVA units and below on wall.
   4. Mount 15 kVA units and above on chamfered 4 IN high concrete housekeeping pad or from
wall and/or ceiling, at 7 FT above finished floor, using equipment support brackets per
Section 26 05 00.
   5. Provide rubber vibrations isolation pads.

C. Enclosures: Painted steel in all areas.
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum
standard of quality for the design and construction of the Work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final
design. If applicable to the final design elements, incorporate the applicable standard of quality
requirements provided in this specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General
      Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established
         standards of quality.
   3. Fabrication and/or layout Drawings:
      a. Panelboard layout with alphanumeric designation, branch circuit breakers size and type,
         as indicated in the panelboard schedules.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are
acceptable. Except where specifically noted otherwise, or-equal manufacturers will be
considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call
out or-equal consideration is requested. See General Condition Article 7.04.

   1. Panelboards:
      a. Eaton.
      b. General Electric Company.
      c. Square D Company.

2.2 MANUFACTURED UNITS

A. Standards: NEMA PB 1, NFPA 70, UL 50, UL 67.

B. Ratings:
   1. Current, voltage, number of phases, number of wires as required.
   2. Panelboards rated 240 Vac or less: 10,000 amp minimum short circuit rating.
   3. Panelboards rated 480 Vac: 14,000 amp minimum short circuit rating.
   4. Service Entrance Equipment rated when required.
C. Construction:
1. Interiors factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
2. Multi-section panelboards: Feed-through or sub-feed lugs.
3. Main lugs: Solderless type approved for copper and aluminum wire.

D. Bus Bars:
1. Main bus bars:
   a. Plated aluminum or copper sized to limit temperature rise to a maximum of 65 DEGC above an ambient of 40 DEGC.
   b. Drilled and tapped and arranged for sequence phasing of the branch circuit devices.
2. Ground bus and isolated ground bus: Solderless mechanical type connectors.
3. Neutral bus bars: Insulated 100 PCT rated and with solderless mechanical type connectors.

E. Enclosure:
1. Boxes: Code gage galvanized steel, furnish without knockouts.
2. Trim assembly: Code gage steel finished with rust inhibited primer and manufacturers standard paint inside and out.
3. Lighting and appliance panelboard:
   a. Trims for surface mounted panelboards, same size as box.
   b. Doors lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike.
   c. Nominal 20 IN wide and 5-3/4 IN deep with gutter space in accordance with NFPA 70.
   d. Clear plastic cover for directory card mounted on the inside of each door.
   e. NEMA 12 rated: Door gasketed.
4. Power distribution panelboard:
   a. Trims cover all live parts with switching device handles accessible.
   b. Less than or equal to 12 IN deep with gutter space in accordance with NFPA 70.
   c. Clear plastic cover for directory card mounted front of enclosure.
   d. NEMA 12 rated: Doors gasketed and lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike.

F. Overcurrent and Short Circuit Protective Devices:
1. Main overcurrent protective device:
   a. Molded case circuit breaker.
2. Branch overcurrent protective devices:
   a. Mounted molded case circuit breaker.
3. See Section 26 28 00 for overcurrent and short circuit protective device requirements.
4. Factory installed.

PART 3 - EXECUTION
3.1 INSTALLATION

A. Install in accordance with the NFPA 70, and in accordance with manufacturer's instructions.
B. Support panelboard enclosures from wall studs or modular channels support structure, per Specification Section 26 05 00.
C. Provide NEMA 12 rated enclosure.
D. Provide each panelboard with a typed directory:
   1. Identify all circuit locations in each panelboard with the load type and location served.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Miscellaneous:
   1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings.
   2. Verify the required instrumentation and control wiring for a complete system.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   2. Product technical data:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification Section.
   3. Fabrication and/or layout Drawings:
      a. Motor control center:
         1) Elevation Drawing with overall dimensions.
         2) Starter and component schedule.
         3) Identification of units and their location in the MCC.
         4) Location of incoming line terminals.
         5) Mounting dimensions.
         6) Available conduit entrance areas.
         7) Nameplate schedule.
         8) Assembly ratings (amps, volts, short circuit, etc.).
         9) Unit ladder logic wiring for each unit depicting electrical interlocking and wiring between units (NEMA ICS 3 Class II) and identification of terminals where field devices or remote control signals are to be terminated.
      b. Separately mounted combination starters:
         1) Unit ladder logic wiring for each unit depicting electrical wiring and identification of terminals where field devices or remote control signals are to be terminated.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Motor control equipment:
   a. Allen-Bradley.
   b. Eaton.
   c. Square D Company.

2.2 MOTOR CONTROL CENTERS

A. Ratings:
   1. 600 V class, 3 PH, 60 Hz with operating voltage and number of wires as required.
   2. Service Entrance Equipment rated when required.

B. Construction:
   2. Totally enclosed, dead front, free standing assemblies, bolted together to form a single assembly.
   3. Fabricate of not less than 14 GA steel with 16 GA steel doors in standardized units.
   4. Nominal size per section: 20 IN wide, 20 or 21 IN deep, and 90 IN high.
   5. Enclosure:
      a. NEMA 1 gasketed.
   6. Horizontal wireways:
      a. At the top, isolated from the main bus.
      b. At the bottom.
      c. Easily accessible.
      d. Full length of the MCC.
   7. Vertical wireway:
      a. Located in each MCC section that accepts plug-in units.
      b. Connect to top and bottom wireways.
      c. Isolated from the unit interiors.
      d. Accessible through a separate hinged door.
      e. Cable tie supports to hold wiring in place.
   8. Unit doors:
      a. Formed round corners and rolled edges.
      b. Minimum of two (2) heavy-duty hinges or continuous piano hinge.
      c. Held closed by means of captive fasteners.
      d. Fabricate to be a part of the structure and not part of the starter.
   9. Unit cubicles:
      a. Draw-out type for motor starters through NEMA Size 5.
      b. Guide rails for supporting and aligning starters.
      c. Operating handle:
         1) With the unit stabs engaged and door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
         2) Circuit breaker and MCP operators includes a separate TRIPPED position.
         3) Mechanical interlock to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism.
         4) Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism.
         5) Non-defeatable interlock to prevent the installation or removal of a unit unless the disconnect is in the OFF position.
         6) Padlockable in the OFF position.
d. Control panel:
   1) Provide control devices (selector switch, indicating devices, etc.) as required.

e. Control power:
   1) Control power transformer:
      a) 120 V secondary.
      b) Fused on primary and secondary side.
      c) Sized for 140 percent of required load.

f. Minimum of one (1) full size space unit (12 IN) for any combination magnetic motor
   starter or starter without overload relay.

g. One-half full size space unit (6 IN) for circuit breakers 100 A and less.
h. Effectively baffled to isolate any ionized gases which may occur within unit starter.

10. Externally mounted overload relay pushbutton.

11. Assemblies effectively ventilated to allow relocation of starters and other components:
   a. Within the assembly and with the same load.
   b. Without having to compensate for changes in location.

12. Finish: Rust inhibited primer and manufacturer's standard paint inside and out.
13. Provide ample unrestricted space for conduit entry from the bottom.
14. Wiring: NEMA ICS 3 Class II, Type B-D.

C. Buses:
1. Material: Tin-plated copper or silver-plated copper.
2. Main horizontal bus:
   a. 600 A.
   b. Extend the full-length of the MCC with provisions for splicing additional sections to
      either end.

3. Vertical buses:
   a. 300 A minimum.
   b. Securely bolted to the horizontal main bus with joint easily accessible for maintenance.
   c. Completely isolated and insulated by means of a barrier.
   d. Extended full length of vertical section to distribute incoming power to each circuit
      breaker and starter in structure.
      1) Starters NEMA Size 5 and larger and certain other components may be cable
         connected to the main bus with the approval of the Engineer.
   e. Extend Vertical bus to spaces provided for future equipment.

4. Ground bus:
   a. Extend the full-length of the MCC with provisions for splicing additional sections to
      either end.
   b. 300 A tin-plated copper.
   c. Solidly grounded to each structure.
   d. Locate near bottom of structure.
   e. Provide for lug connection of equipment ground wires.

D. Overcurrent and Short Circuit Protective Devices:
1. Main device:
   a. Molded case circuit breaker.

2. Feeder devices:
   a. Molded case circuit breaker.

3. Motor protection with full voltage starters:
   b. Molded case circuit breaker.

4. Motor protection with reduced voltage starters:
   a. Molded case circuit breaker.
   b. Motor circuit protector.

5. See Specification Section 26 28 00 for overcurrent and short circuit protective device
   requirements.

6. Factory installed.
E. Motor Starters: See requirements within this Specification Section.


G. Power Monitor Metering:
   1. Separate compartment.
   2. See Specification Section 26 09 13 for meter requirements.

2.3 SEPARATELY MOUNTED COMBINATION STARTERS

A. Standards:
   1. NEMA 250, NEMA ICS 2.
   2. UL 508.

B. Enclosure:
   1. NEMA 4X rated:
      a. Body and cover: Type 304 or 316 stainless steel.
      b. No knockouts, external mounting flanges, hinged and gasketed door.
   2. NEMA 7 and NEMA 9 rated:
      a. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
      b. Drilled and tapped openings or tapered threaded hub.
      c. Gasketed cover bolted-down with stainless steel bolts.
      d. External mounting flanges.
      e. Front operating handle padlockable in the OFF position.
      f. Accessories: 40 MIL PVC exterior coating.
   3. NEMA 12 rated:
      a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
      b. No knockouts, external mounting flanges, hinged and gasketed door.

C. Operating Handle:
   1. With the door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
   2. Circuit breaker and MCP operators includes a separate TRIPPED position.
   3. Mechanical interlock to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism for use by authorized personnel.
   4. Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism for use by authorized personnel.
   5. Padlockable in the OFF position.

D. External mounted overload relay pushbutton.

E. Control Power Transformer:
   1. 120V secondary.
   2. Fused on primary and secondary side.
   3. Sized for 140 PCT of required load.

F. Fault Current Withstand Rating: Equal to the rating of the electrical gear from which it is fed.

G. Motor Starters: See requirements within this Specification Section.

2.4 MOTOR STARTERS

A. Standards:
   1. NEMA ICS 2.
2. UL 508.

B. Full Voltage Non-Reversing (FVNR) Magnetic Starters:
   1. NEMA full size rated contactor.
      a. NEMA half sizes and IEC contactors are not permitted.
   2. Double-break silver alloy contacts.
   3. Overload relays:
      a. Ambient compensated, bimetallic type with interchangeable heaters, 24 percent
         adjustability, single phase sensitivity, an isolated arm contact and manual reset;
         or
      b. Ambient insensitive, adjustable solid state type with phase loss protection, phase
         imbalance protection and manual reset.
   4. Interlock and auxiliary contacts, wired to terminal blocks:
      a. Holding circuit contact, normally open.
      b. Overload alarm contact, normally open.
      c. Normally open auxiliary contact, for remote run status.
      d. Additional field replaceable auxiliary contacts as required per the Sequence of
         Operation.
      e. Two (2) additional normally open spare field replaceable auxiliary contacts.

C. Full Voltage Reversing (FVR) Magnetic Starters:
   1. Two (2) FVNR starters with one (1) overload relay assembled together.
   2. Mechanically and electrically interlocked to prevent line shorts and the energizing of both
      contactors simultaneously.
   3. See FVNR paragraph for additional requirements.

D. Full Voltage Two-Speed (FV2S) Magnetic Starters:
   1. Two (2) FVNR starters with two (2) overload relays assembled together.
   2. Configured for two (2) winding or one (1) winding consequent pole motors.
   3. See FVNR paragraph for additional requirements.

E. Reduced Voltage Solid State (RVSS) Starters:
   1. Rated for continuous 115 PCT of the full load current of the motor that is installed.
   2. Bypass contactor to be engaged after motor is at full speed.
   3. Pushbutton and alphanumeric digital display for programming and status indications visible
      with the starter door closed.
   4. Protection functions, minimum:
      a. Overload.
      b. Phase loss.
      c. Shorted SCR.
      d. Stalled rotor.
      e. Under/over voltage.
      f. CPU fault.
   5. Independently adjustable acceleration and deceleration current limit:
      a. 150 to 400 PCT of motor full load current.
      b. Current limit adjustment accessible only to maintenance personnel.
   6. Adjustable current ramp to provide break-away torque to the motor.
      a. 0 to 150 PCT of motor full load current.
      b. Current ramp adjustment accessible only to maintenance personnel.
   7. Overload relays:
      a. Ambient compensated, bimetallic type with interchangeable heaters, 24 percent
         adjustability, single phase sensitivity, an isolated arm contact and manual reset.
      b. Ambient insensitive, adjustable solid state type with phase loss protection, phase
         imbalance protection and manual reset.
   8. Interlock and auxiliary contacts, wired to terminal blocks:
      a. Holding circuit contact, normally open.
      b. Overload alarm contact, normally open.
c. Normally open auxiliary contact, for remote run status.
d. Additional field replaceable auxiliary contacts as required per the Sequence of Operation.
e. Two (2) additional normally open spare field replaceable auxiliary contacts.


2.5 MANUAL MOTOR STARTERS

A. Standards:
   1. NEMA 250, NEMA ICS 2.
   2. UL 508.

B. Quick-make, quick-break toggle mechanism that is lockable in the OFF position.

C. Types:
   1. Horsepower rated, for ON/OFF control.
   2. Horsepower rated, for ON/OFF control and thermal overload protection.
      a. Switch to clearly indicate ON, OFF, and TRIPPED position.

D. Voltage and current ratings and number of poles as required for the connected motor.

E. Enclosures:
   1. NEMA 4X rated:
      a. Type 304 or 316 stainless steel.
      b. No knockouts, external mounting flanges.
   2. NEMA 7 rated:
      a. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
      b. Drilled and tapped openings or tapered threaded hub, external mounting flanges.
      c. Accessories: 40 MIL PVC exterior coating.
   3. NEMA 12 rated:
      a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
      b. No knockouts, external mounting flanges.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's recommendations and instructions.

B. Mount MCC on 4 IN high concrete pad:
   1. Install two (2) 4 IN wide channel sills flush in pads to support and maintain alignment of the MCC.
   2. Align front of MCC with top edge of pad chamfer.

C. Overload Heaters:
   1. Size for actual motor full load current of the connected motor.
   2. For motors with power factor correction capacitors, size to compensate for the capacitors effect on load current.

D. Combination and Manual Starter Enclosures:
   1. Permitted uses of NEMA 4X enclosure:
      a. Surface mounted in areas designated as wet and/or corrosive.
   2. Permitted uses of NEMA 7 enclosure:
      a. Surface mounted in areas designated as Class I hazardous.
      b. Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
   3. Permitted uses of NEMA 12 enclosure:
      a. Surface mounted in areas designated as dry.
3.2 FIELD QUALITY CONTROL

A. Reduced Voltage Soft Starters:
   1. Manufacturer shall provide a factory authorized technician to confirm proper installation and programming of the starter.

3.3 TRAINING

A. Manufacturer shall provide Factory Authorized Application Engineer to train Owner personnel for a minimum of 4 HRS in the operation and programming of the motor control equipment.

END OF SECTION
SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   2. Product technical data:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification Section.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   1. Wall switches and receptacles:
      a. Cooper Wiring Devices by Eaton.
      b. Leviton Manufacturing Company.
      c. Legrand/Pass & Seymour.

2.2 WALL SWITCHES
A. Basic requirements unless modified in specific requirements paragraph of switches per designated areas or types:
   1. Industrial Specification Grade.
   2. Quiet action, snap switch.
   3. Self grounding with grounding terminal.
   4. Back and side wired.
   5. Solid silver cadmium oxide contacts.
   6. Rugged thermoplastic and/or nylon housing and one-piece switch arm.
   8. Switch handle type: Toggle.

10. Types:
   b. Double-pole.
   c. 3-way.
   d. 4-way.
   e. Momentary contact.


B. Dry Non-Architecturally Finished Area Specific Requirements:

1. Coverplate for use on surface mounted outlet boxes:
   a. Cast aluminum, natural, lacquer, or factory painted finish.
   b. Single or multiple gang as required.

C. Corrosive and Wet or Damp Area Specific Requirements:

1. Corrosion resistant nickel plated metal parts.

2. Coverplate for use on metallic outlet boxes:
   a. Cast aluminum, gasketed, stainless steel hardware, natural, lacquer, or factory painted finish.
   b. Operator type:
      1) Front mounted lever to operate snap switch.
      2) Push/pull operator to operate snap switch.
      3) Spring type door to cover snap switch.
   c. Wet location rated.
   d. Single or multiple gang as required.

2.3 RECEPTACLES

A. Basic requirements unless modified in specific requirements paragraph of receptacles and per designated areas:

1. Industrial Specification Grade.
2. Straight blade.
3. Brass triple wipe line contacts.
4. One-piece grounding system with double wipe brass grounding contacts and self grounding strap with grounding terminal.
5. Back and side wired.
7. High impact nylon body.
8. Receptacle body color:
9. Duplex or simplex.
10. Configuration: NEMA 5-20R.

B. Receptacle Type Specific Requirements:

1. Basic receptacles:
   a. Weather-resistant when located in exterior locations or interior damp or wet areas.

2. Ground Fault Circuit Interrupter (GFCI):
   a. Specification Grade.
   b. Class A protection.
   c. Feed through type.
   d. Test and reset buttons.
   e. Self-testing.
   g. Weather-resistant when located in exterior locations or interior damp or wet areas.
   h. Additional standards: UL 943.
C. Dry Non-architecturally Finished Areas Specific Requirements:
   1. Coverplate for use on surface mounted outlet boxes:
      a. Cast aluminum, natural, lacquer or factory painted finish.
      b. Single or multiple gang as required.

D. Exterior Locations Specific Requirements:
   1. Coverplate:
      a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel
         hardware, copper-free aluminum, 3.2 IN minimum cover depth for #12 AWG cord.

E. Corrosive and Wet or Damp Area Specific Requirements:
   1. Corrosion resistant nickel plated metal parts.
   2. Receptacle body color: Gray.
   3. Weather-resistant.
      a. Identification: Letters “WR” on face of receptacle.
   4. Ground Fault Circuit Interrupter (GFCI):
   5. Coverplate for use on metallic outlet boxes:
      a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel
         hardware, copper-free aluminum, 3.2 IN minimum cover depth for #12 AWG cord.

F. Special Purpose Receptacles: NEMA configuration as required.

2.4 MISCELLANEOUS WIRING DEVICES
   A. Manual Motor Starters: Horsepower rated with or without thermal overloads, see Specification
      Section 26 24 19.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install products in accordance with manufacturer's instructions.
   B. See Specification Section 26 05 33 for device outlet box requirements.
   C. Where more than one (1) receptacle is installed in a room, they shall be symmetrically arranged.
   D. Provide blank plates for empty outlets.
SECTION 26 28 00
OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification Section.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Circuit breakers:
   a. Eaton.
   b. General Electric Company.
   c. Square D Company.

2.2 CIRCUIT BREAKERS
A. Molded Case Type:
   1. General:
      a. Standards: UL 489.
      b. Unit construction.
      c. Over-center, toggle handle operated.
      d. Quick-make, quick-break, independent of toggle handle operation.
      e. Manual and automatic operation.
2. Thermal magnetic type:
   a. Inverse time overload and instantaneous short circuit protection by means of a thermal magnetic element.
   b. Frame size 150 amp and below:
      1) Non-interchangeable, non-adjustable thermal magnetic trip units.
   c. Frame sizes 225 to 400 amp (trip settings less than 400A):
      1) Interchangeable and adjustable instantaneous thermal magnetic trip units.
   d. Ground Fault Circuit Interrupter (GFCI) Listed:
      1) Standard: UL 943.
      2) One- or two-pole.
      3) Class A ground fault circuit.
      4) Trip on 5 mA ground fault (4-6 mA range).
   3. Solid state trip type:
      a. Inverse time overload, instantaneous short circuit and ground fault protection by means of a solid state trip element, associated current monitors and flux shunt trip mechanism.
      b. Frame size 400 amp to 1200 amp (trip settings between 400 and 1200A):
         1) Standard rating.
         2) Interchangeable current sensor or rating plug.
         3) Adjustable long time pick-up setting.
            a) Adjustable from 50 to 100 PCT of the current sensor or rating plug.
         4) Adjustable short time pick-up setting.
         5) Adjustable instantaneous pick-up.
   4. Motor circuit protector:
      a. Adjustable instantaneous short circuit protection by means of a magnetic or solid state trip element.
      b. Sized for the connected motor.

3.1 INSTALLATION

A. Series rated systems not acceptable.
B. Devices shall be ambient temperature compensated.
C. Circuit Breakers:
   1. Molded case circuit breakers shall incorporate the following:
      a. Frame sizes 400 amp and less with trip setting less than 400A shall be thermal magnetic type.
      b. Frame sizes 400 amp and larger shall be solid state trip type.
      c. Motor circuit protectors sized for the connected motor.

3.2 FIELD QUALITY CONTROL

A. Adjustable Circuit Breakers:
   1. Set all circuit breaker adjustable taps as required for coordination except adjust motor circuit protectors per the motor nameplate and NFPA 70 requirements.

END OF SECTION
SECTION 26 28 16
SAFETY SWITCHES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   2. Product technical data:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification Section.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call for or-equal consideration is requested. See General Condition Article 7.04.
   1. Safety switches:
      a. Eaton
      b. General Electric Company.
      c. Square D Company.

2.2 SAFETY SWITCHES
A. General:
   1. Non-fusible or fusible.
   2. Suitable for service entrance when required.
   3. NEMA Type HD heavy-duty construction.
   4. Switch blades will be fully visible in the OFF position with the enclosure door open.
   5. Quick-make/quick-break operating mechanism.
   6. Deionizing arc chutes.
   7. Manufacture double-break rotary action shaft and switchblade as one (1) common component.
   8. Clear line shields to prevent accidental contact with line terminals.
   9. Operating handle (except NEMA 7 and NEMA 9 rated enclosures):
      a. Red and easily recognizable.
      b. Padlockable in the OFF position.
c. Interlocked to prevent door from opening when the switch is in the ON position with a defeater mechanism.

B. Ratings:
1. Horsepower rated of connected motor.
2. Voltage and amperage: As required.
3. Short circuit withstand:
   a. Non-fused: 10,000A.
   b. Fused: 200,000A.

C. Accessories, when indicated in PART 3 of this Specification Section:
1. Neutral kits.
2. Ground lug kits.
3. Auxiliary contact kits:
   a. Opens before main switch.
   b. Rated 10A at 125/250 Vac.
   c. One (1) N.O. and one (1) N.C. contact.

D. Enclosures:
1. NEMA 4X rated (metallic):
   a. Body and cover: Type 304 or 316 stainless steel.
   b. No knockouts, external mounting flanges, hinged and gasketed door.
2. NEMA 7 rated:
   a. Cast gray iron alloy or copper-free aluminum with manufacturers standard finish.
   b. Drilled and tapped openings or tapered threaded hub.
   c. Gasketed cover bolted-down with stainless steel bolts.
   d. External mounting flanges.
   e. Operating handle padlockable in the OFF position.
3. NEMA 12 rated:
   a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
   b. No knockouts, external mounting flanges, hinged and gasketed door.

E. Overcurrent and Short Circuit Protective Devices: Fuses.

F. Standards: NEMA KS 1, UL 98.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's instructions and recommendations.
B. Install switches adjacent to the equipment they are intended to serve.
C. Provide auxiliary contact kit on local safety switches for motors being controlled by a variable frequency drive.
   1. The VFD is to be disabled when the switch is in the open position.
D. Permitted uses of NEMA 4X metallic enclosure:
   1. Surface mounted in areas designated as wet and/or corrosive.
E. Permitted uses of NEMA 7 enclosure:
   1. Surface mounted in areas designated as Class I hazardous.
   2. Provide PVC coating in corrosive areas when PVC coated conduit is used.
F. Permitted uses of NEMA 12 enclosure:
   1. Surface mounted in areas designated as dry in non-architecturally finished areas.
SECTION 26 29 23

VARIABLE FREQUENCY DRIVES: LOW VOLTAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

B. Qualifications:

1. Provide drives that are listed and labeled by UL, ETL, or other Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA regulations, or that have been inspected and subsequent field-labeled by such NRTL.

2. Where listed drives and other components are installed in a common enclosure, the assembly shall be listed and labeled per UL 508 and UL 508A or equivalent NRTL standard.

a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" or equivalent NRTL label prior to shipment to the jobsite.

3. VFD Supplier shall maintain an authorized service organization within 100 miles of the Project Site.

C. Coordination:

1. The intent of this Specification Section is to allow the VFD manufacturer to provide the best solution for the harmonic and motor protection outlined herein.

a. This solution shall include, but not be limited to, all aspects of the distribution system including standby generation, motor feeder cable type and available floor space.

2. VFD shall be supplied complete with all required control components.

a. Provide control as required:

b. VFD manufacturer shall review the application and provide, at no additional cost to the Owner, the hardware and software necessary to allow the VFD to control the driven equipment motor over its required operating range.

1) These may include, but are not limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.

c. Coordinate control devices with devices furnished with driven equipment such as vibration switches, thermal sensors, leak detectors, etc.

1.3 DEFINITIONS

A. Variable Torque (VT):

1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as speed is reduced below full rated.

2. This type of load permits the VFD and the motor to operate at reduced output current at reduced speed.

B. Constant Torque (CT):

1. Defines a load characteristic in which the torque delivered from the motor to the load remains constant as speed is varied.
2. This type of load requires the VFD to be able to continuously deliver rated output current over the entire speed range.

C. Constant Horsepower:
1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as the speed is increased.
2. This characteristic is required for operation of the VFD and motor above rated frequency to maintain output current within the rated value.

D. Inverter Duty Motor: An AC induction motor complying with all requirements of NEMA MG 1 Part 31 for definite-purpose inverter-fed motors.

E. Standard Motor: An AC induction motor that fails to comply with one (1) or more requirements of NEMA MG 1 Part 31.

F. Low Voltage: 600 Vac or less.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
2. Acknowledgement that products submitted meet requirements of the established standards of quality.
3. Provide a schedule for each VFD including the following information:
   a. Equipment Tag Number.
   b. VFD Complete Catalog Number.
   c. VFD Amp Frame Size.
   d. Variable or Constant Torque Rating Basis.
   e. Rated Input Current.
   f. Rated Continuous Output Current.
   g. Rated Short Circuit Current.
   h. VFD cable type specified (shielded or non-shielded).
   i. VFD Maximum Motor Lead Length for the type of cable used.
   j. Motor Manufacturer.
   k. Motor Frame Size.
   l. Motor Full Load Amps.
   m. Motor Service Factor.
   n. As installed motor Lead Length.
   o. VFD options provided to meet harmonic or motor protection specifications.
4. Submit VFD Shop Drawings concurrently with driven equipment and motor Shop Drawings.
5. Product technical data:
   b. Maximum rate of heat rejection from VFD and all related components and associated cooling requirements.
   c. Manufacturer’s installation instructions.
   d. Manufacturer’s programming and operating instructions.
   e. See Specification Section 26 05 00 for additional requirements.
6. Fabrication and/or layout Drawings:
   a. Top, front and side exterior views, with details showing maximum overall dimensions of enclosure, mounting provisions and conduit/cable entry provisions.
   b. Identify minimum clearances from other VFDs or electrical equipment required for proper cooling at top, bottom, side and back of enclosure.
   c. Three-line diagrams showing AC schematic of VFD, input, output and bypass devices including device ratings.
d. Interior layout Drawings showing location of all components within enclosure, field wiring terminal boards, and power and grounding connections.

e. Field wiring diagrams showing locations and sizes of all electrical connections, ground terminations, and requirements for shielded wire usage or any other special installation considerations.

7. Certifications:
   a. Submit with Shop Drawings:
      1) Identification and location of closest authorized service organization.
   b. Submit prior to shipment:
      1) Certified factory test reports confirming compliance with specified requirements.
   c. Submit after installation:
      1) Certified field service reports showing:
         a) Each VFD is operational.
         b) Each VFD and its driven equipment motor are compatible.
         c) Each VFD responds correctly to the input control signals.
         d) Critical frequencies of the drive system and that the VFD has been set to lockout these frequencies.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Low voltage variable speed drives:
   a. Allen Bradley.
   b. Eaton.
   c. Square D Company.

2.2 GENERAL

A. VFDs shall consist of a rectifier-DC bus-inverter combination producing a sine-coded pulse-width-modulated (PWM) output voltage waveform.

B. VFDs, whether installed in motor control center (MCC) construction or separately-mounted, shall constitute a complete combination motor controller per NFPA 70, Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.

1. Motor control.

C. It is the intent of this Specification that VFDs shall be an “engineered” or “configured” drive package in which the VFD chassis, all input, output and bypass power devices, VFD accessories, ancillary switches, contactors, relays, and related control devices are selected, furnished, factory-assembled and tested by the VFD manufacturer in a single enclosure requiring only connection of the power supply circuit, motor branch circuit, and external control wiring in the field.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Application:
   1. VFD(s) shall be of sufficient capacity and shall provide a quality of output waveform for stepless motor control from 10 to 100 PCT of base speed of the driven equipment.
   2. VFDs shall be compatible with:
      a. Inverter duty induction motors.
3. VFDs shall be suitable for Constant Torque (CT) or Variable Torque (VT) applications.
   a. VFD manufacturer shall coordinate with the manufacturer of the driven equipment to
      identify CT and VT applications.
4. VFDs shall be designed to operate successfully under the following site conditions:
   a. Ambient:
      1) Temperature: 0-40 DEGC.
      2) 95 PCT non-condensing relative humidity.
   b. Elevation: Less than 3,300 FT above MSL.
   c. Power supply characteristics:
      1) 480Vac, 3 PH, 60 Hz, 3 wire, (+/- 10 PCT).
      2) Effectively grounded.

B. Ratings and Performance Specifications:
1. Voltage rating:
   a. Nominal: 460 or 480Vac, 3 PH, 60 Hz.
   b. Range for continuous full load operation: +/-10 PCT of nominal.
   c. Voltage imbalance tolerance for full load operation: 3 PCT minimum.
2. Current ratings:
   a. Continuous:
      1) Equal to or greater than the motor nameplate full load.
   b. Short-term overload:
      1) VT: 110 PCT for 1 minute.
      2) CT: 150 PCT for 1 minute.
      3) Permissible for 1 minute every 10 minutes continuously.
   c. Short circuit:
      1) Where a short circuit rating is not indicated or specified for individual VFDs, each
         VFD shall have a rating not less than the MCC, switchboard or panelboard the
         VFD is supplied from.
      2) Where specified short circuit rating indicates additional input impedance is
         required to protect semiconductors, provide input AC line reactors, whether
         required to meet harmonic performance specifications or not.
3. Efficiency:
   a. 97 PCT, minimum, at full speed and full load.
   b. 93 PCT, minimum at 1/2 speed and full load.
4. Displacement power factor:
   a. 95 PCT, minimum from 50 PCT to 100 PCT speed and load.
5. Efficiency and power factor criteria apply from the input terminals to the output terminals of
   the VFD alone, excluding losses of input and output power circuit accessories.
6. Frequency drift:
   a. +0.5 PCT of set frequency.
7. Speed regulation (motor dependent): 3 PCT.
8. Speed range: 10:1.
9. Control type:
   a. Volts/Hertz ratio; constant over the entire operating range of the VFD except:
      1) When operating under voltage boost.
      2) At frequencies over 60 Hz.

C. Operational Features:
1. Insensitive to input phase sequence.
2. Continued operation with momentary voltage dips of 25 PCT of rated voltage, or single
   phase condition: 4 second, minimum.
3. Controls power loss ride-through: 500 MSEC, minimum.
4. Electronic reversing.
5. DC injection braking.
6. Anti-windmilling: Synchronization of VFD starting frequency with spinning or coasting
   load, forward or reverse.
7. Critical frequency band lockout:
   a. Minimum of three (3) settings.
   b. Adjustable bandwidth, 1 - 5 Hz.
8. Capable of operating without the motor connected for start-up and troubleshooting.

D. The VFD shall be provided with the following minimum user-programmable parameters:
1. Carrier frequency.
2. Independent maximum and minimum speeds for forward and reverse operation.
3. Start frequency and hold time.
4. Independent linear acceleration and deceleration time.
5. Preset “jog” speed.
6. Three (3) critical frequency bands.
7. One (1) preset speed selectable by logic input.
8. Volts/Hertz ratio.
9. Voltage boost, magnitude and frequency range.
12. Overcurrent pickup.
13. Overcurrent delay.
15. DC injection level and time.

E. The VFD shall be designed such that the power circuit components are fully protected from line side disturbances and load side faults:
1. General:
   a. Shutdown conditions associated with supply circuit conditions which can be corrected external to the VFD-motor system shall be provided with automatic reset, with shutdown cause logged in memory:
      1) Input under voltage.
      2) Input over voltage.
      3) Input under frequency.
      4) Input over frequency.
      5) Input Phase loss.
      6) DC Bus under voltage.
   b. Shutdown conditions which indicate overload or fault within the VFD, the output circuit, or the motor shall require local manual reset at the VFD, requiring operator intervention.
      1) Over temperature.
      2) Blown fuse.
      3) Component failure.
      4) Overload.
      5) Short circuit.
      6) Ground fault.
      7) DC Bus over voltage.
      8) External safety input (e.g., motor thermal protection).
      9) Logic fault.
   c. When automatic shutdown occurs, VFD shall restart immediately upon reset, whether automatic or manual.
   d. VFD shall hold cause of trip data for a minimum of four (4) shutdowns in memory.
      1) Data to be accessible through the keypad, local communication link and remotely.
2. Input protection:
   a. Input circuit breaker or current-limiting fuses with externally operable disconnect.
      1) Fault current interrupting rating equal to or greater than the specified withstand rating of the VFD.
      2) Handle padlockable in the OFF position.
b. Provide full protection for semiconductors integral to the VFD; units requiring current-limiting fuses or circuit breakers in the supply circuit are not acceptable.

3. Internal protection:
   a. Surge suppression and power device snubbers.
   b. Power devices rated at 2.5 times line voltage.
   c. Instantaneous over current trip.
   d. DC bus over voltage trip.
   e. Power device over temperature trip.
   f. Control logic circuit malfunction trip.

4. Output protection:
   a. Inverse-time overload trip:
      1) UL Class 10 characteristic.
   b. Over voltage trip.
   c. Over frequency trip.
   d. Short circuit trip.
      1) Line to line and line to ground.
   e. Ground fault trip.

2.4 OPERATOR AND REMOTE CONTROL INTERFACE

A. Drive controls shall be microprocessor-based with on-board human machine interface and both local and remote digital communications capability.
   1. All monitoring and control functions, other than those shutdowns specified to be manual reset only, shall be available both locally and remotely.

B. Control circuits shall be 120 Vac or 24 Vac or 24 Vdc.
   1. 120 Vac supplied by CPT in the VFD.
      a. CPT shall have minimum additional capacity of 60 VA greater than that required by control devices.
      b. CPT shall have two (2) fuses on the primary side and one (1) fuse on the secondary side.
      c. CPT shall have surge protection on the primary side independent of any other surge protection in the VFD.
   2. 24 Vac or 24 Vdc supplied by Class 2 power supply in the VFD.
      a. Power supply shall have minimum additional capacity of 33 PCT greater than that required by control devices.
      b. Provide two (2) current-limiting fuses on the AC supply to the power supply.
      c. Power supply shall have surge protection on the primary side independent of any other surge protection in the VFD.

C. Operator Interface:
   1. Door mounted sealed keypad, membrane type with LED or LCD display.
      a. Messages shall be in English and engineering units.
      b. Drive operating parameters shall be programmable.
      c. Menu driven.
      d. Password security.
      e. Display fault and diagnostic data.
      f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.
   2. Provide indication and control interface, integral in the keypad.
      a. Minimum indications:
         1) Run.
         2) Stop.
1) Ready.
2) Alarm.
3) Fault.
4) Local control.
5) Remote control.
6) Control source local.
7) Control source remote.
8) Speed indication.

b. Minimum control functions:
1) Local/Remote switch.
2) Stop button.
3) Start button.
4) Reset button.
5) Speed control buttons.

3. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure.
   a. On occurrence of more than one (1) condition, each shall be recorded or indicated by the diagnostics.

D. Remote Control Interface:
1. Local portable computer interface via RS232/RS242 serial communications port:
   a. Capability to:
      1) Start-Stop VFD.
      2) Control VFD Speed.
      3) Access fault and diagnostic data.

2. Analog and discrete inputs:
   a. Speed reference (setpoint) signal 4-20 mA DC.
      b. Isolated process PID controller with user-programmable setpoint, gain, rate, reset and span for accepting a remote 4-20 mA DC process variable signal.

3. Analog and discrete outputs:
   a. 4-20 mA DC output for remote speed indication, as a function of frequency, calibrated 0 to 100 PCT.
      b. Drive FAULT contacts.
      c. Drive RUNNING contacts.
      d. Drive selector switch in REMOTE/AUTO status contacts.

4. Contacts:
   a. Contacts shall be rated 2 A inductive at 120 Vac.
   b. All contacts shall be wired to field wiring terminal boards.

5. Drive shutdown on external fault input:
   a. Provide isolated input for dry contact from external motor or system safety devices to cause immediate shutdown of VFD.
   b. Safety shutdown to be operable in all operating modes of drive, including local operation from keypad.
   c. Local safety switch, to driven equipment, auxiliary contact to lock-out VFD from running when safety switch is open.

6. Network communications capability:
   a. Provide VFD with communication card, protocol and required programming for digital communication of all VFD program and operational parameters to plant control system via:
      1) Ethernet IP.

2.5 HARMONIC PROTECTION REQUIREMENTS

A. All VFDs shall be capable of satisfactory operation from a source having voltage distortion and notch characteristics identified as acceptable for a “dedicated system” in IEEE 519 Table 10.2.
B. PCC shall be considered:
   1. Building service entrance switchgear, switchboard or MCC.

C. Provide one (1) of the following topologies:
   1. 6-pluse rectifier topology.
   2. 6-pulse rectifier topology with input line reactors or DC link reactors, minimum impedance
      3 or 5 PCT on drive kVA base.
   3. 6-pluse rectifier topology with tuned passive filter with controls such that the filter is not
      energized when VFD is off or starting for each VFDs.

D. VFD manufacturer shall determine, for their proposed equipment, uncorrected harmonic
   distortion levels and mitigation techniques required to meet the specified limits and shall furnish
   the VFD types and all accessory items and equipment necessary to do so, whether specified
   herein or not.

E. Following start-up, with facility at full load operation, provide measurement of harmonic
   voltage, current and notch characteristics at each PCC according to the requirements of
   IEEE 519 Section 9.

2.6 MOTOR PROTECTION REQUIREMENTS

A. The VFD shall produce a quality of output waveform adequate to allow the motor to produce
   rated torque at rated RPM continuously without exceeding the temperature rise given in
   NEMA MG 1 Table 31-2.

B. Provide motor overload, short circuit and ground fault protection integral to drive electronics.

C. The VFD shall not produce voltage spikes in excess of the following values at the motor
   terminals when operated with the feeder types shown on the Drawings and the actual installed
   feeder lengths.
   1. If unmitigated voltage peaks exceed the specified limits, provide output line reactors, filters,
      or other devices as required to meet the specified limits:
      a. Inverter duty motors: 1280 V.
      b. Rise time shall be greater than or equal to 0.1 microsecond.
      c. Motor lead length and data shall be determined by the Contractor based on the actual
         routing of the conductors.

D. Following start-up, provide measurement of peak voltage at the terminals of each motor, unless
   the lead lengths are 10 PCT shorter than the manufacturers published literature for maximum
   lead length for the type of cable installed.
   1. Values in excess of specified limits require correction by Contractor and re-measurement.
   2. Provide certification of compliant measurements as part of Field Service Engineer’s final
      report.

2.7 EQUIPMENT CONSTRUCTION

A. Fabrication and Assembly:
   1. Each VFD system shall be factory-assembled and shall utilize interchangeable plug-in
      printed circuit boards and power conversion components wherever possible.
      a. Factory assembly shall be performed by the VFD manufacturer or authorized agent.
      b. Systems fabricated or assembled in whole or in part by parties other than the VFD
         manufacturer or authorized agent will not be acceptable.
   2. Reactors and/or filters, where required, shall be mounted within or in an ancillary enclosure
      adjacent to the drive enclosure, or with the Engineer's permission may be mounted in a
      separate enclosure.
   3. Cooling fans, as required, shall be provided to run when drive is running.
   4. Enclosures for separately mounted VFD's:
      a. NEMA Type 12 for installation in other unclassified areas.
B. Wiring:
   1. The wiring in the VFD shall be neatly installed in wire ways or with wire ties where wire
      ways are not practical.
      a. Where wire ties are used, the wire bundles are to be held at the back panel with a
         screw-mounted wire tie mounting base.
      b. Bases with a self-sticking back will not be allowed.
   2. Provide terminal boards for all field wiring and inter-unit connections, including analog
      signals.
      a. Provide terminals for shield continuity where required.
   3. Terminal blocks shall be complete with marking strip, covers and pressure connectors.
      a. Non-brittle, interlocking, track-mounted type.
      b. Screw terminals will not be allowed.
      c. A terminal for each conductor of external circuits plus one (1) ground for each shielded
         cable.
      d. For free-standing panels, 8 IN of clearance shall be provided between terminals and the
         panel base for conduit and wiring space.
      e. Not less than 25 PCT spare terminals shall be provided.
      f. Terminals shall be labeled to agree with identification indicated on the Suppliers’
         Submittal Drawings.
      g. Individually fuse each control loop or system and all fuses or circuit breakers shall be
         clearly labeled and located for easy maintenance.
   4. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue
      terminal.
      a. The surface of the sheet metal shall be prepared to assure good conductivity and
         corrosion protection.
   5. Wiring shall not be kinked or spliced and shall have markings on both ends or be color
      coded.
      a. Markings or color code shall match the manufacturer's Drawings.
   6. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals
      for external connection shall be stranded copper, type MTW or SIS, insulated for not less
      than 600 V, with a moisture-resistant and flame-retardant covering rated for not less than
      90 DEGC.

C. Painting: Enclosure, after being phosphate washed, shall be thoroughly cleaned and given at
least one (1) coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

2.8 COMPONENTS AND ACCESSORIES

A. Reactors:
   1. Impedance: 3 PCT or 5 PCT.
   2. Continuous current: Not less than drive rating.
   3. Current overload: 150 PCT for 1 minute.
   4. Insulation temperature rating: 180 DEGC.
   5. Copper windings.
   6. Saturation current rating: 3.5 to 5 times rated current.
   7. Hi-potential rating: 2500 Vac line to ground and line to line, for 1 minute.
   8. Noise reduction features:
      a. Epoxy over cast coil.
      b. Extra dips and bakes of varnish over continuous wound coil.

2.9 SOURCE QUALITY CONTROL

A. Factory Tests:
   1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure
      conformance to Specification requirements.
   2. Prior to final assembly:
      a. Inspect incoming components.
      b. Test and inspect power devices.
3. After final assembly:
   a. Continuity and insulation test of 480 power control circuits.
   b. Drive tests:
      1) Verify all auxiliary circuits operation.
      2) Monitor output variables.
   c. Systems test:
      1) Provide inputs to field connections and simulate on-site operation.
      2) Test all auxiliary equipment.

2.10 MAINTENANCE MATERIALS
   A. Provide manufacturer's recommended renewable spare parts (e.g., power and control fuses).
   B. Spare parts utilized during pre-start-up or start-up and demonstration testing shall be immediately restocked, at no cost to the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install products in accordance with manufacturer's instructions.
   B. Verify the installed motor nameplate electrical requirements do not exceed the VFD capacity.
   C. Provide services of manufacturer's representative to perform start-up services.
   D. The selection of input and output harmonic and voltage spike protection shall also be made on the available physical space.

3.2 START UP
   A. Field Quality Control:
      1. Perform field measurement of harmonics at each PCC per Harmonic Protection Requirements Article.
      a. For each individual VFD.
      b. For the maximum number of VFDs that will be operational at the same time.
      c. When all loads are at 75 PCT load minimum.
      d. Duration: 1 HR minimum.
      2. Perform field measurement of the maximum voltage peak at the terminals of each motor fed from a VFD per Motor Protection Requirements Article.
      a. Use a high speed oscilloscope to produce a plot of Voltage (Y axis) versus Time (X axis).
         1) Time shall be measured in microseconds.
         b. Tests shall be performed at full:
            1) Full voltage and speed.
            2) Loaded to 75 PCT minimum.
            3) Duration: 1 HR minimum.
      3. Record all data necessary for the preparation of required test reports.
   B. Start-up and Demonstration Services:
      1. Supervise start-up of all units including recheck of settings made during the pre-start-up tests.
         a. Perform all work in the presence of the Owner's designated representatives.
      2. Setup all VFDs with carrier frequency at minimum value consistent with proper operation; inform Engineer of carrier frequencies set in excess of 5 kHz and reason for setting.
3. Simulate operation of the VFD and its associated control and instrumentation system in both the manual and automatic modes.
   a. Ensure compatibility of VFD with associated control and instrumentation signals.
4. Simulate VFD failures and demonstrate troubleshooting aids.

C. Instruct Owner's Designated Personnel:
1. Minimum of 4 HRS at the jobsite.
2. Include both field and classroom instruction.
3. Instructions shall include proper operation and maintenance procedures including, but not limited to:
   a. Lubrication.
   b. Troubleshooting.
   c. Repair and replacement.
   d. Parts inventory.
   e. Maintenance records.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 DEFINITIONS
A. Installer: Installer is the person actually installing the product in the field at the Project site.
B. Classification of Buildings:
   1. Class I: Any commercial, industrial, or residential building less than 75 FT in height.
   2. Class II: Any commercial, industrial, or residential building 75 FT or taller.

1.4 SYSTEM DESCRIPTION
A. Provide a complete lightning protection system on the following:
   1. New ESAD Building, including Boiler Room.

1.5 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   2. Product technical data:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification Section.
      c. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
      d. Include data sheets that include manufacturer’s name and product model number.
         1) Clearly identify all optional accessories.
      e. Acknowledgement that products submitted are in compliance with LPI or UL.
      f. Equipment installation details.
   3. Fabrication and/or layout Drawings:
      a. Plan drawing showing type, size, and locations of all lightning protection hardware.
      b. Roof penetration details.
      c. Verification that the installation shall comply with the requirements of, and shall qualify for the UL Master Label Certificate.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Lightning protection system:
   a. A/C Lightning Protection, Inc.
   b. Harger Lightning Protection
   c. Thompson Lightning Protection, Inc.

2.2 MATERIALS

A. Air Terminals:
   1. Class I applications:
      a. Solid or tubular copper nickel tip type.
      b. Solid copper terminals shall be a minimum of 3/8 IN DIA.
         1) Tubular copper shall be a minimum of 5/8 IN DIA.
      c. Minimum height of 12 IN above object being protected.
   2. Class II applications:
      a. Solid copper nickel tip type.
      b. Terminals shall be a minimum of 1/2 IN DIA.
      c. Terminals shall be a minimum of 24 IN above object being protected.

B. Air terminal bases shall be cast bronze with bolt pressure cable connectors.

C. All main and secondary conductors shall be copper cable or copper solid strip sized according to Tables 3-1.1(a) and 3-1.1(b) of NFPA 780.
   1. Except where structural steel is utilized as the main and secondary conductors.
   2. Conductors within 25 FT of the top of a stack shall be lead covered.

D. Conductor fasteners, connector fittings, bonding fittings, conductor splicers and thru-wall or thru-roof assemblies shall be cast bronze, brass or copper with bolt pressure connectors.

E. Ground rods shall be in accordance with Specification Section 26 05 26.

F. All bolts, nuts, and screws shall be stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Installation and materials shall be in accordance with LPI and NFPA standards.

C. Air terminals less than 2 FT in height shall be placed a maximum of 20 FT apart along the perimeter of a flat or gently sloping roof.
   1. Air terminals 2 FT or higher shall be placed a maximum of 25 FT apart along the perimeter.

D. Air terminals shall be placed within 2 FT of the ends of ridges, or edges and corners of roof.
   1. All air terminals along the perimeter shall be interconnected by the main roof conductor loop.

E. Support air terminals against overturning.
   1. Air terminals exceeding 2 FT in height shall be supported at a point not less than one-half its height.
F. Provide a minimum of two (2) unspliced down conductors with a maximum spacing of 100 FT along the perimeter of a building.
   1. Unless structural steel is utilized as the down conductor.
G. Metal objects less than 3/16 IN thick that are required to be bonded shall be protected by an air terminal.
H. Securely attach conductors to the building using non-corrosive fasteners spaced no more than 3 FT apart.
I. Do not install copper conductors or fasteners in contact with aluminum surfaces.
J. Down conductors shall be encased in rigid non-metallic conduit from a minimum of 2 FT below grade to a minimum of 8 FT above grade.
K. All components shall be installed to blend in with the appearance of the building so that they appear as part of the building.
   1. Down conductors shall be mounted in locations along the structure walls where they are least observable.
L. Reinforcing steel shall be electrically continuous and bonded to the lightning protection system.
M. Metal guy wires and cables shall be bonded to the lightning protection system.
N. Class I Steel-Framed Buildings:
   1. Steel columns shall be utilized as the down conductors.
   2. Steel roof beams and trusses shall be utilized as the main and secondary conductors.
   3. Air terminals shall be bonded to the steel columns, roof beams, or trusses.
      a. Building penetration shall be with thru-roof type fittings.
   4. Verify electrical continuity of the framing system.

3.2 FIELD QUALITY CONTROL
A. Installation shall be performed in accordance with UL and NFPA.
B. The completed installation shall qualify for and receive the UL Master Label.
C. Provide a nameplate attached to the structure that includes the name and address of the Contractor responsible for the installation of the lightning protection system.

END OF SECTION
SECTION 26 43 13
LOW VOLTAGE SURGE PROTECTION DEVICES (SPD)

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Qualifications:
   1. Provide devices from a manufacturer who has been regularly engaged in the development, design, testing, listing and manufacturing of SPDs of the types and ratings required for a period of 10 years or more and whose products have been in satisfactory use in similar service.
      a. Upon request, suppliers or manufacturers shall provide a list of not less than three (3) customer references showing satisfactory operation.

1.3 DEFINITIONS
A. Clamping Voltage:
   1. The applied surge shall be induced at the 90 degree phase angle of the applied system frequency voltage.
   2. The voltage measured at the end of the 6 IN output leads of the SPD and from the zero voltage reference to the peak of the surge.
B. Let-Through Voltage:
   1. The applied surge shall be induced at the 90 degree phase angle of the applied system frequency voltage.
   2. The voltage measured at the end of the 6 IN output leads of the SPD and from the system peak voltage to the peak of the surge.
C. Maximum Continuous Operating Voltage (MCOV): The maximum steady state voltage at which the SPD device can operate and meet its specification within its rated temperature.
D. Maximum Surge Current:
   1. The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10 percent deviation of clamping voltage at a specified surge current.
   2. Listed by mode, since number and type of components in any SPD may vary by mode.
E. MCC: Motor Control Center.
F. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements, i.e., line-to-neutral (L-N), line-to-line (L-L), line-to-ground (L-G), neutral-to-ground (N-G).
G. Surge Current per Phase:
   1. The per phase rating is the total surge current capacity connected to a given phase conductor.
      a. For example, a wye system surge current per phase would equal L-N plus L-G; a delta system surge current per phase would equal L-L plus L-G.
      b. The N-G mode is not included in the per phase calculation.

H. System Peak Voltage: The electrical equipment supply voltage sine wave peak (i.e., for a 480/277 V system the L-L peak voltage is 679V and the L-N peak voltage is 392 V).

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Manufacturer's qualifications.
      c. Standard catalog cut sheet.
      d. Electrical and Mechanical Drawing showing unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
      e. Testing procedures and testing equipment data.
      f. Create a Product Data Sheet for each different model number of SPD provided (i.e., Model XYZ with disconnect and Model XYZ without disconnect, each require a Product Data Sheet).
         1) Data in the Product Data Sheet heading:
            a) SPD Type Number per PART 2 of the Specification.
            b) Manufacturer’s Name.
            c) Product model number.
         2) Data in the Product Data Sheet body:
            a) Column one: Specified value/feature of every paragraph of PART 2 of the Specification.
            b) Column two: Manufacturer’s certified value confirming the product meets the specified value/feature.
            c) Name of the nationally recognized testing laboratory that preformed the tests.
            d) Warranty information.
         3) Data in the Product Data Sheet closing:
            a) Signature of the manufacturer’s official (printed and signed).
            b) Title of the official.
            4) Date of signature.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.6 WARRANTY

A. Minimum of a five (5) year Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

2.2 GENERAL


2.3 TYPE 3 SPD

A. Product:
   1. Integrate mounted in a switchboard, panelboards or motor control centers.
   2. Hybrid solid state high performance suppression system.
      a. Do not use gas tubes, spark gaps or other components in suppression system which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
   3. Do not connect multiple SPD modules in series to achieve the specified performance.
   4. Designed for parallel connection.
   5. Field connection: Use mechanical or compression lugs for each phase, neutral and ground that will accept bus bar or #10 through #1/0 conductors.
   6. Device monitor:
      a. Long-life, solid state, externally visible indicators and Form C contact(s) that monitor the on-line status of each mode of the units suppression filter system or power loss in any of the phases.
      b. A fuse status only monitor system is not acceptable.

B. Operating Voltage: The nominal unit operating voltage and configuration as required.

C. Modes of Protection: All modes.
   1. Three phase (delta): L-L, L-G.
   2. Three phase (wye): L-N, L-L, L-G and N-G.
   4. Single phase: L-N, L-G and N-G.

D. Maximum Continuous Operating Voltage: Less than 130 PCT of system peak voltage.

E. Operating Frequency: 45 to 65 Hz.

F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.

G. Maximum Surge Current: 160,000 A per phase, 80,000 A per mode minimum.

H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High or B combination waveform impulses with no degradation of more than 10 PCT deviation of the clamping voltage.

I. SPD Protection:
   1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
   2. An IEEE B combination wave shall not cause the fuse to open and render the SPD inoperable.
J. Maximum Clamping Voltages: Dynamic test at the 90 degree phase angle including 6 IN lead length and measured from the zero voltage reference:

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Test Mode</th>
<th>IEEE C62.41</th>
<th>UL 1449</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-L &lt; 250 V</td>
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<td>1000 V</td>
<td>800 V</td>
</tr>
<tr>
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<td>600 V</td>
<td>500 V</td>
</tr>
<tr>
<td></td>
<td>L-G</td>
<td>800 V</td>
<td>600 V</td>
</tr>
<tr>
<td></td>
<td>N-G</td>
<td>800 V</td>
<td>600 V</td>
</tr>
<tr>
<td>L-L &gt; 250 V</td>
<td>L-L</td>
<td>2000 V</td>
<td>1800 V</td>
</tr>
<tr>
<td>L-N &gt; 150 V</td>
<td>L-N</td>
<td>1150 V</td>
<td>1000 V</td>
</tr>
<tr>
<td></td>
<td>L-G</td>
<td>1550 V</td>
<td>1200 V</td>
</tr>
<tr>
<td></td>
<td>N-G</td>
<td>1550 V</td>
<td>1200 V</td>
</tr>
</tbody>
</table>

K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

2.4 TYPE 5 SPD

A. Product:
   1. Externally mounted next to equipment or internally to control panel for point-of-use loads.
   2. Hybrid solid state high performance suppression system.
   3. Designed for parallel connection.

B. Operating Voltage: Nominal unit operating voltage and configuration as required.

C. Modes of Protection: All modes.
   1. Three phase (delta): L-L, L-G.
   2. Three phase (wye): L-N, L-L, L-G and N-G.
   4. Single phase: L-N, L-G and N-G.

D. Maximum Continuous Operating Voltage: Less than 130 PCT of system peak voltage.

E. Operating Frequency: 45 to 65 Hz.

F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.
G. Maximum Surge Current: 120,000 A per phase, 60,000 A per mode minimum.

H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High or B combination waveform impulses with no degradation of more than 10 PCT deviation of the clamping voltage.

I. SPD Protection:
   1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
   2. An IEEE B combination wave shall not cause the fuse to open and render the SPD inoperable.

J. Maximum Clamping Voltages: Dynamic test at the 90 degree phase angle including 6 IN lead length and measured from the zero voltage reference:

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<tr>
<td></td>
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<tr>
<td></td>
<td>N-G</td>
<td>1550 V</td>
<td>1200 V</td>
</tr>
</tbody>
</table>

K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

2.5 SOURCE QUALITY CONTROL

A. SPD approvals and ratings shall be obtained by manufacturers from nationally recognized testing laboratories.

B. The SPD are to be tested as a complete SPD system including:
   1. Integral unit level and/or component level fusing.
   2. Neutral and ground shall not be bonded during testing.
   3. 6 IN lead lengths.
   4. Integral disconnect switch when provided.

C. The “as installed” SPD system including the manufacturers recommended circuit breaker, the SPD is connected to, will not open when tested with a IEEE C3 combination waveform.

D. Tests to be performed in accordance with IEEE C62.45:
   2. Single pulse surge current capacity test.
   3. Repetitive surge current capacity testing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Type 3 SPD:
   1. Connected in parallel to the equipment.
   2. Install in dedicated electrical equipment compartment, bucket or panelboard box at the
      factory before shipment.
   3. Provide leads that are as short and straight as possible.
   4. Maximum lead length: 12 IN.
   5. Minimum lead size: #2 stranded AWG or bus bar.
   6. Connect leads to the equipment to be protected by one (1) of the following means:
      a. Through a circuit breaker or molded case switch mounted in the equipment.
      b. Use manufacturer recommended circuit breaker size.
      c. Circuit breaker or switch to be operable from the equipment exterior or from behind a
         hinged door.

C. Type SPD:
   1. Mounting options:
      a. On wall or support structure adjacent to the equipment to be protected with leads routed
         through conduit; OR
      b. Nipple connection directly to the equipment to be protected.
   2. Install leads as short and straight as possible.
   3. Maximum lead length: 5 FT.
   4. Minimum lead size:
      a. Type 2 and 4 SPD: #2 stranded AWG.
      b. Type 5: #10 stranded AWG.
   5. When conduit connection is used, provide a minimum of four (4) twists per foot in the lead
      conductors and install in NFPA 70 sized conduit.
   6. Connect leads to the equipment to be protected by one (1) of the following means:
      a. Through a circuit breaker or molded case switch mounted in the equipment.
         1) Use manufacturer recommended circuit breaker size.
      b. Directly to the protected equipment bus, when SPD has integral disconnect switch.
      c. To the load side of field mounted equipment’s local disconnect switch.
         1) Provide taps or lugs as required to provide a UL and NFPA 70 compliant
            connection.

END OF SECTION
SECTION 26 50 00
INTERIOR AND EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum
standard of quality for the design and construction of the Work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final
design. If applicable to the final design elements, incorporate the applicable standard of quality
requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 DEFINITIONS
A. Average Rated Life for HID, fluorescent and induction luminaire light sources:
   1. The time after which 50 PCT of a large group of light sources will have failed and 50 PCT
      will have survived under normal operating conditions.
B. Useful Life for LED Luminaire Light Sources:
   1. The operating hours before reaching 70 PCT of the initial rated lumen output (L70) with no
      catastrophic failures under normal operating conditions.
   2. This is also known as 70 PCT "Rated Lumen Maintenance Life" as defined in IESNA LM-80.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester Work.
   2. Product technical data:
      a. Acknowledgement that products submitted meet requirements of the established
         standards of quality.
      b. Provide submittal data for all products specified in PART 2 of this Specification
         Section.
      c. Luminaire data sheet:
         1) Name of manufacturer.
         2) Complete order information (catalog number).
         3) Description of construction and optics.
         4) Total input wattage.
         5) Luminous efficacy (lumens/Watt).
         6) Photometric performance data including candlepower distribution and coefficient
            of utilization (CU) table.
         7) Dimensional size.
         8) Weight.
         9) UL nameplate data for luminaires used in Class 1, Division 1 and 2 areas.
      10) Effective Projected Areas (EPA) for pole mounted luminaires.
      d. Solid state Luminaire additional data:
         1) Voltage.
         2) Initial and IES L70 lumens.
         3) Luminous efficacy (lumens/Watt).
         4) Correlated Color Temperature (CCT).
         5) Color Rendering Index (CRI).
1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.6 WARRANTY

A. Minimum of a five (5) year Warranty from date of manufacture against failure for solid-state luminaire including LED arrays, LED drivers and integral control devices. The solid-state product is considered defective if more than 15 PCT of the individual light emitting diodes fail to illuminate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Solid State Light Sources:
   a. Cree.
   b. Xicato.
   c. Luminaire manufacturer’s proprietary system.

2. LED Driver: Luminaire manufacturer's standard.

3. Emergency ballasts:
   a. Iota Engineering.
   b. Philips Bodine.

2.2 GENERAL REQUIREMENTS

A. All Luminaires and Electrical Components:

1. UL labeled.

2. Luminaires complete with lamps and ballasts or LED modules and drivers.

3. Rated for area classification.
   a. In Class I, Division 1 and 2 areas, the temperature rating of the luminaires and lamp or LED combination shall not exceed the auto-ignition temperature of the atmosphere in which the Luminaire is used.
B. Electrical components of recessed luminaires shall be accessible and removable through luminaire without having to remove luminaire from ceiling.

C. No live parts normally exposed to contact.

D. When intended for use in wet areas: Mark luminaire "Suitable for wet locations."

E. When intended for use in damp areas: Mark luminaire "Suitable for damp locations" or "Suitable for wet locations."

2.3 LUMINAIRES

A. Standards and Listings:
   2. UL 1598.
   3. UL 844 for hazardous locations.
   4. NEMA LE 4 for recessed locations.

B. Housings:
   1. Following minimum requirements:
      a. Extruded aluminum housings, shall be at least 1/8 IN thick.
      b. Punch and form housings prior to finishing (post-paint).

C. Castings:
   1. Following minimum requirements:
      a. Uniform quality, free from imperfections affecting strength and appearance.
      b. Exterior surfaces, if not receiving a finish coat, shall be smooth and match adjacent surfaces. At least one coat of clear methacrylate lacquer shall be applied unless a painted finish is specified.

D. Fasteners:
   1. Following minimum requirements:
      a. Aluminum or steel luminaires: Cadmium-plated or an equivalent.
      c. Bronze luminaires: Bronze or stainless steel.

E. Finishes:
   1. Following minimum requirements:
      a. Painted surfaces:
         1) Manufacturer's standard metal pretreatment and baked or air-dried, light-stabilized enamel finish; acrylic, alkyd, epoxy, polyester or polyurethane.
         2) White finishes shall have minimum 85 PCT reflectance.
      b. Unpainted surfaces:
         1) Interior: Clear anodic coating, satin finish.
         2) Exterior: Clear anodic coating.

F. Lens/Louver Frames:
   1. Following minimum requirements:
      a. Extruded aluminum with mitered corners.
      b. Hinging or other normal motion shall not cause lens or louver to drop out.
      c. No light leak between frame and housing.

G. Lenses:
   1. Following minimum requirements:
      a. 100 PCT virgin, UV stabilized acrylic.
      b. Linear fluorescent luminaires: Male conical prismatic, minimum thickness 0.150 IN, size as required.
      c. Held securely in place but must also be removable for cleaning and relamping.
      d. Luminaires with directional lenses shall include a lens orientation device to ensure that lens installation provides light distribution as designed.
H. Reflectors:
   1. Following minimum requirements:
      a. Linear fluorescent luminaires: High-purity #12 aluminum reflector sheet, 0.047 IN (15 GA) or heavier, free from fabrication or assembly damages. No exposed rivets, springs or other hardware after installation. Shape reflectors in modified elliptical or parabolic contour to produce no apparent brightness. Lamp image or any part of lamp shall not be visible in 45 degree zone.
      b. Down Light Reflector and Baffle Finishes: First-quality "Alzak" anodized specular finish.
      c. Troffer reflector finish: Integral reflectors shall be painted white after fabrication with a minimum reflectance value of 90 PCT.

I. Gaskets:
   1. Following minimum requirements:
      a. Gaskets at face plates or frames of recessed luminaires which serve as ceiling trim and which allow interior access.
      b. Moisture seal gaskets at exterior locations and in other designated wet areas.
      c. Secure frames to luminaire bodies with screws or other means, to result in tight installation, without light leaks.

J. Ventilation:
   1. Ventilation openings of adequate size and quantity to permit operation of lamps and ballast without affecting rated output or life expectancy. Include wire mesh screens.

K. Wiring:
   1. Factory-wired to be compatible with the project electrical and controls systems.

L. Mounting Accessories:
   1. Provide appropriate mounting accessories for each luminaire, compatible with various structural conditions encountered.
   2. Luminaire Suspension Material:
      a. Unfinished Spaces:
         1) 1/2 IN minimum diameter swivel stem, unless otherwise noted.
         2) Safety chain on high bay type.
      b. Finished Spaces: Unless otherwise noted.
         1) Manufactured cable or stem and outlet box canopy.
            a) Contemporary design with swivel self-aligning features.
            b) Size canopy to cover outlet box, minimize size of canopy not associated with outlet box.
            c) Finish to match luminaire.

2.4 SOLID-STATE LUMINAIRES - ADDITIONAL REQUIREMENTS

A. Standards:
   2. NEMA SSL 1.
   3. UL 1012, 1310, and 8750.
   4. UL 844 for hazardous locations.

B. Solid state modules and driver to be provided and warranted by luminaire manufacturer.

C. Solid-State Modules:
   1. Minimum uniform color temperature of 3500K.
      a. Color temperature measurement shall have a maximum 3 SDCM on the MacAdam Ellipse for frosted lensed luminaires, and 2 SDCM for other luminaire types (ANSI C78.377).
   2. Minimum color rendering index (CRI) of 80.
3. LED module light output and efficacy: Measured in accordance with IESNA LM-79 standards.
4. LED useful life and lumen maintenance: Measured in accordance with IESNA LM-80 standards.
5. Driver and LED module: Minimum useful life of 50,000 HRS.
6. Individual LEDs connected such that a failure of one LED will not result in a light output loss of the entire luminaire.

D. Driver:
1. Compatible with solid-state modules and control devices specified.
2. Operate from 60 Hz input source of 120V through 277V with sustained variations of +/- 10 PCT (voltage and frequency).
3. Input current Total Harmonic Distortion (THD): Less than 20 PCT when operated at nominal line voltage.
4. Power Factor: Greater than 0.90.
5. Avoid interference with infrared devices and eliminate visible flicker.
6. Comply with ANSI C62.41 Category A for Transient protection.
7. Comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
8. Dimmable drivers capable of continuous dimming over a range of 100 PCT to 1 PCT of rated lumen output. Dimming controlled by a 0-10VDC signal.
9. Control device must be compatible with type of driver, and coordinated prior to submission of Shop Drawings. List of compatible dimming controllers must include the range of perceived brightness. No visible flicker throughout the dimming range.
10. Remote-mounting:
   a. Provide maximum allowable distances for secondary wire runs to luminaires.
   b. Provide remote mounting hardware and enclosures as required.
11. Operating temperature range must be suitable for site temperature conditions within exterior and gasketed luminaires.

E. Emergency Battery Driver:
1. UL 924.
2. Confirm compatibility with LED modules utilized.
3. Consist of a high temperature, maintenance-free nickel cadmium battery, charger and electronic circuitry.
4. A solid state charging indicator light to monitor the charger and battery.
6. The following product family shall be selected based on coordination with LED lamp type:
   a. Philips Bodine “BSL23C”: Can operate up to 4.5 W at 410 mA.
   b. Philips Bodine “BSL26C”: Can operate up to 5.1 W at 265 mA.
   c. Philips Bodine “BSL722”: Can operate up to 23 W at 770 mA.
   d. Philips Bodine “BSL23C”: Can operate up to 23 W at 770 mA in operating conditions ranging from -20 DEGC (-4 DEGF) to 60 DEGC (140 DEGF).
   e. Alternate manufacturer: Iota.

F. Luminaire properly heat sinked to assure LED junction temperature ratings are not exceeded.
1. Provide ambient operating temperature range for which product is warranted.

2.5 EXIT SIGNS AND EMERGENCY LIGHTING UNITS

A. Standards:
1. UL 924.
3. Local State or City requirements.

B. Exit Signs:
1. Housing and finish: As required for area classification.
2. LED illuminated with integral driver.
3. AC and battery powered.
4. Battery powered units:
   a. Self-testing/self-diagnostic.
      1) Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
   b. Consist of battery, charger and electronic circuitry.
   c. Solid state charging indicator light to monitor the charger and battery.
   e. A user selectable audible alarm.

C. Emergency Lighting Units:
1. Housing: Aluminum and rated for area classification.
2. Self-testing/self-diagnostic.
   a. Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
3. Consist of battery, charger and electronic circuitry.
4. Solid state charging indicator light to monitor the charger and battery.
6. A user selectable audible alarm.

2.6 MAINTENANCE MATERIALS
A. Furnish a minimum of 2 or 10 PCT of total of each type and wattage of lamps, whichever is greater.
B. Furnish a minimum of 10 PCT of total of each type and amperage of fuses for fixtures indicated to be fused.
C. Spare parts are to be stored in a box clearly labeled as to its contents.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Coordinate Luminaire Types with Ceiling Construction:
   1. Provide mounting hardware for the ceiling system in which the luminaire is to be installed.
B. Provide mounting brackets and/or structural mounting support for wall-mounted luminaires.
   1. Do not support luminaire from conduit system.
   2. When luminaire is supported from outlet boxes, install per NFPA 70.
   3. Supports for luminaire mounted on exterior walls shall not be attached to exterior face of the wall.
C. Support surface mounted luminaires from the building structure, except as noted.
   1. Do not anchor fixture supports to the under side of the ESAD. Lighting in the ESAD Gallery shall be from wall mounted fixtures.
   2. Luminaires up to 4 FT wide and 4 FT long: A minimum of four supporting points, one at each corner.
   3. Luminaires smaller than 2 FT in length: A minimum of two supporting points.
D. Provide pendant luminaires with swivel hangers which will allow luminaire to swing in any direction but will not permit stem to rotate.
   1. Provide hangers with enclosure rating (NEMA 4, or 7) equal to enclosure requirements of area in which they are installed.
   2. Swivel hangers for luminaires in mechanical equipment areas: Shock absorbing type.
   3. Secure low and high bay luminaires with safety chain or safety aircraft cable to the building structure.
      a. Chain or cable to prevent luminaire from falling more than 3 IN before the luminaire is caught by the chain or cable.
E. Provide access panels for recessed luminaires that require access for maintenance when such access is not provided for in design of luminaire.
   1. Locate luminaires in accordance with reflected ceiling plans.

F. Install exterior luminaires so that water can not enter or accumulate in the wiring compartment.

G. Emergency Battery Ballasts:
   1. Where emergency battery ballasts are shown controlled via switching device, wire ballast so lamps will not operate when normal power is available and switching device turns lights off.
   2. Lamps will operate in emergency mode regardless of switch position.
   2. Luminaire manufacturer to supply the emergency battery ballasts with luminaire.

H. Ground luminaire and ballasts.

3.2 ADJUST AND CLEAN

A. Replace all fixtures with inoperable lamps or LED sources with new fixtures prior to final acceptance.

B. Aim all emergency lighting units, so that, the path of egress is illuminated.

END OF SECTION
SECTION 31 23 00
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Earthwork - excavation, backfilling, grading, compaction, disposal of waste and surplus materials, placing crushed stone, construction of berms, sheeting, bracing, dewatering and other earthwork related work.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE
A. Referenced Standards:
   1. ASTM International (ASTM):
      c. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
      d. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   2. Occupational Safety and Health Administration (OSHA):
      a. 29 CFR Part 1926.650, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Certifications.

B. Samples:
   1. Coordinate samples and testing for approval of off-site materials with the Geotechnical Engineer.
   2. Submit samples and source of fill and backfill materials proposed for use to Geotechnical Engineer 5 days prior to placement.
   3. Submit samples and source of borrow materials proposed for use to Geotechnical Engineer 5 days prior to placement.
   4. Test reports.

1.4 PROJECT CONDITIONS
A. Dispose of Waste Materials, Legally, Off Site:
   1. Burning, as a means of waste disposal, is not permitted.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill and Backfill:
   1. Selected material approved by Geotechnical Engineer from site excavation or from off site borrow.
   2. Structural Fill under Egg Shaped Digester Foundation:
      a. 12 IN minimum thick layer of clean, well graded crushed stone, containing 100 percent passing the 3 IN sieve and less than 10 percent fines.
   3. On-Site Soils:
      a. Not suitable for use as structural fill or low plasticity cohesive fill. Do not place beneath pavement, structures, or other improvements. Do not use for backfill around structure or within 12 FT of structures.
      b. May be placed in lawn areas only.
      c. On-site soils from the existing composting area which contain fly-ash are not to be reused on site.
         1) Refer to Geotechnical Report prepared for the site to identify areas where these soils are located.

B. Granular Fill under Manholes and Handholes: Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33 gradation size No. 67, 3/4 IN to No. 4.

C. Structural backfill against vertical surfaces outside of all structures:
   a. Low volume change cohesive soil.
   b. Free of organic matter, frozen material, and debris.
   c. ASTM D2487 classification: CL.
   d. Liquid limit: Less than 45.
   e. Plasticity index: Between 10 and 20.

PART 3 - EXECUTION

3.1 PROTECTION

A. Erosion Control:
   1. Clean paved roadways daily or more often if needed of any spillage of dirt, rocks or debris from vehicles and equipment entering or leaving site.
   2. Conduct work to minimize erosion of site. Remove eroded material washed off site.
      a. If necessary or requested by Engineer, construct stilling areas to settle and detain eroded material.

B. Protect existing surface and subsurface features on-site and adjacent to site as follows:
   1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
   2. Protect and maintain bench marks, monuments or other established reference points and property corners.
      a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
   3. Verify location of utilities.
      a. Omission or inclusion of utility items does not constitute nonexistence or definite location.
      b. Secure and examine local utility records for location data.
      c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
         1) If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
2) Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.
3) Obtain Owner’s approval prior to disconnecting any utility service
d. Repair damages to utility items at own expense.
c. In case of damage, notify Engineer at once so required protective measures may be taken.
4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
a. Protect new and existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
b. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
c. All repairs to be made and paid for by Contractor.
5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

3.2 SITE EXCAVATION AND GRADING

A. The site excavation and grading work includes the offsite disposition of all material:
1. That exceed quantities required for earthwork on the project.
2. That the Geotechnical engineer classifies as unclassified excavation.
3. That the Geotechnical engineer classifies as unacceptable.
4. That the Geotechnical engineer classifies as potentially contaminated.

B. Excavation and Grading:
1. Perform as required by the Contract Drawings.
2. Contract Drawings may indicate both existing grade and finished grade required for construction of Project.
   a. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations.
   b. Perform other layout work required.
   c. Replace property corner markers to original location if disturbed or destroyed.
3. Protection of finish grade:
   a. During construction, shape and drain embankment and excavations.
   b. Maintain ditches and drains to provide drainage away from building and structure areas at all times.
   c. Maintain the condition and subgrade moisture content prior to construction of floor slabs. Avoid construction traffic over completed subgrade.
   d. Protect graded areas against action of elements prior to acceptance of work.
      1) Promptly remove water that has ponded in any areas along with any softened or disturbed soils.
      e. Reestablish grade where settlement or erosion occurs.

C. Borrow:
1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
2. Include cost of all borrow material in original proposal.
3. Fill material to be approved by Geotechnical Engineer prior to placement.

D. Grading Tolerances: 0.1 FT.

3.3 USE OF EXPLOSIVES

A. Blasting with any type of explosive is prohibited.
3.4 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from Geotechnical Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Provide dewatering system necessary to successfully complete compaction and construction requirements.

C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by Geotechnical Engineer.

D. Stabilize subgrade with well graded granular materials as directed by Geotechnical Engineer.

E. Assure by results of testing that compaction densities comply with the following requirements:
   1. Structures:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COMPACTION DENSITY</th>
<th>MOISTURE CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under fill material</td>
<td>98 percent per ASTM D698</td>
<td>-2 to +3 percent of optimum</td>
</tr>
</tbody>
</table>

2. Specific areas:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COMPACTION DENSITY</th>
<th>MOISTURE CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside structures under equipment support foundations</td>
<td>98 percent per ASTM D698</td>
<td>-2 to +3 percent of optimum</td>
</tr>
</tbody>
</table>

Granular fill egg shaped digester base slab                                                                 |
75 percent relative density per ASTM D4253 and ASTM D4254 or 98 percent of ASTM D698 | Workable moisture level |

3.5 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:
   1. In general, work includes, but is not necessarily limited to, excavation for structures, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
   2. Obtain fill and backfill material necessary to produce grades required.
      a. Materials and source to be approved by Geotechnical Engineer.
      b. Excavated material may not be used for fill and backfill.
   3. In the paragraphs of this Specification Section, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:
   1. General:
      a. Do not commence excavation for foundations for structures until Geotechnical Engineer approves:
         1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
         2) Density and moisture content of site area compacted fill material meets requirements of specifications.
      b. Engineer grants approval to begin excavations.
   2. Dimensions:
      a. Excavate to elevations and dimensions indicated or specified.
      b. Allow additional space as required for construction operations and inspection of foundations.
c. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction.

d. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings.

   a. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Geotechnical Engineer.

   b. Remove unsuitable subgrade soils located below foundations (and all fat clays under the egg shaped digester as required by Geotechnical Engineer). The bottom of the overexcavation shall be located outside the exterior limits of foundations around the perimeter of structure the following horizontal distance, whichever is greater:

      1) Distance equal to depth of overexcavation below bottom of foundations.
      2) Ten (10) FT for egg shaped digester.
      3) As directed by Geotechnical Engineer.

   c. When excavation has reached required subgrade elevations, notify Geotechnical Engineer, who will make an inspection of conditions.
      1) If Geotechnical Engineer determines that bearing materials at required subgrade elevations are unsuitable, remove and replace unsuitable material in accordance with Subgrade Stabilization as specified herein.

4. Install working surface over approved subgrade as described below:

   a. Structural fill under egg shaped digester: 12 IN minimum thick layer of clean well graded crushed stone.

5. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill.

   a. Remove loose materials and bring excavations into approved condition to receive concrete or fill material.

   b. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to density stated in this Specification Section before fill material can be placed thereon.

6. Make excavations large enough for working space, forms, and inspection.

7. Notify Geotechnical Engineer and Engineer as soon as excavation is completed in order that subgrades may be inspected.

   a. Do not commence further construction until subgrade under compacted fill material, under foundations, and under equipment support pads has been inspected and approved by the Geotechnical Engineer as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon.

   b. Geotechnical Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.

   c. Place fill material, foundations, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.

   d. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.

8. Dewatering:

   a. Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.
b. The dewatering wells to be installed and operating prior to starting excavation. The water levels in the wells or independent piezometers should be monitored prior to starting the excavation to verify that the wells are capable of lowering the groundwater level to at least 2 FT below the base of the excavation; additional wells should be installed as needed. The wells/piezometers should also be monitored during construction.

c. Groundwater shall be maintained at least 2 FT below the bottom of any excavation.

d. Review Geotechnical investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.

e. Employ dewatering specialist for selecting and operating dewatering system.

f. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.

g. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.  
   1) Install groundwater monitoring wells as necessary.

h. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.

i. If dewatering system is to be installed next to existing structures consult with Geotechnical Engineer before installation.

9. Subgrade stabilization:

  a. If subgrade under foundations, fill material, or equipment support pads is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by Geotechnical Engineer.

  b. Provide compaction density of replacement material as stated in this Specification Section.

  c. Loose, wet, or soft materials, when approved by Geotechnical Engineer, may be stabilized by a compacted working mat of well graded crushed stone.  
     1) Stabilization using a compacted working mat will not be allowed to stabilize fat clays.

  d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.

  e. Remove and replace frozen materials as directed by Geotechnical Engineer.

  f. Method of stabilization shall be performed as directed by Geotechnical Engineer.

  g. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Geotechnical Engineer.

10. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction.

  a. Do not place building foundations including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DegF before structure is completed and heated to a temperature of at least 50 DegF.

11. Protection of structures:

  a. Prevent new and existing structures from becoming damaged due to construction operations or other reasons.

  b. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.

12. Shoring:

  a. Shore, slope, or brace excavations as required to prevent them from collapsing.

  b. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapse.

13. Drainage:

  a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.
b. Maintain excavations where foundations, equipment support pads or fill material are to be placed free of water.

c. Provide pumping required to keep excavated spaces clear of water during construction.

d. Should any water be encountered in the excavation, notify Engineer and Geotechnical Engineer.

e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.

14. Frost protection:
   a. Do not place foundations, equipment support pads, or fill material on frozen ground.
   b. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved.
   c. Protect excavation from frost if placing of concrete or fill is delayed.
   d. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
   e. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DegF.

C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Equipment Support Pads and Piping:

1. General:
   a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by Geotechnical Engineer and scarified to a depth of 6 IN and compacted to density specified herein.
   b. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2 percent.
   c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Geotechnical Engineer as being free of undesirable material and compacted to specified density.

2. Obtain approval of fill and backfill material and source from Geotechnical Engineer prior to placing the material.

3. Fill and backfill placement:
   a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Geotechnical Engineer.
   b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
   c. Compact material by means of equipment of sufficient size and proper type to obtain specified density.
   d. Use hand operated equipment for filling and backfilling within 5 FT of walls and less than 3 FT above pipes
      1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum
   e. Use hand operated equipment for filling and backfilling next to walls.
   f. Do not place fill and backfill when the temperature is less than 40 DegF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.
   g. Use vibratory equipment to compact granular material; do not use water.

4. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content as required to fill the specified overexcavation to bottom of foundation.

D. Filling and Backfilling Outside of Structures:

1. This paragraph of this Specification applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving.
2. Provide material as approved by Geotechnical Engineer for filling and backfilling outside of structures.

3. Fill and backfill placement:
   a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Geotechnical Engineer.
   b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
   c. Compact material with equipment of proper type and size to obtain density specified.
   d. Use hand operated equipment for filling and backfilling within 5 FT of walls and less than 3 FT above pipes:
      1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum.
      2) Contractor is responsible for method of compaction so as not to damage wall.
   e. Use only hand operated equipment for filling and backfilling next to walls.
   f. Do not place fill or backfill material when temperature is less than 40 DegF and when subgrade to receive material is frozen, wet, loose, or soft.
   g. Use vibratory equipment for compacting granular material; do not use water.

4. Backfilling against walls:
   a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved.
   b. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.
   c. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
   d. Bring backfill and fill up uniformly around the structures and individual walls and piers.

E. Backfilling Outside of Structures under Piping:
   1. When backfilling outside of structures requires placing backfill material under piping, the material shall be placed from bottom of excavation to underside of piping at the density required for fill under piping as indicated in this Specification Section.
   2. This compacted material shall extend transversely to the centerline of piping a horizontal distance each side of the exterior edges of piping equal to the depth of backfill measured from bottom of excavation to underside of piping.
   3. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other Specification Sections for the Project.

3.6 FIELD QUALITY CONTROL

A. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA standards 29 CFR Part 1926.650 Subpart P, and state requirements. Where conflict between OSHA and state regulations exists, the more stringent requirements shall apply.

END OF SECTION
SECTION 31 23 33
TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
1. Excavation, trenching, backfilling and compacting for all underground utilities and piping.
2. All related utility and process appurtenances.
B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Division 26 - Electrical.
4. Section 40 – Process Piping Connections.

1.2 QUALITY ASSURANCE
A. Referenced Standards:
1. ASTM International (ASTM):
   b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using
      Standard Effort (12,400 FT-lb/ft³ (600 kN-m/m³)).
   c. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils
      Using a Vibratory Table.
B. Qualifications: Owner will hire an independent soils laboratory to conduct in-place moisture-
density tests for backfilling to assure that all work complies with this Specification Section.

1.3 DEFINITIONS
A. Excavation: All excavation will be defined as unclassified.

1.4 SUBMITTALS
A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of
   the submittal process.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
3. Submit respective pipe or conduit manufacturer's data regarding bedding methods of
   installation and general recommendations.
4. Submit sieve analysis reports on all granular materials.
B. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of
   the submittal process.
2. Trench shield (trench box) certification if employed:
   a. Specific to Project conditions.
   b. Re-certified if members become distressed.
   c. Certification by registered professional Structural Engineer, registered in the State of
      Nebraska.
   d. Engineer is not responsible to, and will not, review and approve.
1.5 SITE CONDITIONS

A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.
   1. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.
B. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.
C. Verify location of existing underground utilities.
D. Do not allow surface water to pond on site and direct precipitation away from excavations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Material:
   1. As approved by Geotechnical Engineer.
      a. Free of rock cobbles, roots, sod or other organic matter, and frozen material.
      b. Moisture content at time of placement: -2 PCT to +3 PCT of optimum moisture content as specified in accordance with ASTM D698.
B. Subgrade Stabilization Materials:
   1. As approved by Geotechnical Engineer.
   2. Provide subgrade stabilization material consisting of crushed limestone, quartzite, or dolomite meeting the requirements for Class 1S coarse aggregate in accordance with ASTM C33 and conforming to the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1-1/2 IN</th>
<th>3/4 IN</th>
<th>3/8 IN</th>
<th>No. 10</th>
<th>No. 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCT Passing by Weight</td>
<td>100</td>
<td>65-95</td>
<td>36-70</td>
<td>10-30</td>
<td>0-10</td>
</tr>
</tbody>
</table>

C. Bedding Materials:
   1. As approved by the Geotechnical Engineer.
   2. Granular bedding materials:
      a. Provide bedding material consisting of crushed limestone, quartzite, or dolomite meeting the requirements for Class 1S coarse aggregate in accordance with ASTM C33 and conforming to the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>1-1/2 IN</th>
<th>1 IN</th>
<th>3/4 IN</th>
<th>3/8 IN</th>
<th>No. 4</th>
<th>No. 10</th>
<th>No. 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe less than 18 IN DIA (% Passing by Weight)</td>
<td>100</td>
<td>100</td>
<td>--</td>
<td>--</td>
<td>20-60</td>
<td>0-30</td>
<td>0-10</td>
</tr>
</tbody>
</table>

D. Geogrid:
   1. For use below subgrade stabilization materials.
   2. As approved by Engineer:
      a. Tensar BX1100.
      c. Mirafi BXG110.
      d. Or equal.
E. Non-Woven Geotextile for Wrapping Pipe Joints:
   1. For use on pipe joints in areas of subgrade stabilization.
   2. As approved by Engineer:
      a. Contech C-60NW.
b. US Fabrics US 160NW.
c. Mirafi 160N.
d. Or Equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Remove and dispose of unsuitable materials as directed by Geotechnical Engineer to site provided by Contractor.

3.2 EXCAVATION

A. Unclassified Excavation: Remove rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by Geotechnical Engineer.

B. Groundwater Dewatering:
   1. Where groundwater is, or is expected to be, encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade to allow subgrade stabilization, pipe, bedding and backfill material to be placed in the dry, and to maintain a stable trench wall or side slope.
   2. The dewatering wells are to be installed and operating prior to starting excavation. The water levels in the wells or independent piezometers should be monitored prior to starting excavation to verify the wells are capable of lowering the groundwater level to at least 2 FT below the bottom of the trench; install additional wells as needed. The wells/piezometers shall also be monitored during construction.
   3. Groundwater shall be drawn down and maintained at least 2 FT below the bottom of any trench or manhole excavation prior to excavation.
   4. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
      a. Employ dewatering specialist for selecting and operating dewatering system.
   5. Keep dewatering system in operation until dead load of pipe, structure and backfill exceeds possible buoyant uplift force on pipe or structure.
   6. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction and as approved by the Owner.
      a. Install groundwater monitoring wells as necessary.
   7. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
   8. If dewatering system is to be installed next to existing structures consult with the Geotechnical Engineer prior to installation.
   9. Cost of groundwater dewatering shall be incidental to the lump sum bid.

C. Trench Excavation:
   1. Excavate trenches by open cut method to depth necessary to accommodate work.
   2. Support existing utility lines and yard piping where proposed work crosses at a lower elevation.
      a. Stabilize excavation to prevent undermining of existing utility and yard piping.
   3. Any trench or portion of trench, which is opened and remains idle for seven (7) calendar days, or longer, as determined by the Owner, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner.
      a. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
   4. Observe following trenching criteria:
      a. Trench size:
         1) Excavate width to accommodate free working space.
         2) Provide 24 IN of clearance between pipe and trench wall or trench shield.
         3) Cut trench walls vertically from bottom of trench to 1 FT above top of pipe, conduit, or utility service.
4) Keep trenches free of surface water runoff.
   a) Include cost in Bid.
   b) No separate payment for surface water runoff pumping will be made.

D. Trenching for Electrical Installations:
1. Observe the preceding Trench Excavation paragraph in PART 3 of this Specification Section.
2. Modify for electrical installations as follows:
   a. Do not over excavate trench.
   b. Cut trenches for electrical runs with minimum 30 IN cover.
   c. See Division 26 for additional requirements.

3.3 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. Pipe Bedding:
1. Trench bottoms shall be undercut to allow for placement of bedding under the pipe as shown on the Drawings.
2. When encountering wet, soft, and easily disturbed soils at the bedding level carefully use a horizontal trimming action with a smoothed edge bucket to reduce disturbance of sensitive soils.
3. Bedding shall comply with the following:
   a. Hand place, shovel slice, and permanently tamp all bedding.
   b. Compact to specific requirements.
4. After each pipe has been brought home, set to proper line and grade as required by the Contract Documents, place additional bedding material as shown in the Drawings uniformly and simultaneously along each side of the pipe to prevent any displacement of the pipe, to hold it in its proper alignment and position, and to provide side wall support during subsequent operations.

B. Subgrade Stabilization:
1. Stabilize the subgrade when directed by the Engineer.
2. Observe the following requirements when unstable trench bottom materials are encountered.
   a. Notify Owner when unstable materials are encountered.
   b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
      1) Replace with subgrade stabilization with no additional compensation.
   c. Owner will pay for cost of removal and replacing of unstable trench bottom not caused by Contractor failure to dewater, rainfall, or Contractor operations.
   d. For all pipe placed in areas of subgrade stabilization wrap each pipe joint with a 2 FT wide strip of geotextile.
      1) Tape to pipe barrel to hold in place during backfill placement.

3.4 BACKFILLING METHODS

A. Do not backfill until tests to be performed on system show system is in full compliance with specified requirements.

B. Carefully Compacted Backfill:
1. Furnish as shown on pipe bedding detail in Drawings.
   a. Place backfill in lifts not exceeding 8 IN (loose thickness).
   b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
   c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
   d. Compact each lift to specified requirements.

C. Common Trench Backfill:
1. Furnish as shown on pipe bedding detail in Drawings.
   a. Place backfill in lift thicknesses not exceeding 8 IN (loose thickness).
b. Observe specific manufacturer’s recommendations regarding backfilling and compaction.
c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.
d. Compact each lift to specified requirements.

D. Water flushing for consolidation is not permitted.

E. Backfilling for Electrical Installations:
   1. Observe the preceding Carefully Compacted Backfill paragraph or Common Trench Backfill paragraph in PART 3 of this Specification Section or when approved by the Engineer.

3.5 COMPACTION

A. General:
   1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
   2. In no case shall degree of compaction below minimum compactions specified be accepted.

B. Compaction Requirements:
   1. Unless otherwise recommended by Owner’s Independent Soils Laboratory, comply with following minimum trench compaction criteria.
      a. Bedding material:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SOIL TYPE</th>
<th>COMPACTION DENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>All locations</td>
<td>Cohesionless soils</td>
<td>75 PCT relative density by ASTM D4253 and ASTM D4254</td>
</tr>
</tbody>
</table>

b. Carefully compacted backfill:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SOIL TYPE</th>
<th>COMPACTION DENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>All applicable areas</td>
<td>Cohesive soils</td>
<td>95 PCT of maximum dry density by ASTM D698</td>
</tr>
</tbody>
</table>

c. Common trench backfill:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SOIL TYPE</th>
<th>COMPACTION DENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>All other areas</td>
<td>Cohesive soils</td>
<td>95 PCT of maximum dry density by ASTM D698</td>
</tr>
</tbody>
</table>

3.6 FIELD QUALITY CONTROL

A. Testing:
   1. In-place moisture-density tests are to be done as directed by the Geotechnical Engineer.
   2. Costs of "Passing" tests paid by Owner.
   3. Perform additional tests as directed until compaction meets or exceeds requirements.
   4. Cost associated with "Failing" tests shall be paid by Contractor.
   5. Reference to Engineer in this Specification Section will imply Geotechnical Engineer when employed by Owner and directed by Engineer to undertake necessary inspections as approvals as necessary.
   6. Assure Owner has immediate access for testing of all soils related work.
   7. Ensure excavations are safe for testing personnel.

END OF SECTION
DIVISION 40

PROCESS INTERCONNECTIONS
SECTION 40 05 00

PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination:
  1. Coordinate all interfacing work with WWTP contractor.
B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.3 DEFINITIONS
B. HPIC: High performance industrial coating.

1.4 SYSTEM DESCRIPTION
A. Piping Systems Organization and Definition:
  1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
  2. See PIPING SPECIFICATION SCHEDULES in PART 3.

1.5 SUBMITTALS
A. Shop Drawings:
  2. Product technical data including:
     a. Acknowledgement that products submitted meet requirements of the established standards of quality.
     b. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
  3. Layout Drawings:
     a. Interior piping Drawings (minimum scale 1/8 IN equals 1 FT) with information including:
        1) Dimensions of piping from column lines or wall surfaces.
        2) Centerline dimensions of piping.
        3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
        4) Location and type of pipe supports and anchors.
        5) Locations of valves and valve actuator type.
        6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
        7) Acknowledgement of valve, equipment and instrument tag numbers.
        8) Provisions for expansion and contraction.
        9) Line slopes and air release vents.
b. Schedule of interconnections to existing piping and method of connection.

B. Operation and Maintenance Data:
   1. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
   2. Qualifications of lab performing disinfection analysis on water systems.
   3. Test reports:
      a. Copies of pressure test results on all piping systems.
      b. Reports defining results of dielectric testing and corrective action taken.
      c. Disinfection test report.
      d. Notification of time and date of piping pressure tests.

1.6 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester -General Requirements.

B. Protect pipe coating during handling using methods recommended by manufacturer.
   1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

C. Prevent Damage to Pipe During Transit:
   1. Repair abrasions, scars, and blemishes.
   2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

   1. Insulating unions:
      a. "Dielectric" by Epco.
   2. Dirt strainers (Y type):
      b. Sarco.
      c. Armstrong.
   3. Dry disconnect couplings:
      a. Kamlock.
   4. Dielectric flange kit:
      a. PSI.
      b. Maloney.
      c. Central Plastics.
   5. Pipe saddles (for gage installation):
      a. Dresser Style 91 (steel and ductile iron systems).
      b. Dresser Style 194 (nonmetallic systems).
   6. Elastomeric bellows type expansion joints:
      a. Garlock, Guardian 200/204.
      b. PROCO, equivalent model.
      c. Red Valve, equivalent model.
   7. Dismantling joints:
      a. Romac DJ400.
      b. Smith Blair 972.
2.2 PIPING SPECIFICATION SCHEDULES
   A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping
      specification schedules located at the end of PART 3 of this Specification Section.

2.3 COMPONENTS AND ACCESSORIES
   A. Insulating Components:
      1. Dielectric flange kits:
         a. Flat faced.
         b. 1/8 IN thick dielectric gasket, phenolic, non-asbestos.
         c. Suitable for 175 PSI, 210 DEGF.
         d. 1/32 IN wall thickness bolt sleeves.
         e. 1/8 IN thick phenolic insulating washers.
      2. Dielectric unions:
         a. Screwed end connections.
         b. Rated at 175 PSI, 210 DEGF.
         c. Provide dielectric gaskets suitable for continuous operation at union rated temperature
            and pressure.
   B. Dirt Strainers:
      1. Y-type.
      2. Composition bronze.
      3. Rated for test pressure and temperature of system in which they are installed.
      4. 20 mesh Monel screen.
      5. Threaded bronze plug in the blowoff outlet.
      6. Threaded NPT end connections.
   C. Reducers:
      1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment
         connections.
   D. Protective Coating and Lining:
      1. Include pipe, fittings, and appurtenances where coatings, linings, coating, tests and other
         items are specified.
      2. Field coating pipe in accordance with Specification Section 09 96 00.
   E. Dry Disconnect Couplings:
      1. Adapters:
         a. Male adapters.
         b. Adapters:
            1) Female NPT end connection for sludge and flush applications.
            2) Male NPT end connection for chemical applications.
         c. Construct adapters for sludge applications from cast iron or steel.
      2. Couplers:
         a. Built-in valve and spring loaded poppet which close automatically when disconnected.
         b. Designed to remain with only one (1) arm locked in closed position.
         c. Construct couplers for sludge applications fabricated from material utilized for
            adapters.
         d. Gasket: Compatible with conveyed liquid.
      3. Dust caps: For all adapters.
   F. Valves:
      1. See PIDs and schematics for definition of valves used in each system.
   G. Elastomeric Bellows Type Expansion Joints:
      1. Flanges: ANSI 125/150.
      2. Materials:
         a. Bellows:
            1) Hot Water (over 95 DEGF): EPDM.
2) All other: Compatible with fluid.

b. Restraint:
   1) Provide restraint limit bolts (control rods) and nuts to restrain joint at test pressure
      of piping.
   2) Control rod material: 316 stainless steel.

c. Working pressure: Equal to or greater than test pressure of connecting piping.

d. Minimum axial movement: 3/8 IN.

3. Arches:
   a. Provide double open arches.

PART 3 - EXECUTION

3.1 EXTERIOR BURIED PIPING INSTALLATION

A. Provide a minimum of 5 FT and maximum of 8 FT earth cover over exterior buried piping
   systems and appurtenances conveying water, fluids, or solutions subject to freezing.

B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals
   specified in Specification Section 01 73 20.

C. Install expansion devices as necessary to allow expansion and contraction movement.

D. Laying Pipe In Trench:
   1. Excavate and backfill trench in accordance with Specification Section 31 23 33.
   2. Clean each pipe length thoroughly and inspect for compliance to specifications.
   3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
   4. Install gasket or joint material according to manufacturer's directions after joints have been
      thoroughly cleaned and examined.
   5. Except for first two (2) joints, before making final connections of joints, install two (2) full
      sections of pipe with earth tamped along side of pipe or final with bedding material placed.
   6. Lay pipe in only suitable weather with good trench conditions.
      a. Never lay pipe in water.
   7. Seal open end of line with watertight plug if pipe laying stopped.

E. Lining Up Push-On Joint Piping:
   1. Lay piping with general routing shown on drawings and modified by Contractor’s final
      design.
   2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
   3. Observe maximum deflection values stated in manufacturer's written literature.
   4. Provide special bends when specified or where required alignment exceeds allowable
      deflections stipulated.
   5. Install shorter lengths of pipe in such length and number that angular deflection of any joint,
      as represented by specified maximum deflection, is not exceeded.

F. Anchorage and Blocking:
   1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for
      preventing movement of piping caused by forces in or on buried piping tees, wye branches,
      plugs, or bends.
   2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.
      a. Concrete blocks shall not cover pipe joints.

G. Install insulating components where dissimilar metals are joined together.

3.2 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

A. Install piping with clearance and allowance for:
   1. Expansion and contraction.
   2. Operation and access to equipment, doors, windows, hoists, moving equipment.
   3. Headroom and walking space for working areas and aisles.
4. System drainage and air removal.

B. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in Specification Section 01 73 20.

C. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.

D. Pipe Support:
   1. Support pipe as required in Specification Section 40 05 07.
   2. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight.
      a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
   3. Size pipe supports with consideration to specific gravity of liquid being piped.

E. Locate and size sleeves and castings required for piping system.

F. Do not use bushings.

G. Equipment Drainage and Miscellaneous Piping:
   1. Provide drip pans and piping at equipment where condensation may occur.
   2. Hard pipe stuffing box leakage to nearest floor drain.
   3. Avoid piping over electrical components such as motor control centers, panelboards, etc.
      a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and over full length of electrical equipment.
      b. Hard pipe drainage to nearest floor drain.
   4. Collect system condensate at drip pockets, traps and blowoff valves.
   5. Provide drainage for piping at locations shown on PIDs and required for system maintenance.
   6. For applications defined above and for other miscellaneous piping which is not addressed by a specific piping service category in PART 1, provide 304 stainless steel piping and fittings.
      a. Size to handle application with 3/4 IN being minimum size provided.

H. Unions:
   1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
   2. Mechanical type couplings may serve as unions.
   3. Additional flange unions are not required at flanged connections.

I. Install expansion devices as necessary to allow expansion/contraction movement.

J. Provide full face gaskets on all systems.

K. Anchorage and Blocking:
   1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.

L. Equipment Pipe Connections:
   1. Equipment - General:
      a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
      b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
      c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint.
      1) Provide tightening torque in accordance with manufacturer's recommendations.
      d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.

f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.

g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.

h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four (4) bolts per joint installed and tightened.

   1) Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.

   2) Realign as necessary, install flange bolts and make equipment connection.

i. Provide utility connections to equipment shown on Drawings, scheduled or specified.

2. Plumbing and HVAC equipment:

   a. Make piping connections to plumbing and HVAC equipment, including but not limited to installation of fittings, strainers, pressure reducing valves, flow control valves and relief valves provided with or as integral part of equipment.

   b. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to building sewer system.

      1) Size trap as required by IPC.

M. Provide insulating components where dissimilar metals are joined together.

3.3 CONNECTIONS WITH EXISTING PIPING

   A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

   B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.

   C. Undertake connections in fashion which will disturb system as little as possible.

   D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed.

   E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

   F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Specification Section.

   G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.4 CATHODIC PROTECTION

   A. Isolate, dielectrically, all piping from all other metals including reinforcing bars in concrete slabs, other pipe lines, and miscellaneous metal.

3.5 PRESSURE GAGES

   A. Provide at locations shown on the PIDs and required per Contractor’s design.

3.6 FIELD QUALITY CONTROL

   A. Pipe Testing - General:

      1. Test piping systems as follows:

         a. Test exposed, non-insulated piping systems upon completion of system.

         b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.

         c. Test buried piping after backfilling has been complete.

      2. Utilize pressures, media and pressure test durations as specified in the PIPING SPECIFICATION SCHEDULES.

      3. Isolate equipment which may be damaged by the specified pressure test conditions.
4. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.
   a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
   b. Notify the Engineer 24 HRS prior to each test.
5. Completely assemble and test new piping systems prior to connection to existing pipe systems.
6. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Testing:
1. Testing medium: Unless otherwise specified in the PIPING SPECIFICATION SCHEDULES, utilize the following test media.
   a. Process and mechanical systems:

<table>
<thead>
<tr>
<th>PIPE LINE SIZE</th>
<th>SPECIFIED TEST PRESSURE</th>
<th>TESTING MEDIUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 IN and smaller</td>
<td>75 PSI or less</td>
<td>Air or water</td>
</tr>
<tr>
<td>2 IN and smaller</td>
<td>Greater than 75 PSI</td>
<td>Water</td>
</tr>
<tr>
<td>Greater than 2 IN</td>
<td>3 PSI or less</td>
<td>Air or water</td>
</tr>
<tr>
<td>Greater than 2 IN</td>
<td>Greater than 3 PSI</td>
<td>Water</td>
</tr>
</tbody>
</table>

b. Natural and digester gas. Inert gas.
c. Liquid systems:

<table>
<thead>
<tr>
<th>PIPE LINE SIZE (DIA)</th>
<th>GRAVITY OR PUMPED</th>
<th>SPECIFIED TEST PRESSURE</th>
<th>TESTING MEDIUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 12 IN</td>
<td>Gravity</td>
<td>25 PSIG or less</td>
<td>Water</td>
</tr>
<tr>
<td>All sizes</td>
<td>Pumped</td>
<td>250 PSIG or less</td>
<td>Water</td>
</tr>
</tbody>
</table>

2. Allowable leakage rates:
   a. Hazardous gas systems, all exposed piping systems, all pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage at the specified test pressure throughout the duration of the test.
3. Hydrostatic pressure testing methodology:
   a. General:
      1) All joints, including welds, are to be left exposed for examination during the test.
      2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
      3) Provide temporary restraints for expansion joints for additional pressure load under test.
      4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
      5) Do not coat or insulate exposed piping until successful performance of pressure test.
   b. Waste, Drain and Vent systems:
      1) Test at completion of installation of each stack or section of piping by filling system with water and checking joints and fittings for leaks.
      2) Eliminate leaks before proceeding with work or concealing piping.
      3) Minimum test heights shall be 10 FT above highest stack inlet.
4. Natural gas systems - testing methodology:
   a. Per local gas company standards.

5. Air testing methodology:
   a. General:
      1) Assure air is ambient temperature.
   b. Low pressure air testing:
      1) Place plugs in line and inflate to 25 PSIG.
      2) Check pneumatic plugs for proper sealing.
      3) Introduce low pressure air into sealed line segment until air pressure reaches 4 PSIG greater than ground water that may be over the pipe.
         a) Use test gage conforming to ASME B40.100 with 0 to 15 PSI scale and accuracy of 1 percent of full range.
      4) Allow 2 minutes for air pressure to stabilize.
      5) After stabilization period (3.5 PSIG minimum pressure in pipe) discontinue air supply to line segment.
      6) Record pressure at beginning and end of test.

C. Dielectric Testing Methods and Criteria:
   1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained.
   2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition.

3.7 CLEANING, DISINFECTION AND PURGING

A. Cleaning:
   1. Clean interior of piping systems thoroughly before installing.
   2. Maintain pipe in clean condition during installation.
   3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
   4. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.
   5. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.
      a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.
      b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.
   6. After erection of piping and tubing, but prior to installation of service outlet valves, blow natural gas and digester gas systems clear of free moisture and foreign matter by means of air, nitrogen or carbon dioxide.
      a. Oxygen shall never be used.

B. Purging Natural and Digester Gas:
   1. Existing piping:
      a. Turn off gas supply.
      b. Vent line pressure outdoors.
      c. If section exceeds the following, then remaining gas shall be displaced with an inert gas.
         1) 50 FT for 2-1/2 IN pipe and smaller.
   2. New piping:
      a. Including but not limited to:
         1) All fuel gas piping.
         2) Digesters.
         3) Digester gas equipment.
         4) Fuel gas trains.
b. Purge air filled system with fuel gas:
   1) Providing piping length is less than:
      a) 30 FT for 3 IN pipe.
      b) 15 FT for 4 IN pipe.
      c) 10 FT for 6 IN pipe.
   2) Providing a moderately rapid and continuous flow of fuel gas is introduced.
      a) Introduce fuel gas at one (1) end.
      b) Vent air at opposite end.
   3) Provided fuel gas flow is continuous without interruption until vented gas is free of
      air.
   4) The point of discharge shall not be left unattended during purging.
   c. If the piping is 3 IN or larger and exceeds lengths stated above.
      1) Purge air with inert gas in accordance with NFPA 54 and NFPA 69.
      2) Purge inert gas with fuel gas.

3. Discharge of purged gases:
   a. Open end of piping shall not discharge into confined spaces or areas where there are
      sources of ignition.

3.8 LOCATION OF BURIED OBSTACLES

A. Furnish exact location and description of buried utilities encountered and thrust block placement.
B. Reference items to definitive reference point locations such as found property corners, entrances
   to buildings, existing structure lines, fire hydrants and related fixed structures.
C. Include such information as location, elevation, coverage, supports and additional pertinent
   information.
D. Incorporate information on "As-Recorded" Drawings.

3.9 PIPE INSULATION

A. Insulate pipe and pipe fittings in accordance with Specification Section 40 42 00.

3.10 SCHEDULES
A. SPECIFICATION SCHEDULE - SYSTEM 1

1. General:
   a. Piping symbol and service:
      1) DS - Digested Sludge.
      2) SGR - Sludge Recirculation.
      3) SG - Sludge.
   b. Test requirements:
      1) Test medium: Water.
      2) Pressure: 125 PSIG.
      3) Duration: 6 HRS.
   c. Gaskets:
      1) Flanged, push-on and mechanical joints (ductile iron): Rubber,
         AWWA/ANSI C111/A21.11.

2. System components:
   a. Pipe size 3 IN through 16 IN:
      1) Exposed service:
         a) Material: Flanged: Ductile iron, Class 53.
            (1) Grooved type joint system: use pipe thickness per AWWA C606.
         d) Coating: Factory applied prime coat (no asphaltic coating). HPIC finish coat.
            See Specification Section 09 96 00.
         e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
         f) Joints:
            (1) Flanged or grooved type mechanical coupling (AWWA C606) joints.
            (2) For both systems, provide screwed-on flanges at equipment, valves and
                structure penetrations.
         g) Insulate and provide PVC jacketing over all exterior exposed piping and
            valves. Heat trace if necessary.
      2) Buried service:
         a) Materials: Ductile iron, Pressure Class 350.
         c) Lining: Cement.
         d) Coating: Bituminous.
         e) Fittings:
            (1) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
            (2) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for
                 sizes 3 IN to 16 IN.
         f) Joints:
            (1) Push-on with mechanical (stuffing box type) joints at fittings and valves.
            (2) All joints shall be restrained.
            (3) Polyethylene encasement per AWWA C105.
B. SPECIFICATION SCHEDULE - SYSTEM 2

1. General:
   a. Piping symbol and service:
      1) NG – Natural Gas.
   b. Test requirements:
      1) Test medium: Cylinder Nitrogen.
      2) Pressure: 20 PSIG.
      3) Duration: 6 HRS.

2. System components:
   a. Pipe size through 3 IN:
      1) Exposed service:
         a) Material: Steel, Grade B, black, Schedule 40.
         b) Reference: ASTM A53.
         c) Lining: None.
         d) Coating: HPIC; See Specification Section 09 96 00.
         e) Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150.
         f) Joints: Threaded, ASME B16.9 steel butt- or socket-welded joints.
      2) Buried service:
         a) Materials: Steel, Grade B, black, Schedule 40.
         b) Reference: ASTM A53.
         c) Lining: None.
         d) Coatings: Factory coating-mill wrapped with 3-M “Scotchkote”, or Energy Coating Company “Encoat” with fittings and uncoated portions fully wrapped after testing with 30M “Scotchkote” tape.
         e) Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150.
         f) Joints: Treaded, ASME B16.9 steel butt or socket welded joints.

3. Natural Gas Piping Installation:
   a. Install piping in accordance with NFPA, local gas company regulations, codes and local ordinances, complete with necessary appurtenances.
   b. Install buried pipe at approximately 30 IN deep.
   c. Gas cocks:
      1) Install before gas utilization equipment connected to system, at each branch main and at connection to meter.
      2) Design to operate safely under pressures indicated.
      3) Install ground joint unions at intervals to facilitate repairs.
      4) Cocks shall be of type and lubricant recommended by manufacturer for this class of service, and as approved by local gas company.
   d. Pipe drainage:
      1) Drain horizontal piping to risers.
      2) Locate drains where required for system drainage.
      3) Install tee fitting with bottom outlet plugged or provide with threaded, capped nipple at bottom of risers or in accordance with applicable codes.
   e. Make piping connections with shellacked joints or ground joint unions.
   f. Natural gas regulators:
      1) Acceptable manufacturers:
         a) Fisher.
      2) Design requirements:
         a) Self-contained, diaphragm operated.
         b) Spring loaded.
         c) Field adjustable.
      3) Natural gas service, CSA approved.
      4) Size for required operating conditions.
   g. Provide vents from gas regulators, pressure reducing valves, and other vented devices to the outdoors and terminate in accordance with applicable codes.
   h. Connect piping to pressure reducing valve outside of building.
i. Provide flexible connections to vibration isolated equipment suitable for pressures, local and national codes and intended application.

j. Remove cutting and threading burrs.

k. Plug each gas outlet (including valves) with threaded plugs or caps immediately after installation and retain until the piping or equipment connections are completed.

l. Continuously ground gas piping electrically, bond tightly to the grounding connection.

m. Install piping parallel to other piping, but maintain a minimum 12 IN clearance between gas piping and any piping that could reach 200 DEGF.
C. SPECIFICATION SCHEDULE - SYSTEM 3

1. General:
   a. Piping symbol and service:
      1) GHWR - Glycol Return.
      2) GHWS - Glycol Supply.
      3) HWR - Heating Water Return.
      4) HWS - Heating Water Supply.
   b. Test requirements:
      1) Test medium: Water.
      2) Pressure: 125 PSIG.
      3) Duration: 6 HRS.
   c. Gaskets and O-rings: EPDM.

2. System components:
   a. All Pipe Sizes:
      1) Exposed service:
         a) Material: Steel, Grade B, black, Schedule 40.
         (1) Grooved type joint system: Use thickness per AWWA C606.
         b) Reference: ASTM A53.
         c) Lining: None.
         d) Coating: HPIC; See Specification Section 09 96 00.
         e) Fittings: Malleable iron or steel meeting ASME B16.3 and ASTM A234.
         f) Joints:
            (1) Threaded joints for pipe 2 IN and below. Flanged joints (AWWA C207)
                for pipelines 3 IN and greater. Optional grooved type mechanical coupling
                (AWWA C606) joints for all applicable sizes.
            (2) For any system, provide rigid flanges at equipment, valves and structure
                penetrations above 2 IN and unions at those locations 2 IN and below.
D. SPECIFICATION SCHEDULE - SYSTEM 4

1. General:
   a. Piping symbol and service:
      1) NPW - Nonpotable Water.
   b. Test requirements:
      1) Test medium: Water.
      2) Pressure: 100 PSIG.
      3) Duration: 6 HRS.
   c. Gaskets and O-rings:
      1) O-rings and flanged joints: Viton.

2. System components:
   a. Pipe size to 1 IN:
      1) Exposed service:
         a) Materials: Stainless steel tubing, TP-304L.
         b) Reference: ASTM A269.
         c) Lining: None.
         d) Coating: None.
         e) Fittings: Stainless steel 304L compression type tube fittings.
         f) Joints: Compression type couplings, unions at equipment and valves.
         g) Minimum wall thickness:
            (1) 1/16 IN OD: 0.010 IN.
            (2) 1/8 to 1/4 IN OD: 0.028 IN.
            (3) 5/16 to 1/2 IN OD: 0.049 IN.
            (4) 5/8 to 1 IN OD: 0.065 IN.
   b. Pipe size Above 1 IN:
      1) Exposed service:
         a) Materials: Steel, Grade B, black, Schedule 40.
         (1) Grooved type joint system: Use pipe thickness per AWWA C606.
         b) Reference: ASTM A53.
         c) Lining: None.
         d) Coating: HPIC. See Specification Section 09 96 00.
         e) Fittings: Malleable iron or steel meeting ASME B16.3 and ASTM A234.
         f) Joints:
            (1) Threaded or grooved type mechanical coupling (AWWA C606) joints.
            (2) For any system, provide flanges at equipment, valves and structure penetrations above 2 IN and unions at those locations 2 IN and below.
   2) Buried service:
      a) Materials: PVC, Type 1, Grade 1, Schedule 80.
      b) Reference: ASTMD1785.
      c) Lining: None.
      d) Coating: None.
      e) Fittings: Solvent welded socket type complying with ASTM D2467.
      f) Joints: Solvent welded.
E. SPECIFICATION SCHEDULE - SYSTEM 5

1. General:
   a. Piping symbol and service:
      1) DG - Digester Gas.
   b. Test requirements:
      1) Test medium: See Article 3.6.
      2) Pressure: 10 PSIG.
      3) Duration: 6 HRS.
   c. Gaskets:
      1) Flanged joints: AISI 304 stainless steel, spiral wound, non-asbestos filler, 3/16 IN thick with compression ring to match required flange dimensions.

2. System components:
   a. Pipe size 1 IN and greater:
      1) Exposed service:
         a) Material: Stainless steel, Schedule 10S, Grade TP316L.
         b) References: ASTM A312, ASME B36.19.
         c) Lining: None.
         d) Coating: None.
         e) Fittings: Butt welded stainless meeting ASTM A774.
         f) Joints: Butt welded with ASTM A182 stainless steel flanges at equipment and valves.
         g) Insulate and provide PVC jacketing over all exterior, exposed piping and valves.
      2) Buried service:
         a) Material: Stainless steel, Schedule 40S, Grade TP316L.
         b) References: ASTM A312, ASME B36.19.
         c) Lining: None.
         d) Coating: None.
         e) Fittings: Butt welded stainless meeting ASTM A774.
         f) Joints: Butt welded.
F. SPECIFICATION SCHEDULE - SYSTEM 6

1. General:
   a. Piping symbol and service:
      1) VT - Vent.
      2) D - Drain.
   b. Test requirements:
      1) Test medium: Water.
      2) Pressure: See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
      3) Duration: 6 HRS.

2. System components:
   a. Pipe size 1-1/4 IN and 1-1/2 IN:
      1) Exposed service:
         b) Reference: ASTM A53.
         c) Lining: Galvanized.
         d) Coating: HPIC; See Specification Section 09 96 00.
         e) Fittings: Cast iron drainage.
            (1) ASTM A126, Class B.
         f) Joints: Threaded.
   b. Pipe size 2 IN and larger:
      1) Exposed service.
         a) Material: Cast iron soil pipe.
         b) Reference: ASTM A74, CISPI 301.
         c) Lining: None.
         d) Coating: HPIC; See Specification Section 09 96 00.
         e) Fittings: ASTM A74.
         f) Joints: No-hub with elastomeric sealing sleeve and stainless steel clamp assembly conforming to CISPI 301.
      2) Buried service
         a) Material: Cast-iron soil pipe.
         b) Reference: ASTM A74.
         c) Lining: None.
         d) Coating: Bituminous.
         e) Fittings: ASTM A74.
         f) Joints: Hub and spigot.

3. Waste Piping Installation:
   a. Install horizontal waste lines less than 4 IN DIA with a slope of not less than 1/4 IN/FT or 2 PCT toward the point of disposal.
   b. Install 4 IN and larger piping at 1/8 IN/FT.
   c. Install as close to construction as possible to maintain maximum head room.
   d. Make changes of direction with 1/8 bends and junctions with wye fittings.
   e. Use short wye fittings in vertical pipe only.
   f. Install handhole test tee at base of each stack.
   g. Install cleanouts at dead ends, at changes of direction and at 50 FT intervals on horizontal runs.
      1) Where cleanouts occur in concealed spaces, provide with extensions to floors above or to walls as required.
   h. Install piping true to grade and alignment.
      1) Begin at the system low point.
   i. Locate vertical extensions of underground piping below partition walls for concealment in wall.
      1) In locations where hubs are wider than partition, set hubs 1 IN below final floor.
   j. For hub and spigot joints, install hub facing flow.
4. Vent Piping Installation:
   a. Run vent stack parallel to each soil or waste stack to receive branch vents from fixtures.
   b. Originate each vent stack from soil or waste pipe at its base.
   c. Where possible, combine waste or vent stacks before passing through roof so as to minimize roof openings.
   d. Offset pipes running close to exterior walls away from such walls before passing through roof to permit proper flashing.
   e. Provide pipes passing through roofs with cast iron increasers minimum of 12 IN below roof one size larger than pipe but in no case less than 4 IN.
   f. Terminate each vent with approved frostproof jacket.
   g. Carry vent stacks 4 IN and larger full size through roof.
      1) Extend vent stacks at least 12 IN above roofing.
   h. Pipe vents from pressure regulating devices in compliance with local codes.

END OF SECTION
PART 1 - GENERAL
1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Scaled Drawings showing location, installation, material, loads and forces, and deflection of all hangers and supports.
      c. Analyze each pipe system for all loads and forces on hangers and supports and their reaction forces to the structure to which they are fastened.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester-General Requirements.

PART 2 - PRODUCTS
2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

2.2 MANUFACTURED UNITS
A. General:
   1. Galvanized components:
      a. Electro-galvanized components:
         1) Bar, forged or cast fabrications: ASTM B633, SC4.
         2) Rolled sheet fabrications: ASTM A917 and ASTM A918, 50N50NU.
      b. Hot-dipped galvanized components: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.
   2. Dissimilar metals protection:
      a. Galvanized-to-galvanized and galvanized-to-aluminum: No protection required.
      b. All other galvanized-to-dissimilar metal connections: Neoprene or nylon pads, shims, grommets, etc.
B. Hanger Rods:
   1. Material:
      a. Minimum allowable tensile stress of 12,000 psi at 650 DegF per MSS SP-58.
   2. Continuously threaded.
   3. Electro-galvanized or cadmium plated after threads are cut.
   4. Load limit:

<table>
<thead>
<tr>
<th>NOMINAL ROD DIAMETER</th>
<th>MAXIMUM SAFE LOAD, (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 IN DIA (min)</td>
<td>610</td>
</tr>
<tr>
<td>1/2 IN DIA</td>
<td>1,130</td>
</tr>
<tr>
<td>5/8 IN DIA</td>
<td>1,810</td>
</tr>
<tr>
<td>3/4 IN DIA</td>
<td>2,710</td>
</tr>
<tr>
<td>7/8 IN DIA</td>
<td>3,770</td>
</tr>
<tr>
<td>1 IN DIA</td>
<td>4,960</td>
</tr>
</tbody>
</table>

C. Hangers:
   1. Materials for corrosive areas: 304 stainless steel.
   2. Hanger type schedule:

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>PIPE SIZE</th>
<th>HANGER TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>All except noted</td>
<td>4 IN and less</td>
<td>ANVIL Figure 108 with Figure 114</td>
</tr>
<tr>
<td>All except noted</td>
<td>Over 4 IN</td>
<td>ANVIL Figure 590</td>
</tr>
<tr>
<td>Steam, condensate and hot water</td>
<td>All</td>
<td>ANVIL Figure 181, Figure 82</td>
</tr>
<tr>
<td>Service in chemical storage areas and as indicated on drawings for corrosion resistance</td>
<td>All</td>
<td>CorPro CP - Hanger or equal</td>
</tr>
</tbody>
</table>

D. Beam Clamps for Hanger Rods:
   1. Heavy duty.
   2. ANVIL Figure 134.

E. Trapeze Hangers for Suspended Piping:
   2. Angles, channels or other structural shapes.

F. Vertical Pipe Supports:
   1. At base of riser.
   2. Lateral movement:
      a. Clamps or brackets:
         1) Stainless steel.
         2) ANVIL Figure 103.

G. Expanding Pipe Supports:
   1. Spring hanger type.
   2. MSS SP-58.

H. Pipe Support Saddle:
   1. For pipe located 3 FT or less from floor elevation.
   2. Stainless steel.
   3. ANVIL Figure 264.
I. Pipe Support Risers:
   1. Schedule 40 pipe.
   2. 304 L stainless steel for exterior installations.
   3. Size: As recommended by saddle manufacturer.

J. Pipe Support Base Plate:
   1. 4 IN larger than support.
   2. Collar 3/16 IN thickness, circular in shape, and sleeve type connection to pipe.
   3. Collar fitted over outside of support pipe and extended 2 IN from floor plate.
   4. Collar welded to floor plate.
   5. Edges ground smooth.
   6. Assembly hot-dipped galvanized after fabrication.

K. Pipe Covering Protection Saddle:
   1. For insulated pipe at point of support.
   2. ANVIL Figure 167, Type B.

L. Wall Brackets:
   1. For pipe located near walls and 8 FT or more above floor elevation.
   2. ANVIL Figure 199.

M. Pipe Anchors:
   1. 1/4 IN steel plate construction.
   2. Hot-dipped galvanized after fabrication.
   3. Designed to prevent movement of pipe at point of attachment.

N. Pipe Guides:
   1. For locations on both sides on each expansion joint or loop.
   2. To ensure proper alignment of expanding or contracting pipe.
   3. ANVIL Figure 256.

2.3 DESIGN REQUIREMENTS

A. Supports capable of supporting the pipe for all service and testing conditions.
   1. Provide 5 to 1 safety factor.

B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.

C. Design supports and hangers to allow for proper pitch of pipes.

D. For waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
   1. ASME B31.3.
   2. MSS SP-58 and MSS SP-69.

E. Check all physical clearances between piping, support system and structure.
   1. Provide for vertical adjustment after erection.

F. Support vertical pipe runs in pipe chases at base of riser.
   1. Support pipes for lateral movement with clamps or brackets.

G. Place hangers are to be installed on outside of pipe insulation.
   1. Use a pipe covering protection saddle for insulated pipe at support point.
   2. Insulated piping 1-1/2 IN and less:
      a. Provide a 9 IN length of high density perlite or high density calcium silicate at saddle.
      b. See Specification Section 40 42 00.
   3. Insulated piping over 1-1/2 IN: Provide a 12 IN length of high density perlite or high density calcium silicate at saddle.
H. Pipe Support Spacing:
   1. General:
      a. Factor loads by specific weight of liquid conveyed if specific weight is greater than
         water.
      b. Locate pipe supports at maximum spacing scheduled.
      c. Provide at least one (1) support for each length of pipe at each change of direction and
         at each valve.
   2. Steel, ductile iron, and cast-iron pipe support schedule:

<table>
<thead>
<tr>
<th>PIPE SIZES - IN</th>
<th>MAXIMUM SPAN - FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2 and less</td>
<td>5</td>
</tr>
<tr>
<td>2 thru 4</td>
<td>10</td>
</tr>
<tr>
<td>5 thru 8</td>
<td>15</td>
</tr>
<tr>
<td>10 and greater</td>
<td>20</td>
</tr>
</tbody>
</table>

   3. Support each length and every fitting:
      a. Bell and spigot piping:
         1) At least one (1) hanger.
         2) Applied at bell.
      b. Mechanical coupling joints:
         1) Place hanger within 2 FT of each side of fittings to keep pipes in alignment.
   4. Space supports for soil and waste pipe and other piping systems not included above every
      5 FT.
   5. Provide continuous support for nylon tubing.

PART 3 - EXECUTION

3.1 INSTALLATION

   A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable
      constraints to correct the condition.
      1. Included in this requirement are movements from:
         a. Trap discharge.
         b. Water hammer.
         c. Similar internal forces.
   B. Weld Supports:
      1. AWS D1.1 or ASME standard.
      2. Weld anchors to pipe in accordance with ASME B31.3.
   C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and
      with maintenance or disassembly of equipment.
   D. Inspect hangers for:
      1. Design offset.
      2. Adequacy of clearance for piping and supports in the hot and cold positions.
      3. Guides to permit movement without binding.
      4. Adequacy of anchors.
   E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.
   F. Install individual or continuous slot concrete inserts for use with hangers for piping and
      equipment.
      1. Install concrete inserts as concrete forms are installed.
G. Welding:
   2. Integral attachments:
      a. Include welded-on ears, shoes, plates and angle clips.
      b. Ensure material for integral attachments is of good weldable quality.
   3. Preheating, welding and postheat treating: ASME B31.3, Chapter V.

H. Field Painting: Comply with Specification Section 09 96 00.

END OF SECTION
SECTION 40 05 19
PIPE: DUCTILE

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.
   2. Acknowledgement that products submitted meet requirements of the established standards of quality.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester -General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   1. Flanged adaptors:
      a. Rockwell (Style 912 (cast)).
      b. Dresser (Style 127 (cast)).
   2. Dismantling joints:
      a. Romac (DJ300).
   3. Compression sleeve coupling:
      a. Rockwell (Style 431 (cast)).
      b. Dresser (Style 153 (cast)).
   4. Mechanical coupling:
      a. Victaulic (Style 31, 307, 397, and 399).
      b. Tyler.
   5. Insulating couplings:
      a. Rockwell (Style 416).
      b. Dresser (Style 39).
   6. Reducing couplings:
      a. Rockwell (Style 415).
      b. Dresser (Style 62).
   7. Transition coupling:
      a. Rockwell (Style 413).
b. Dresser (Style 62).
8. Polyethylene encasement tape:
   a. Chase (Chasekote 750).
   b. Kendall (Polyken 900).
   c. 3 M (Scotchrap 50).
9. Restrained joints:
   a. American (Lock Fast) - 12 IN and below.
   b. U.S. Pipe (TR-Flex) - 4 IN to 54 IN.
   c. American (Lock Fast) - Above 12 IN.
10. Mechanical Caps and Plugs:
   a. American.
   b. US Pipe.
   c. Griffin.
11. Mechanical Joint Gland Type Restraint:
   a. EBAA Iron, Inc. Series 1100.
   b. Uni-Flange, Series 3000.
   c. Star Grip, Series 3000.
12. Dismantling Joint:
   a. Romac DJ400.
   b. Smith Blair 972.

2.2 MATERIALS

A. Ductile Iron Pipe:
   1. AWWA/ANSI C115/A21.15.
   2. AWWA/ANSI C150/A21.50.
   3. AWWA/ANSI C151/A21.51.

B. Fittings and Flanges:
   1. AWWA/ANSI C110/A21.10.
   2. AWWA/ANSI C115/A21.15.
   3. Flanges drilled and faced per ASME B16.1 for both 125 and 250 psi applications.

C. Nuts and Bolts:
   1. Buried: Cadmium-plated meeting SAE AMS-QQ-P-416, Type 1, Class 2 (Cor-Ten) for buried application.
   2. Exposed: Mechanical galvanized ASTM B695, Class 40.
   3. Wet, submerged, or corrosive areas: 316 Stainless steel.
   5. Threaded per ASME B1.1.
   6. Project ends 1/4 to 1/2 IN beyond nuts.

D. Gaskets: See individual piping system requirements in Section 40 05 00.

E. If mechanical coupling system is used, utilize pipe thickness and grade in accordance with AWWA C606.

F. Polyethylene Encasement: See AWWA/ANSI C105/A21.5

G. See Piping Schedules in Section 40 05 00.

2.3 MANUFACTURED UNITS

A. Dismantling Joints:
   1. Materials:
   b. End ring and body: Carbon steel with AWWA C207 Class D flanges.
   e. Tie rods: Steel, ASTM A193.
B. Couplings:
   1. Flanged adaptors:
      a. Unit consisting of steel or carbon steel body sleeve, flange, followers, Grade 30 rubber
gaskets.
      b. Provide units specified in the ACCEPTABLE MANUFACTURERS Article.
      c. Supply flanges meeting standards of adjoining flanges.
      d. The working pressure rating of the entire assembly shall be greater than or equal to the
test pressure specified on piping schedule for each respective piping application.
   2. Compression sleeve coupling:
      a. Unit consisting of steel sleeve, followers, Grade 30 rubber gaskets.
      b. Provide units specified in the ACCEPTABLE MANUFACTURERS Article.
      c. Supply flanges meeting standards of adjoining flanges.
      d. The working pressure rating of the entire assembly shall be greater than or equal to the
test pressure specified on piping schedule for each respective piping application.
      e. Provide field coating for buried couplings per AWWA C203.
   3. Mechanical couplings:
      a. Use of mechanical couplings and fittings in lieu of flanged joints is acceptable where
specifically specified in Section 40 05 00.
      b. Utilize units defined in Article 2.

2.4 FABRICATION
A. Furnish and install without outside coatings of bituminous material any exposed pipe scheduled
to be painted.
B. Furnish cast parts with lacquer finish compatible with finish coat.
C. Glass Lining:
   1. Minimum two-coat process.
      a. Base coat heated to solidly fuse glass to pipe surface.
      b. Subsequent coat(s) heated to form integral bond with preceding coat.
   2. Final finish parameters:
      a. Thickness: 8-12 MILS.
      b. Hardness: Above 5 on MOHS scale.
      c. Density: 2.5-3.0 grams per cubic centimeter.
      d. Metal to lining bonding: Capable of withstanding strain of 0.0001 IN/IN without
damage to lining.
   3. Complete compatibility between fittings and piping.

2.5 LININGS AND COATINGS
A. Where specified in piping schedule, provide linings to a minimum thickness of 40 MILS.

2.6 SOURCE QUALITY CONTROL
A. Factory Test:
   1. Subject pipe to hydrostatic test of not less than 500 PSI with the pipe under the full test
pressure for at least 10 seconds.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Joining Method - Push-On Mechanical (Gland-Type) Joints:
   1. Install in accordance with AWWA/ANSI C111/A21.11.
   2. Assemble mechanical joints carefully according to manufacturer's recommendations.
   3. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint.
   4. Do not overstress bolts.
   5. Where piping utilizes mechanical joints with tie rods, align joint holes to permit installation
of harness bolts.
B. Joining Method - Push-On Joints:
1. Install in accordance with AWWA/ANSI C151/A21.51.
2. Assemble push-on joints in accordance with manufacturer's directions.
3. Bevel and lubricate spigot end of pipe to facilitate assembly without damage to gasket.
   a. Use lubricant that is non-toxic, does not support the growth of bacteria, has no
dothing effects on the gasket material, and imparts no taste or odor to water in
   pipe.
4. Assure the gasket groove is thoroughly clean.
5. For cold weather installation, warm gasket prior to placement in bell.
6. Taper of bevel shall be approximately 30 degrees with centerline of pipe and approximately
   1/4 IN back.

C. Joining Method - Flanged Joints:
1. Install in accordance with AWWA/ANSI C115/A21.15.
2. Extend pipe completely through screwed-on flanged and machine flange face and pipe in
   single operation.
3. Make flange faces flat and perpendicular to pipe centerline.
4. When bolting flange joints, exercise extreme care to ensure that there is no restraint on
   opposite end of pipe or fitting which would prevent uniform gasket compression or would
   cause unnecessary stress, bending or torsional strains to be applied to cast flanges or flanged
   fittings.
5. Allow one (1) flange free movement in any direction while bolts are being tightened.
6. Do not assemble adjoining flexible joints until flanged joints in piping system have been
   tightened.
7. Gradually tighten flange bolts uniformly to permit even gasket compression.

D. Flange Adaptors 12 IN and Less:
1. Locate and drill holes for anchor studs after pipe is in place and bolted tight.
2. Drill holes not more than 1/8 IN larger than diameter of stud projection.

E. Cutting:
1. Do not damage interior lining material during cutting.
2. Use abrasive wheel cutters or saws.
3. Make square cuts.
4. Bevel and free cut ends of sharp edges after cutting.

F. Support exposed pipe in accordance with Section 40 05 00.

G. Install buried piping in accordance with Section 40 05 00.

H. Install restrained joint systems where specified in Section 40 05 00 under specific piping system.

3.2 FIELD QUALITY CONTROL
A. Test piping systems in accordance with Section 40 05 00.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Fabrication details and welding procedure specifications for all work to be done under this Specification Section.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester –General Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tubing:
   1. ASTM A269.
   2. Filler material: Extra low carbon (ELC) with 0.03 percent maximum carbon.

B. Pipe: ASTM A312.

C. Pipe Fittings: ASTM A774.

D. Flanges:
   1. Flat faced.
   2. Welding neck or slip on type.
   3. ASTM A182, Type 316L.

E. Nuts, Bolts and Washers:
   1. ASTM A320, Type 316.
   2. Two (2) nuts provided for 1 IN DIA bolt applications and larger.

F. Expansion Joints:
   2. Liner: Series 300 stainless steel.
2.2 FABRICATION

A. All tube, piping, fitting product to be immersion pickled subsequent to manufacturing and fabrication operations and prior to shipping.
   1. Pickling solution of 6-10 percent nitric acid and 3-4 percent hydrofluoric acid.
   2. Temperature and exact concentrations to be such only a modest etch is produced but all oxidation and ferrous contamination is removed from metal surface.
   3. All pickling solution residues are to be neutralized after pickling.

B. Diameter tolerance and wall thickness tolerance are to conform to ASTM A530.

C. Joints:
   1. Shop welded circumferential butt weld joints.
   2. ASME B16.1, Class 150.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect and verify condition of piping and appurtenances.
   1. Installation constitutes installer's acceptance of condition for satisfactory installation.

3.2 PREPARATION

A. Correct defects or conditions which may interfere with or prevent a satisfactory installation.

B. Ensure ends of pipe to be fitted with flanges have all protrusions ground flush.

3.3 INSTALLATION

A. Ensure all pipe cutting, threading and jointing conforms to requirements of ASME B31.1.
   1. Lubricate all pipe threads with Teflon tape.

B. Welding:
   1. Provide welds sound and free from embedded scale or slag, and tensile strength at weld not less than pipe.
   2. Perform butt welds only with an inert gas shielded process.
   3. Adequate inert gas protection is to be provided to the top and under or backside of the weld to protect from atmospheric contamination.
   4. Filler metal is to be applied to all manually-performed welds appropriate for the base material being welded.
   5. Only inert gas shielded welding processes are to be used for spool fabrication.
   6. Provide butt welds with 100 percent penetration to the interior or back side of the weld joint.
   7. Weld reinforcement on both sides of the weld are to be smooth, uniform and no more than 1/16 IN in height.

C. Joining Method - Flanges:
   1. Leave 1/8 IN to 3/8 IN flange bolts projecting beyond face of nut after tightening.
      a. Coordinate dimensions and drillings of flanges with flanges for valves, equipment, and other systems.
      b. Tighten bolts evenly around pipe until following range of torques is achieved:

<table>
<thead>
<tr>
<th>BOLT SIZE, IN</th>
<th>RANGES OF TORQUE, FT/LBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8</td>
<td>40 - 60</td>
</tr>
<tr>
<td>3/4</td>
<td>60 - 90</td>
</tr>
<tr>
<td>1</td>
<td>70 - 100</td>
</tr>
<tr>
<td>1-1/4</td>
<td>90 - 120</td>
</tr>
</tbody>
</table>
3.4 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Specification Section 40 05 00.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes steel pipe, fittings, appurtenances, products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of the established standards of quality.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester -General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Flanged adaptors:
   a. Rockwell (Style 913 (steel)).
   b. Dresser (Style 128 (steel)).

2. Insulating couplings:
   a. Rockwell (Style 416).
   b. Dresser (Style 39).

3. Transition coupling:
   a. Rockwell (Style 413).
   b. Dresser (Style 62).

4. Compression sleeve coupling:
   a. Rockwell (Style 411 (steel)).
   b. Dresser (Style 38 (steel)).

5. Flexible connectors for hot water equipment:
   a. Flexonics (FLG Series).
2.2 MATERIALS

A. All materials used in steel piping systems defined in Section 40 05 00 shall meet or exceed pressure test requirements specified for each respective system.

B. Steel Pipe (Mill Type): ASTM A53, Type E or S.

C. Fittings (For Mill Type Pipe):
   1. ASTM A234.

D. Flanges (Mill Type Pipe):
   1. ASME B16.5.
   2. Flat faced.

E. Nuts and Bolts:
   1. Buried: Cadmium-plated meeting SAE AMS-QQ-P-416, Type 1, Class 2 (Cor-Ten) for buried application.
   2. Exposed: Mechanical galvanized ASTM B695, Class 40.
   3. Heads and dimensions per ASME B1.1.
   5. Project ends 1/4 to 1/2 IN beyond nuts.

F. Gaskets: See individual piping systems in Section 40 05 00.

2.3 MANUFACTURED UNITS

A. Couplings:
   1. Flanged adaptors:
      a. Steel or carbon steel body sleeve, flange, followers and Grade 30 rubber gaskets.
      b. Provide units specified in Article 2.1.
      c. Flanges meeting standards of adjoining flanges.
      d. Entire assembly to be rated for test pressure specified on Piping Schedule for each respective application.
   2. Compression sleeve coupling:
      a. Steel sleeve, followers Grade 30 and rubber gaskets.
      b. Provide units specified in Article 2.1.
      c. Flanges meeting standards of adjoining flanges.
      d. Entire assembly to be rated for test pressure specified on Piping Schedule for each respective application.
      e. Provide field coating for buried couplings per AWWA C203.

2.4 ACCESSORIES

A. Heating Water Application:
   1. For steel heating lines, provide braided, flanged stainless steel connectors for connection to equipment.
   2. Provide pump connectors with stainless steel construction, rubber filled bellows and flanged end connections.

2.5 FABRICATION

A. Provide piping for use in this Project with minimum wall thicknesses as follows:
   1. 1/8 - 5 IN DIA pipe: Schedule 40.
   2. 6 - 10 IN DIA pipe: 3/16 IN.
   3. Wall thicknesses indicated are for standard weight pipe.
      a. Design pipe in accordance with operating pressures shown in Piping Schedules for a design stress limited to 50 percent of yield.

B. Protective Coatings and Linings:
   1. Field paint pipe in accordance with Section 09 96 00.
2.6 SOURCE QUALITY CONTROL

A. Testing:
   1. Shop hydrostatic test fabricated steel pipe and fittings.
   2. Field hydrostatic test all pipe as specified in Section 40 05 00.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Joining Methods - Flanges:
   1. Facing method:
      a. Insert slip-on flange on pipe.
      b. Assure maximum tolerances for flange faces from normal with respect to axis of pipe is 0.005 IN per foot of flange diameter.
      c. Test flanges after welding to pipe for true to face condition and reface, if necessary, to bring to specified tolerance.
   2. Joining method:
      a. Leave 1/8 to 3/8 IN of flange bolts projecting beyond face of nut after tightening.
      b. Coordinate dimensions and drillings of flanges with flanges for valves, pumps, equipment, tank, and other interconnecting piping systems.
      c. When bolting flange joints, exercise extreme care to assure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or cause unnecessary stress, bending or torsional strains being applied to cast flanges or flanged fittings.
         1) Allow one (1) flange free movement in any direction while bolts are being tightened.
      d. Do not assemble adjoining flexible coupled, mechanical coupled or welded joints until flanged joints in piping system have been tightened.
      e. Gradually tighten flange bolts uniformly to permit even gasket compression.
      f. Do not overstress bolts to compensate for poor installation.

C. Joining Method - Couplings:
   1. Compression sleeve:
      a. Install coupling to allow space of not less than 1/4 IN but not more than 1 IN.
      b. Provide harnessed joint.
         1) Use joint harness arrangements detailed in AWWA M11.
      c. Design harness assembly with adequate number of tie rods for test pressures indicated in Section 40 05 00 and allow for expansion of pipe.
      d. Provide ends to be joined or fitted with compression sleeve couplings of the plain end type.
      e. Grind smooth welds the length of one (1) coupling on either side of joint to be fitted with any coupling.
      f. Assure that outside diameter and out-of-round tolerances are within limits required by coupling manufacturer.

D. Joining Method - Threaded and Coupled (T/C):
   1. Provide T/C end conditions that meet ASME B1.2 requirements.
   2. Furnish pipe with factory-made T/C ends.
   3. Field cut additional threads full and clean with sharp dies.
   4. Leave not more than three (3) pipe threads exposed at each branch connection.
   5. Ream ends of pipe after threading and before assembly to remove burrs.
   6. Use Teflon thread tape on male thread in mating joints.

E. Support exposed piping in accordance with Section 40 05 00.

F. Install buried piping per Section 40 05 00.
3.2 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 40 05 00.

END OF SECTION
SECTION 40 05 26
PIPE: CAST-IRON SOIL

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of the established standards of quality.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester -General Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Pipe (General Application):
   1. ASTM A74.
   2. No hub: CISPI 301.
B. Joints (General Application):
   1. Standard:
      a. Oakum.
      b. Lead, FS QQ-C-40 Type 1.
   3. Mechanical: No hub, CISPI 310.

2.2 FABRICATION
A. Cast-Iron Soil Pipe: SV service rated.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Observe manufacturer's recommendation for handling, cutting, jointing, installing, and testing.
B. Install products in accordance with CISPI.
C. Support exposed piping in accordance with Section 40 05 00.
D. Install buried piping in accordance with Section 40 05 00.

E. If "standard joint" is used, assure lead is run in one (1) continuous pour.
   1. No second pouring or driving of lead is permitted.
   2. Provide minimum of 12 OZ of lead per inch of pipe diameter per joint.

3.2 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 40 05 00.

END OF SECTION
SECTION 40 05 51
VALVES: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
   3. Test reports.
B. Operation and Maintenance Manuals:

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digestor -General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, refer to individual valve Specification Sections for acceptable manufacturers. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

2.2 MATERIALS
A. Refer to individual valve Specification Sections.

2.3 VALVE ACTUATORS
A. Valve Actuators - General:
   1. Provide actuators on all valves.
   2. Counter clockwise opening as viewed from the top.
   3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
   4. Size actuator to produce required torque with a maximum pull of 80 LBS at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 LBS on handwheel or chainwheel or 300 FT/LBS torque on the operating nut.
5. Actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.

6. Extension stem:
   a. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
   b. Pin all stem connections.
   c. Center in valve box or grating opening band with guide bushing.

B. Buried Valve Actuators:
1. Provide screw or slide type adjustable cast iron valve box, 5 IN minimum diameter, 3/16 IN minimum thickness, and identifying cast iron cover rated for traffic load.
2. Box base to enclose buried valve gear box or bonnet.
3. Provide 2 IN standard actuator nuts complying with AWWA C500, Section 3.16.
4. Provide at least two (2) tee handle keys for actuator nuts, with 5 FT extension between key and handle.

5. Extension stem:
   a. Provide for buried valves greater than 4 FT below finish grade.
   b. Extend to within 6 IN of finish grade.
   c. Provide concrete pad encasement of valve box as shown for all buried valves.

C. Exposed Valve Manual Actuators:
1. Provide for all exposed valves not having electric actuators.
2. Provide handwheels for gate valves.
   a. Size handwheels for valves in accordance with AWWA C500.
3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and smaller.
   a. Lever actuators for butterfly valves shall have a minimum of 5 intermediate lock positions between full open and full close.
   b. Provide at least two (2) levers for each type and size of valve furnished.
4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.
5. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
6. Provide chain actuators for valves 6 FT or higher from finish floor to valve centerline.
   a. Cadmium-plated chain looped to within 3 FT of finish floor.
   b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull without "gagging" the wheel.
   c. For smaller valves with lever or handle operators, provide offset tee handles with attached chain for operation from the operating floor.

D. Electric Actuators (480 V, 3 PH):
1. Conform to AWWA C542.
2. Provide electric valve actuators with integral control devices and a remote pushbutton station, unless valve actuator control station is more than 6 FT above an operating floor; then provide a remote control station.
3. Furnish electric actuator integral with valve consisting of:
   a. Motor.
   b. Gearing.
   c. Handwheel.
   d. Limit and torque switches.
   e. Lubricants.
   f. Heating elements.
   g. Wiring.
   h. Terminals for motor power and controls.
   i. Drive nut.
4. Housing/enclosure:
   a. Provide cast iron gear housing and cast iron load bearing enclosure.
   b. Non load bearing enclosure and housing: Aluminum or cast iron.
c. Rated for area classification shown on Drawings.
d. Provide O-ring seals for covers and entries.
e. Terminal and limit switch compartment covers are to be fastened to gear housing by stainless steel fasteners with capture device to prevent loss.

5. Motors:
a. Provide motors that are totally enclosed, high torque design made expressly for valve actuator service and capable of operating the valve under full differential pressure for complete open-close and reverse cycle of travel at least twice in immediate succession without overheating.
b. Design motors in accordance with NEMA MG 1 standards, with Class B insulation, and to operate successfully at any voltage within 10 percent above or below rated voltage.
c. Provide positive method to ensure motor bearings are permanently lubricated.
d. Provide three (3) thermal switches imbedded in windings:
   1) 120 degrees apart.
   2) Provide motor shutdown at high temperature.
e. Motor housing:
   1) Aluminum.
   2) Totally enclosed non-ventilated with cooling fins.
f. Provide motor capable of operating in any position.
g. Provide motor sealed from gearcase to allow any mounting position.
h. Provide motors suitable for 480 V, 3 PH, 60 Hz.

6. Gearing:
a. Provide power gearing consisting of heat treated steel helical gears, carburized and hardened alloy steel worm, and alloy bronze worm gear, all grease or oil bath lubricated, designed for 100 PCT overload, and effectively sealed against entrance of foreign matter.
b. Provide gearing mechanism constructed to permit field changes of reduction gear ratio.
c. Design actuators so that motor comes up to speed before stem load is encountered in either opening or closing operation.
d. Limit switch gearings and feedback device reduction gearing:
   1) Steel or bronze.
e. Support rotating shafts with anti-friction bearings.
f. Provide separate drive nut/thrust bearing assembly:
   1) Mounted to base of actuator.
   2) High tensile bronze.
   3) Quarter turn actuator: Provide 90 degree mounting intervals.
   4) Provide grease fitting on drive assembly.

7. Handwheel:
b. Positive declutch mechanism to engage and disengage handwheel.
c. Handwheel shall not rotate during motor operation.
d. Inoperable motor shall not prevent manual operation.

8. Limit torque and thrust loads in both closing and opening directions by torque limit switches:
a. Provide torque switches with micrometer adjustment and reference setting indicator.
   1) Assure adjustment variation of approximately 40 PCT in torque setting.
b. Provide switches having rating of not less than 6 A at 120 Vac and 2.2 A at 115 Vdc.
c. Limit and torque switches shall have totally sealed contacts.

9. Furnish electric actuator with two (2) geared limit switch assemblies with each switch assembly having four (4) separate limit switches:
a. Assure each limit switch assembly is geared to driving mechanism and is independently adjustable to trip at any point at and between the fully open and fully closed valve position.
b. Provide minimum of two (2) normally open contacts and two (2) normally closed contacts at each end of valve travel.
c. Provide switches with inductive contact rating of not less than 6 A at 120 Vac, 3 A at 240 Vac, 1.5 A at 480 Vac, 2.2 A at 115 Vdc and 1.1 A at 230 Vdc.
d. Limit switches shall be fully adjustable when power is applied to actuator.

10. Provide space heating elements sized to prevent condensation in both motor and geared limit switch compartment(s).
   a. Furnish heating elements rated at 120 Vac with heaters continuously energized.

11. Open-close actuator controls:
   a. Provide control assembly with necessary holding relays, reversing starter, control transformers of sufficient capacity to provide control power, space heating element power and valve position transmitter.
   b. Provide control assembly in an enclosure rated for the defined area classification.
   c. Controls for open/close actuator:
      1) Provide remote pushbutton station with enclosure rated for area classification shown on Drawings with:
         a) Open pushbutton.
         b) Close pushbutton.
         c) Stop pushbutton.
         d) Remote/local switch.
         e) Full open light.
         f) Full close light.
         g) Open and close relays as required.
      2) Provide control enclosure to accept:
         a) Remote open/close switches.
      3) Provide contacts in control enclosure:
         a) Remote/local contact.
         b) Full open contact.
         c) Full close contact.
      4) Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.

E. Electric Actuators (120 V, 1 PH):
   1. General:
      a. Only acceptable for Valves sizes 3 IN and less.
      b. Conform to AWWA C542.
      c. Self-contained including motor, gearing, torque switch, limit switches and cast housing.
      d. Electrical enclosure: NEMA 4 or NEMA 7 to comply with area rating classification shown on Drawings.
      e. Factory assembled requiring only field connection of power and control wires.
      f. Comply with Specification Section 01 61 03.
   2. Motors:
      a. Produce 1.5 times the required torque.
      b. Sized for two (2) complete open-close cycles without overheating.
      c. One (1) fully closed to fully open cycle to occur within 60 SEC.
      d. Class F insulation.
      e. Operate at plus or minus 10 PCT voltage.
      f. 120 Volt, single phase, 60 Hz.
      g. Provide thermal cutout switch and internal heater for actuator enclosure.
      h. Control wiring as shown on Drawing control diagrams.
   3. Remote pushbutton station:
      b. Control relays shall include:
         1) Open relay.
         2) Closed relay.
         3) ESAD No. 2 PLC interface relay.
      c. Push-to-test indicating lights shall include:
         1) Open.
2) Closed.
3) Remote.

d. Selector switches shall include:
   1) Local-Remote.
   2) Open-Close.

e. Space heater for enclosure.
f. Control wiring as shown on control diagrams.
g. Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.

F. Valve Lockout Devices:
   1. Device manufactured from same material as valve operator, preventing access to valve operator, to accept lock shackle.

2.4 FABRICATION

A. End Connections:
   1. Provide the type of end connections for valves as required in the Piping Schedules presented in Specification Section 40 05 00 or as shown on the Drawings.
   2. Comply with the following standards:
      b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
      c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.

B. Refer to individual valve Specification Sections for specifications of each type of valve used on Project.

C. Nuts, Bolts, and Washers:
   1. Wetted or internal to be bronze or stainless steel.
      a. Exposed to be zinc or cadmium plated.

D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Painting Requirements: Comply with Specification Section 09 96 00 for High Performance Industrial Coatings.

C. Setting Buried Valves:
   1. Set valves and valve boxes plumb.
   2. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
   3. Install in closed position.
   4. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
   5. After installation, backfill up to top of box for a minimum distance of 4 FT on each side of box.

D. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.

E. Install electric actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.

F. For threaded valves, provide union on one (1) side within 2 FT of valve to allow valve removal.
G. Install valves accessible for operation, inspection, and maintenance.

3.2 ADJUSTMENT

A. Adjust valves, actuators and appurtenant equipment to comply with Specification Section 01 75 00.
   1. Operate valve, open and close at system pressures.

B. For all 480 Vac electric actuators, employ and pay for services of valve actuator manufacturer's field service representative to:
   1. Inspect valve actuators covered by this Specification Section.
   2. Supervise adjustments and installation checks:
      a. Open and close valves electrically under local manual and demonstrate that all limit switches are properly adjusted and that switch contacts are functioning properly by verifying the inputs are received at the remote input/output (RIO) panels or local control panel as appropriate.
      b. Position modulating valves electrically under local manual control and demonstrate that the valve position feedback potentiometer is properly adjusted and that the feedback signal is received at the RIO panels or local control panel as appropriate.
      c. Simulate a valve position command signal at the RIO panel or local control panel as appropriate and demonstrate that the valve is controlled to the desired position without excessive hunting.
   3. Provide Owner with a written statement that the valve actuator manufacturer has verified that the actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted and that the valve actuator responds correctly to the valve position command.

END OF SECTION
SECTION 40 05 62
PLUG VALVES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05-Egg Shaped Anaerobic Digester-General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester –General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

2.2 NON-LUBRICATED ECCENTRIC PLUG VALVES (SLUDGE, SEWAGE GAS APPLICATIONS)
A. Acceptable Manufacturers:
   1. DeZurik.
   2. Millikin.
   3. Victaulic.
B. Materials:
   1. Body: Cast-iron ASTM A126, Class B.
   2. Plug: One or two-piece construction ductile iron, ASTM A536 65-45-12 or cast iron, ASTM A126 Class B.
   3. Plug facing: Grease and/or petroleum-resistant resilient Neoprene or Buna-N compound, 70 Type A durometer hardness per ASTM D2240.
   4. Shaft bearing bushings: Permanently lubricated TFE or Delrin sleeve type stainless steel or bronze.
6. Stem seal: per AWWA C517, Section 4.4.7.

### 2.3 LUBRICATED SEAL PLUG VALVES (NATURAL GAS APPLICATIONS)

**A. Acceptable Manufacturers:**
2. Walworth.
3. Millikin.

**B. Materials:**
1. Body: Cast iron ASTM A126, Class B.
2. Plug: Cast iron ASTM A126, Class B.
3. Plug facing: Teflon on tapered plug.

### 2.4 DESIGN REQUIREMENTS

**A. Non-Lubricated Eccentric Plug Valves (Sludge):**
1. Port area:
   a. Valves 4 IN through 20 IN: Equal to or exceed 80 PCT of full pipe area.
2. Valve body: Fitted with bolted bonnet.
4. Stem seal: Adjustable and replaceable without disassembling valve or bonnet.
5. Designed for seating drip tight in any flow direction.
6. Rating:
   a. 1/2 through 12 IN, 175 PSI working pressure.
7. Actuator:
   a. Actuator gearing in enclosure suitable for running in oil with seals on shaft to prevent entry of dirt or water.
   b. Positive identification on actuator indicating valve position.
   c. Adjustable stop to set closing torque.

**B. Lubricated Plug Valves (Natural Gas):**
1. Pressure lubricated valve with sealed ports and grooves.
   a. Re-seatable under full pressure in any position.
2. Pressure rating: 200 PSI WOG.
3. Port area: Minimum 60 PCT of pipe area.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. Install valves with valve stem horizontal, plug seat on inlet side and with plug rotating up into the open position for valves in horizontal lines.

B. Install valve with actuator above pipe or plug centerline.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester -General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

2.2 METALLIC BALL VALVES 1/4 TO 3 IN DIA

A. Comply with MSS SP-110.

B. Acceptable Manufacturers:
   1. Apollo.
   2. Watts.

C. Materials:
   1. Body: Bronze or Carbon Steel.
   3. Seats: RPTFE.
D. Design Requirements:
   1. Rated for a minimum of:
      a. 400 PSI and 250 DEGF.
      b. 150 psi of saturated steam.
      c. 29 IN vacuum.
   2. Two-position lockable handle.
   3. Stem with blowout-proof design.
   4. Balancing stop for all applications.
   5. Bodies with mounting pad for applications requiring actuators.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
   1. Inspect equipment covered by this Specification Section.
   2. Supervise adjustments and installation checks.
   3. Provide test equipment, tools, and instruments necessary to accomplish equipment testing.
   4. Conduct startup of equipment and perform operational checks.
   5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, has been started up, and is ready for operation by Owner's personnel.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP Contractor.

1.3 SUBMITTALS
A. Shop Drawings:
1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of the established standards of quality.
3. For valves 8 IN and larger, furnish "Affidavit of Compliance" with Owner in accordance with AWWA C504.
B. Operation and Maintenance Manuals:
1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
1. Butterfly valves:
   a. DeZurik.
   b. Mueller/Lineseal.
   c. Pentair/Keystone.

2.2 GENERAL USE BUTTERFLY VALVES
A. Comply only with AWWA C504.
B. Materials:
1. Valve bodies:
   a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
   b. Wafer valves may be constructed of ASTM A48, Class 40 cast iron.
2. Valve shafts:
   a. One-piece stainless steel, Type 304.
   c. Bushings/Packing/O-rings: EPDM, RTFE or TFE.
   d. Bearings: Reinforced TFE or equal.
3. Valve discs:
   a. Cast iron with welded nickel edge or 304 Stainless Steel disk.
4. Valve seats:
   a. EPDM or Hycar.
5. Shaft bearing: Bronze, TFE-coated stainless steel or reinforced TFE.
6. Shaft seal in addition to any sealing provided by seat: Suitable synthetic rubber rings or PTFE V-ring suitable for operating conditions.

2.3 ACCESSORIES
A. Furnish actuator integral with valve.
B. Valve Flange Seal Rings:
   1. If Steel Slip-on flanges are being used on the process piping, flange seals will be required for proper installation of valves.

PART 3 - EXECUTION
3.1 INSTALLATION
A. See Section 40 05 51.

END OF SECTION
SECTION 40 05 66
CHECK VALVES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum
standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final
design. If applicable to the final design elements, incorporate the applicable standard of quality
requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General
   Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established
         standards of quality.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General
   Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester -General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the manufacturers listed within subsequent
sections of this specification are acceptable. Except where specifically noted otherwise, or-equal
manufacturers will be considered by the Engineer for approval if Contractor submits Shop
Drawings which clearly call out or-equal consideration is requested. See General Condition
Article 7.04.

2.2 CHECK VALVES: 2.5 IN AND SMALLER
A. Class 125 Bronze Swing Check Valves (Water, Wastewater):
   1. Comply with MSS SP-80.
   2. Acceptable manufacturers:
      a. Nibco T413-Y.
      b. Stockham B-319Y.
   3. Materials:
   4. Design requirements:
      a. 125 PSI steam to 406 DEGF, 200 PSI WOG.
      b. Horizontal swing, renewable disc.
2.3 SWING CHECK VALVES: 3 IN TO 24 IN

A. Swing Check Valves (Sludge):
   1. Comply with AWWA C508.
   2. Acceptable manufacturers:
      a. Clow.
      b. American Darling.
      c. Golden Anderson.
   3. Materials:
      a. Body and cover: Cast iron.
      b. Seat ring, hinge: Bronze.
      c. Disc:
         1) 3 to 4 IN: Bronze.
         2) 6 to 24 IN: Cast iron with bronze or rubber face.
      d. Hinge shaft: Stainless steel.
      e. Bearings, connecting hardware: Bronze.
   4. Design requirements:
      a. 175 psi working pressure (3 to 12 IN).
      b. Furnish with outside weight and lever or lever and spring.

B. Class 125 Iron Check Valves (Water, Glycol Solution):
   2. Acceptable manufacturers:
      a. Nibco F-918B.
      b. Stockham 373 1/2.
   3. Materials:
      a. Iron body, bronze mounted.
      b. Seat ring, disc face: Bronze.
      c. Hinge pin: Bronze or stainless steel.
      d. Connecting hardware: Bronze or plated steel.
   4. Design requirements:
      a. Class 125.
      b. Bolted cap.

2.4 BALL CHECK VALVES: 3 IN TO 12 IN

A. Ball Valves (Sludge, Digested Sludge):
   1. Acceptable manufacturers:
      a. Flomatic.
      b. HDL.
   2. Materials:
      a. Body and cover: Ductile iron.
      b. Interior Lining: Epoxy.
      c. Seal: Buna-N.
      d. Retainer Ring (as applicable): Stainless Steel.
      e. Ball: Buna-N Covered Iron Ball.
   3. Design requirements:
      a. 150 PSI working pressure (3 to 12 IN).
      b. Access Port with above ball to allow full ball removal.
PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 40 05 51.
B. Install in accordance with manufacturer's instructions.

END OF SECTION
SECTION 40 42 00
PIPE, DUCT AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester –General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Elastomeric insulation:
   a. Rubatex.
   b. Armstrong.

2. Fiberglass insulation:
   a. CertainTeed Corporation.
   b. Johns Manville.
   c. Owens Corning.
   d. Knauf.

3. PVC jacket:
   a. Ceel-Co.
   b. PIC Plastics.

4. Equipment insulation:
   a. CertainTeed Corporation.
   b. Johns Manville.
   c. Owens Corning.

5. Ductwork insulation:
   a. CertainTeed.
   b. Johns Manville.
c. Owens Corning.
6. High density perlite:
   b. Industrial Insulation Group (LIC).
7. High density calcium silicate:
   a. Industrial Insulation Group (LIC).
8. Adhesives, mastics, sealants, and finishes:
   a. Dow Corning.
   b. Johns Manville.
   c. Knauf.

2.2 PIPING INSULATION - ELASTOMERIC

A. General:
   1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and
      adhesive used to adhere the facing or jacket to the insulation), as tested by procedure
      ASTM E84, NFPA 255 and UL 723, not exceeding:
      a. Flame spread: 25.
      b. Smoke developed: 50.
   2. Accessories (adhesives, mastics, cements, and tapes): Same component ratings as listed
      above.
   3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed
      above requirements.
   4. Permanent treatment of jackets or facings to impart flame and smoke safety is required.
      a. Water-soluble treatments are prohibited.
   5. Insulated shields at pipe support points.

B. Pipe, Fitting, and Valve Insulation:
   1. Flexible elastomeric closed cell pipe insulation.
      a. Average thermal conductivity not to exceed 0.27 (Btu-IN)/(HR-FT²-DEGF) at mean
         temperature of 75 DEGF; temperature range -40 to 220 DEGF; permeability not to
         exceed 0.20 by ASTM E96; water absorption 3 PCT by ASTM D1056 and ozone
         resistance.
   2. Provide minimum insulation thickness conforming to schedules in this specification.

2.3 PIPING INSULATION - FIBERGLASS

A. Pipe and Fitting Insulation:
   1. Preformed fiberglass pipe insulation:
      a. Density: 4 LBS/CF.
      b. Temperature rated: 650 DEGF.
      c. Average thermal conductivity not to exceed 0.23 (Btu-IN)/(HR-FT²-DEGF) at mean
         temperature of 75 DEGF.
      d. Fire hazard rating:
         1) UL 723, ASTM E84, NFPA 255.
         2) Flame spread not exceeding 25 and smoke developed not exceeding 50.
   2. Moisture adsorption:
      a. ASTM C553.
      b. Not greater than 0.5 PCT moisture by volume when exposed to moisture laden air at
         120 DEGF and 96 PCT RH.
   3. Fungi and bacteria resistance:
      a. ASTM C665.
      b. Does not breed or promote growth.
      c. Flame attenuated glass fibers bonded with thermosetting resin.
   4. Piping jackets (general applications):
2.4 PIPE INSULATION INSERTS AT HANGERS

A. High Density Perlite:
   1. Pre-formed.

   2. Fire hazard rating:
      a. UL 723, ASTM E84, NFPA 255.
      b. Flame spread: Zero (0).
      c. Smoke developed: Zero (0).

   3. Average density: 13 LBS/CF.
   4. Compressive strength: 80 PSI to produce 5 PCT compression.
   5. Maximum surface temperature: 1,200 DEGF.

B. High Density Calcium Silicate:
   1. Pre-formed.

   2. Fire hazard rating:
      a. UL 723, ASTM E84, NFPA 255.
      b. Flame spread: Zero (0).
      c. Smoke developed: Zero (0).

   3. Average density: 14 LBS/CF.
   4. Compressive strength: 100 PSI to produce 5 PCT compression.
   5. Maximum surface temperature: 1,200 DEGF.

2.5 EQUIPMENT INSULATION

A. Insulation for Equipment:
   1. Fire hazard classification:
      a. UL 723, ASTM E84, NFPA 255.
      b. Flame spread not exceeding 25 and smoke developed not exceeding 50.

   2. Provide minimum insulation thickness conforming to Schedules in this specification.

2.6 DUCTWORK INSULATION: FIBERGLASS

A. Flexible Insulation:
   1. Material: Commercial-grade fiberglass thermal insulation, formaldehyde free.
   2. Scheduled thickness and installed R-value. Installed R-value when compressed to a
      maximum of 25 PCT following recommended duct wrap stretch outs.
   3. Factory-applied foil scrim vapor barrier facing.
   4. Average thermal conductivity not to exceed 0.27 (Btu-IN)/(HR-FT2-DEGF) at a mean
      temperature of 75 DEGF (installed).
   5. Fungi and bacteria resistance:
      a. ASTM C1338.
      b. Does not breed or promote growth.

   6. Fire hazard classification:
      a. UL 723, ASTM E84, NFPA 255.
      b. Flame spread not exceeding 25 and smoke developed not exceeding 50.

   7. Basis of design: Johns Manville Microlite fiberglass duct wrap insulation.

B. Semi-Rigid Insulation for Indoor Installation:
   1. Scheduled thickness and R-value.
   2. Factory applied vapor barrier facing-white scrim foil.
   3. Average thermal conductivity not to exceed 0.23 (Btu-IN)/(HR-FT2-DEGF) at a mean
      temperature of 75 DEGF.
4. Fungi and bacteria resistance:
   a. ASTM C1338.
   b. Does not breed or promote growth.
5. Moisture adsorption:
   a. ASTM C553.
   b. Not greater than 0.5 PCT moisture by volume when exposed to moisture laden air at
      120 DEGF and 96 PCT RH.

   C. Semi-Rigid Insulation for Outdoor Installation:
   1. Scheduled thickness and R-value.
   2. Factory-applied foil scrim vapor barrier facing.
   3. Average thermal conductivity not to exceed 0.23 (Btu-IN)/(HR-FT²-DEGF) at mean
temperature of 75 DEGF.
   4. Minimum density: 3 LBS/CF.
   5. Fungi and bacteria resistance:
      a. ASTM C1338.
      b. Does not breed or promote growth.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. General:
   1. Piping below ground covered with earth will not be insulated.
   2. Consider ductwork, piping and equipment as exposed.
   3. Provide release for insulation application after installation and testing is complete.
      a. Apply insulation on clean, dry surfaces after inspection.
   4. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers,
supports and sleeves.
   5. Provide insulation with vapor barrier for piping, ductwork and equipment where surfaces
      may be cooler than surrounding air temperatures.
      a. Provide vapor barrier (0.17 perm-IN; ASTM C553) continuous and unbroken.
      b. Hangers, supports, anchors, and related items that are secured directly to cold surfaces
         must be adequately insulated and vapor-sealed to prevent condensation.
   6. Apply specified adhesives, mastics and coatings at the manufacturer's recommended
      coverage per unit volume.

C. Piping Insulation - Elastomeric:
   1. Do not insulate until satisfactory completion of required pressure testing.
   2. Apply insulation to clean, dry surfaces.
   3. Slip insulation on pipe prior to connection.
      a. Whenever the slip-on technique is not possible provide insulation neatly slit and
         snapped over the pipe.
   4. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
   5. Seal joints, slits, miter-cuts and other exposed edges of insulation with adhesive,
      recommended by the insulation manufacturer, to ensure complete vapor barrier.

D. Piping Insulation - Fiberglass:
   1. Apply over clean dry pipe.
      a. Butt all joints together firmly.
   2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the
      insulation manufacturer.
   3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
4. PVC pipe jacket:
   a. Apply jacketing with a minimum of 1 IN overlap.
      1) Weld longitudinal and circumferential seams with adhesives as recommended by
         manufacturer.
   b. Provide slip-joints every 30 FT and between fittings if distance exceeds 8 FT.
      1) Construct slip-joints by overlapping jacket sections 6 to 10 IN.
   c. Provide pre-molded PVC covers of same material and manufacturer as jacket for
      fittings, valves, flanges, and related items in insulated piping systems.

5. Aluminum pipe jacket:
   a. Field-applied aluminum jacket with vapor-sealed longitudinal and butt joints.
   b. Provide smooth and straight joint with a minimum 2 IN overlap.
   c. Secure joints with corrosion-resistant screws spaced 0.25 to 0.50 IN back from edge.
   d. Center spacing of screws 5 IN maximum or as required to provide smooth tight-fitted
      joints.
   e. Place joints on least exposed side of piping to obtain neat appearance.

E. Equipment: Install per manufacturer's instructions.

F. Ductwork Insulation - Fiberglass:
   1. Flexible insulation:
      a. Butt edges tightly.
         1) Secure insulation with Benjamin Foster 85-20 adhesive applied in 6 IN strips on
            12 IN centers and/or pins, applied on not more than 18 IN centers so that the
            insulation conforms to the duct surfaces uniformly and firmly.
      b. Seal joints with facing overlap or 4 IN wide strips of like facing material adhered and
         stapled in place.
      c. Properly seal any penetration in vapor barrier facing with Benjamin Foster 85-20.
      d. Cut insulation slightly longer than the perimeter of the duct to ensure full thickness at
         corners.
   2. Semi-rigid insulation and duct interior lining board:
      a. Impaling over pins.
         1) Apply insulation with edges tightly butted.
         2) Apply insulation with mechanically welded fasteners to the duct and secured with
            speed clips.
         3) Clip pins off close to clip.
         4) Space pins as required to hold insulation firmly against duct surface but not less
            than one (1) pin per 1.5 SQ FT.
         5) Seal joints and speed clips with 3 IN wide strip of facing adhered with Benjamin
            Foster 85-20 adhesive.
      b. If the welded pin method is impossible, secure insulation to the duct with Benjamin
         Foster 85-20 adhesive.
         1) Cover the entire surface of duct with adhesive.
         2) Use corner metal angle to protect edge of insulation.
         3) Protect edge of insulation.
         4) Seal joints as above.
      c. For outdoor application finish with Benjamin Foster #4610 weatherproof mastic with
         white glass fabric membrane.

G. Install interior duct lining board as indicated above.
   1. Overall length shall be a minimum of 10 LF past any type of air supply fan.

3.2 REPAIR

A. Whenever any factory applied insulation or job-applied insulation is removed or damaged,
replace with the same quality of material and workmanship.
3.3 SCHEDULES

A. Refrigeration Lines (35-60 DEGF):
   1. Elastomeric.
   2. 1/2 IN thickness for lines 1 IN and smaller.

B. Pipe, Fittings and Valves:
   1. Fiberglass.

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>PIPE SIZE</th>
<th>THICKNESS</th>
<th>JACKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Potable Water (NPW)</td>
<td>All</td>
<td>1 IN</td>
<td>PVC</td>
</tr>
<tr>
<td>Glycol Supply/Return (GS/GR), Heating Water Supply/Return (HTWS/HTWR)</td>
<td>1-1/2 IN and less</td>
<td>1-1/2 IN</td>
<td>PVC</td>
</tr>
<tr>
<td>Exposed Exterior Sludge Piping (SG/SGR)</td>
<td>All</td>
<td>3 IN</td>
<td>Alum</td>
</tr>
</tbody>
</table>

C. Equipment:

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>INSULATION SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot water, heating equipment, heat exchangers, air separators, strainers, condensate, receivers</td>
<td>2 IN fiberglass insulation. Glass mesh jacket adhered and coated with two (2) coats of Foster 30-36 white insulation coatings.</td>
</tr>
<tr>
<td>Hot water pumps, flash tanks, compression tanks</td>
<td>Uninsulated</td>
</tr>
<tr>
<td>Below drain pans serving cooling coils, pre-heat systems, domestic water heaters</td>
<td>1 IN flexible elastomeric closed cell sheet.</td>
</tr>
<tr>
<td>Boiler and smoke stack</td>
<td>Conform to Specification Section 46 73 41</td>
</tr>
</tbody>
</table>

D. Ductwork:
   1. Fiberglass.

<table>
<thead>
<tr>
<th>DUCT SERVICE</th>
<th>INSULATION AND THICKNESS</th>
<th>MINIMUM R-VALUE (HR-FT²-DEGF)/Btu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside air ducts, inside building</td>
<td>3 IN semi-rigid with vapor barrier</td>
<td>12.0</td>
</tr>
<tr>
<td>Supply air ducts inside building</td>
<td>2 IN flexible with vapor barrier</td>
<td>6.0</td>
</tr>
<tr>
<td>Supply and return air ducts outside building and where exposed to atmospheric air</td>
<td>3 IN semi-rigid for outdoor installation</td>
<td>12.0</td>
</tr>
<tr>
<td>All other ductwork</td>
<td>Uninsulated</td>
<td>N/A</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 40 62 16
COMPUTER NETWORK AND HUMAN MACHINE INTERFACE (HMI) HARDWARE

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 – Egg Shaped Anaerobic Digester -General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

2.2 PANEL MOUNTED INDUSTRIAL COMPUTERS
A. Acceptable Manufacturers:
B. Provide panel mounted industrial computers.
C. Design and Fabrication:
   1. Integrated display computer with solid-state drive.
   2. Minimum processing speed: 2.0 GHz.
   3. Storage drive: Minimum 8 GB.
   5. Display: Color graphics.
   6. Touch screen.
   7. Provide password protection to prevent unauthorized entries for a minimum of two (2) levels:
      a. Authorization to operate.
      b. Authorization to adjust setpoints.
   8. Operating temperature: 32 DEGF to 131 DEGF.
   9. Humidity: 10 to 90 PCT RH non-condensing.
2.3 ETHERNET SWITCHES

A. Acceptable Manufacturers:
   1. Hirschmann.
   3. Allen-Bradley/Cisco.

B. Provided Managed Ethernet Switches.

C. Managed Ethernet Switches:
   1. Design and fabrication:
      a. Support Ethernet 100 MBit/s.
      b. Support SNMP and Web based management.
      d. IGMP (Internet Group Management Protocol) support for IP multicast filtering to
         enable switches to automatically route messages only to appropriate ports.
      e. Backbone ports for connection to multimode fiber via type ST connectors.
      f. Check all received data for validity.
         1) Discard invalid and defective frames or fragments.
      g. Monitor connected TP/TX line segments for short-circuit or interrupt using regular link
         test pulses in accordance with IEEE 802.3.
      h. Monitor attached fiber optic lines for open circuit conditions in accordance with
         IEEE 802.3.
      i. As applicable, meet requirements of IEEE 802.3.
      j. Provide LED status lights to indicate:
         1) Power: Supply voltage present.
         2) Fault.
         3) Port status.
      k. Environmental rating:
         1) Operating temperature: 32 DEGF to 122 DEGF.
         2) Humidity: 95 PCT relative humidity, non-condensing.

2.4 SOFTWARE

A. Provide all software and associated programming/configuration required to meet performance
   requirements of the Contract Documents.
   1. At substantial completion of the Project:
      a. Turn current licenses for all software over to the Owner in the Owner's name and install
         the latest version, upgrade or service pack for all software.

B. Ethernet Network Management Software:
   1. Software to include an OPC Server, capable of integrating real-time SNMP data into OPC
      client enabled HMI software databases.

C. All software must be latest edition and licensed to the Owner.

END OF SECTION
SECTION 40 90 00
INSTRUMENTATION FOR PROCESS CONTROL: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination:
   1. Coordinate all interfacing work with the WWTP contractor.
   2. Ensure coordination of instrumentation with other work to ensure that necessary wiring, conduits, contacts, relays, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.
B. Qualifications:
   1. Instrumentation subcontractor shall have satisfactorily provided a control system for a minimum of five (5) projects of similar magnitude and function:
C. Comply with electrical classifications and NEMA enclosure types shown in the Contract Documents.

1.3 SYSTEM DESCRIPTION
A. Control System Requirements:
   1. The instrument and control system consists of all primary elements, transmitters, switches, controllers, computers, recorders, indicators, panels, signal converters, signal boosters, amplifiers, special power supplies, special or shielded cable, special grounding or isolation, auxiliaries, software, wiring, and other devices required to provide complete control of the work.
B. All signals shall be directly linearly proportional to measured variable unless specifically noted otherwise.
C. Single Instrumentation Subcontractor:
   1. Furnish and coordinate instrumentation system through a single instrumentation subcontractor.
   2. Prior to Shop Drawing preparation, the Instrumentation Subcontractor shall inspect the Owner's existing equipment and as-constructed electrical documentation and be able to fully coordinate the interface of new and existing instrumentation and controls.
      a. Furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 – Egg Shaped Anaerobic Digester-General Requirements.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards the
      established standards of quality.
   b. Equipment catalog cut sheets.
   c. Instrument data sheets:
      1) ISA S20 or approved equal.
      2) Separate data sheet for each instrument.
   d. Materials of construction.
   e. Minimum and maximum flow ranges.
   f. Physical limits of components including temperature and pressure limits.
   g. Electrical power requirements and wiring diagrams.
   h. NEMA rating of housings.
3. PLC equipment Drawings.
4. HMI graphics.
5. Nameplate layout Drawings.
6. Drawings, systems, and other elements are represented schematically in accordance with
   ISA S5.1 and ISA S5.3.
   a. The nomenclature, tag numbers, equipment numbers, panel numbers, and related series
      identification contained in the Contract Documents shall be employed exclusively
      throughout submittals.
7. All Shop Drawings shall be modified with as-built information/corrections.
8. All panel and wiring drawings shall be provided in both hardcopy and softcopy.
   a. Furnish electronic files on CD-ROM or DVD-ROM media.
   b. Drawings in AUTO CAD format.
   c. Furnish a copy of the PLC and display unit programming on CD-Rom or DVD-Rom
      media.
9. Provide a parameter setting summary sheet for each field configurable device.
10. Certifications:
    a. Documentation verifying that calibration equipment is certified with NIST traceability.
    b. Approvals from independent testing laboratories or approval agencies, such as UL, FM
       or CSA.
       1) Certification documentation is required for all equipment for which the
          specifications require independent agency approval.
11. Testing reports: Source quality control reports.

1.5 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 – Egg Shaped Digester -General Requirements.

PART 2 - PRODUCTS

2.1 NEMA TYPE REQUIREMENTS
A. Provide enclosures/housing for control system components in accordance with the following:
   1. Areas designated as wet: NEMA Type 4.
   2. Areas designated as wet and/or corrosive: NEMA Type 4X.
   3. Areas designated as Class I hazardous, Groups A, B, C, or D as defined in NFPA 70:
      a. NEMA Type 7 unless all electrical components within enclosure utilize intrinsically
         safe circuitry.
      1) Utilize intrinsically safe circuits to the maximum extent practical
   4. Non-architecturally finished areas designated as dry, noncorrosive, and nonhazardous:
      NEMA Type 12.
2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. System Operating Criteria:
   1. Stability: After controls have taken corrective action, as result of a change in the controlled variable or a change in setpoint, oscillation of final control element shall not exceed two (2) cycles per minute or a magnitude of movement of 0.5 percent full travel.
   2. Response: Any change in setpoint or change in controlled variable shall produce a corresponding corrective change in position of final control element and become stabilized within 30 seconds.
   3. Agreement: Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 percent of full scale over a 6:1 operating range.
   4. Repeatability: For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position final element.
   5. Sensitivity: Controls shall respond to setpoint deviations and measured variable deviations within 1.0 percent of full scale.
   6. Performance: All instruments and control devices shall perform in accordance with manufacturer's specifications.

2.3 ACCESSORIES

A. Provide identification devices for instrumentation system components.
B. Provide corrosion resistant spacers to maintain 1/4 IN separation between equipment and mounting surface in wet areas.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wherever feasible, use bottom entry for all conduit entry to instruments and junction boxes.
B. Install electrical components per the requirements of the Electrical design.
C. Panel-Mounted Instruments:
   1. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.
   2. Locate all devices mounted inside enclosures so terminals and adjustment devices are readily accessible without use of special tools and with terminal markings clearly visible.

3.2 FIELD QUALITY CONTROL

A. Maintain accurate daily log of all startup activities, calibration functions, and final setpoint adjustments.
   1. Documentation requirements include the utilization of the forms located at the end of this Specification Section.
      a. Loop Check-out Sheet.
      b. Instrument Certification Sheet.
      c. Final Control Element Certification Sheet.
B. Instrumentation Calibration:
   1. Verify that all instruments and control devices are calibrated to provide the performance required by the Contract Documents.
   2. Calibrate all field-mounted instruments, other than local pressure and temperature gages, after the device is mounted in place to assure proper installed operation.
   3. Calibrate in accordance with the manufacturer's specifications.
   4. Bench calibrate pressure and temperature gages.
      a. Field mount gage within seven (7) days of calibration.
5. Check the calibration of each transmitter and gage across its specified range at 0, 25, 50, 75, and 100 percent.
   a. Check for both increasing and decreasing input signals to detect hysteresis.
6. Replace any instrument which cannot be properly adjusted.
7. Calibration equipment shall be certified by an independent agency with traceability to NIST.
   a. Certification shall be up-to-date.
   b. Use of equipment with expired certifications shall not be permitted.
8. Calibration equipment shall be at least three (3) times more accurate as the device being calibrated.

C. Loop check-out requirements are as follows:
1. Check control signal generation, transmission, reception and response for all control loops under simulated operating conditions by imposing a signal on the loop at the instrument connections.
   a. Use actual signals where available.
   b. Closely observe controllers, indicators, transmitters, HMI displays, recorders, alarm and trip units, remote setpoints, ratio systems, and other control components.
      1) Verify that readings at all loop components are in agreement.
      2) Make corrections as required.
      a) Following any corrections, retest the loop as before.
2. Stroke all control valves, cylinders, drives and connecting linkages from the local control station and from the control room operator interface.
3. Check all interlocks to the maximum extent possible.
4. In addition to any other as-recorded documents, record all setpoint and calibration changes on all affected Contract Documents and turn over to the Owner.

D. Provide verification of system assembly, power, ground, and I/O tests.
E. Verify existence and measure adequacy of all grounds required for instrumentation and controls.

END OF SECTION
SECTION 40 91 10
PRIMARY METERS AND TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials, and execution requirements to establish a minimum standard of quality for design and construction of this work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with the WWTP contractor.

1.3 SYSTEM DESCRIPTION
A. The instruments specified in this Specification Section are the primary element components identified on the PIDs. Contractor to furnish and install any additional instrumentation required by its final design.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 – Egg Shaped Anerobic Digester -General Requirements.
   2. Product technical data including:
      a. Acknowledgement that the submitted products meet the requirements of the established standards of quality.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

2.2 PRESSURE COMPONENTS
A. Pressure Transmitters:
   1. Acceptable manufacturers:
      a. Rosemount, Model 3051.
      b. Foxboro, I/A series.
      c. Honeywell 100e.
   2. Materials:
      a. Isolating diaphragm: 316 stainless steel.
      c. Housing: Aluminum.
      d. Vent/drain valve: 316 stainless steel.
      e. Fill fluid:
         1) Utilize manufacturer's standard fill for all applications.
   3. Design and fabrication:
      a. Smart transmitters utilizing microprocessor based electronics.
b. Output: 4-20 mA DC proportional to pressure.

c. Nonvolatile EEPROM memory.

d. Power supply: 24 Vdc.

e. Adjustable zero and span.

f. Temperature limits: -20 to 180 DEGF.
   1) -4 to 175 DEGF for LCD indicators.

g. Overpressure limits: Withstand 150 PCT of stated maximum service pressure without damage.

h. Humidity limits: 0 to 100 PCT relative humidity.

i. Damping: Adjustable between 0 and 32 seconds.

j. Inaccuracy (includes effects of linearity, repeatability and hysteresis): +/-0.10 PCT of calibrated span for 15:1 rangeability.

k. Stability: +/-0.2 PCT of upper range limit for 12 months.

l. Temperature effect:
   1) Total effect including span and zero errors: +/-0.2 PCT of upper range limit per 100 DEGF for minimum 15:1 rangeability.

m. Minimum 1/2 IN pressure connection.

n. Equip with test jacks or accessible terminals for testing output.

o. Equip with isolation valve and test connections with isolation valves and/or plugs.

B. Differential Pressure Transmitters:

1. Acceptable manufacturers:
   a. Rosemount, Model 3051.
   b. Foxboro, I/A series.
   c. Honeywell 100e.

2. Materials:
   a. Isolating diaphragm: 316 stainless steel.
   c. Housing: Aluminum.
   e. Fill fluid:
      1) Utilize manufacturer's standard fill for other applications.

3. Design and fabrication:
   a. Smart transmitter utilizing microprocessor based electronics.
   b. Output: 4-20 mA DC proportional to:
      1) Non-flow applications: Differential pressure.
      2) Flow applications: Square root of the differential pressure.
   c. Nonvolatile EEPROM memory.
   d. Power supply: 24 Vdc.
   e. Adjustable zero and span.
   f. Temperature limits: -20 to 180 DEGF.
      1) -4 to 175 DEGF for LCD indicators.
   g. Overpressure limits:
      1) Withstand body rated pressure on either side without damage or loss of calibration.
      2) Withstand 150 PCT of stated maximum service pressure without damage.
   h. Humidity limits: 0 to 100 PCT relative humidity.
   i. Damping: Adjustable between 0 and 32 seconds.
   j. Inaccuracy (includes effects of linearity, repeatability and hysteresis): +/-0.10 PCT of calibrated span for 15:1 rangeability.
   k. Stability: +/-0.2 PCT of upper range limit for 12 months.
   l. Temperature effect:
      1) Total effect including span and zero errors: +/-0.2 PCT of upper range limit per 100 DEGF for minimum 15:1 rangeability.
   m. Minimum 1/2 IN pressure connection.
   n. Equip with test jacks or accessible terminals for testing output.
o. Equip with a three-valve manifold as follows:
   1) Two (2) transmitter isolating valves.
   2) One (1) transmitter equalizing valve.
   p. Provide with test connections with isolation valves and/or plugs.

C. Pressure Switches:
   1. Acceptable manufacturers:
      a. Mercoid.
      b. Automatic Switch Company.
      c. United Electric.
   2. Materials:
      a. Wetted switch elements: 316 stainless steel.
      b. Diaphragm seal housing: 316 stainless steel.
      c. Pressure snubber:
         1) Filter disc: 316 stainless steel.
         2) Housing: 316 stainless steel.
   3. Accessories:
      a. Provide ball valve to isolate pressure switch from source.
      b. Utilize pressure snubbers with porous metal discs to provide pulsation dampening on
         pressure switch as shown on schedule.
      c. On applications where a pressure switch and a pressure gage are used at the same
         location, it is permissible to utilize one (1) pulsation dampener and diaphragm seal to
         isolate both elements from the process fluid.
   4. Design and fabrication:
      a. Utilize hermetically sealed mercury contact switches.
      b. Two (2) SPDT contacts rated:
         1) 1 amp inductive at 125 Vdc.
         2) 2 amp inductive at 120 Vac.
      c. Switch set points:
         1) Set points between 30 and 70 PCT of switch rated working range.
         2) Operating pressure not to exceed 75 PCT of switch rated working range.
      d. Accuracy: Better than 1 PCT of full scale.
      e. Process connection: Minimum of 1/4 IN.

D. Pressure Guage:
   1. Acceptable manufacturers:
      a. Ashcroft.
      b. Ametek.
      c. McDaniel.
   2. Materials:
      a. Bourdon tube, socket, connecting tube: 316 stainless steel.
      c. Pressure snubber:
         1) Filter disc: 316 stainless steel.
         2) Housing: 316 stainless steel.
   3. Accessories:
      a. Utilize pressure snubbers with porous metal discs to provide pulsation dampening on
         gage applications as shown on schedule.
      b. Provide 1/2 IN stainless steel antisiphon pigtail inlet connection for hot water
         applications.
   4. Design and fabrication:
      a. All components suitable for service at:
         1) 250 DEGF.
         2) The maximum process temperature to which the gage is to be exposed.
      b. Provide viewer protection from element rupture.
c. Calibrate gages at jobsite for pressure and temperature in accordance with manufacturer's instructions.

d. Unless otherwise required by codes, provide stem mounted or flush mounted, as required, with dial diameter as follows:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>DIAL SIZE</th>
<th>GAGE CONNECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2 IN or less</td>
<td>2-1/2 IN</td>
<td>1/4 IN</td>
</tr>
<tr>
<td>Larger than 1-1/2 IN</td>
<td>4-1/2 IN</td>
<td>1/2 IN</td>
</tr>
</tbody>
</table>

e. Equip with white faces, black numerals and black pointers.

f. Gage tapping position to be clear of equipment functions and movements, and protected from maintenance and operation of equipment.

1) Gage to be readable from an accessible standing position.


g. Gage accuracy: 1 PCT of full range.

h. Select gage range so that:

1) The normal operating value is in the middle third of the dial.

2) Maximum operating pressure does not exceed 75 PCT of the full scale range.

E. Diaphragm Seal:

1. Acceptable manufacturers:
   a. Ashcroft.
   b. Ametek.

2. Materials:
   a. Lower housing: 316 stainless steel.
   b. Diaphragm material: 316 stainless steel.

3. Design and fabrication:
   a. Isolates instrument from process fluids which are corrosive or contain solids.
   b. Upper housing with bleed screw.
   c. Lower housing with flushing connection.
   d. Fill fluid:
      1) Utilize manufacturer's standard fill.
   e. Process connections:
      1) Instrument: 1/2 IN NPT.
      2) Process: 0.5 IN female NPT.

4. Installed where specified or shown on Drawings.

F. In-Line Isolation Sleeve (Annular Seal):

1. Acceptable manufacturers:
   a. Ametek.
   b. Red Valve.
   c. Ashcroft.

2. Materials:
   b. Flanges: 316 stainless steel.
   c. Flexible liner: Buna-N.

3. Design and fabrication:
   a. Provide full 360 degree annular pressure sensor with flexible in-line sleeve.
   b. Sensor shall not restrict the process flow (non-intrusive).
   c. Seal shall be of wafer design to fit between two flanges.
   d. Instrument connection: 0.25 IN female NPT.
   e. Fill fluid:
      1) Utilize manufacturer's standard fill.
   f. Pressure rating: To meet requirements of schedule.
2.3 TEMPERATURE COMPONENTS

A. Thermometer:
1. Acceptable manufacturers:
   a. Ashcroft.
   b. Ametek.
2. Materials:
   b. Ring: 316 stainless steel.
   c. Stem: 316 stainless steel.
   e. Bulb: AISI 316 stainless steel.
3. Design and fabrication:
   a. Type:
      1) Bimetallic for applications not exceeding 800 DEGF.
      b. Every angle case connection.
      c. Hermetically sealed case with external adjustment.
   d. Dial:
      1) Minimum 4-1/2 IN.
      2) White face.
      3) Black numbers and pointer.
   e. Thermometer well:
      1) Extension neck for insulated lines.
   f. Accuracy +/-1 PCT of full span.
   g. Shatterproof glass.

B. RTD's:
1. Acceptable manufacturers:
   a. Rosemount.
   b. Foxboro.
   c. Burns Engineering, Inc.
2. Materials:
   b. Sheath:
      1) 900 DEGF maximum: Type 316 stainless steel.
      2) 1200 DEGF maximum: Inconel.
   c. Insulation: Ceramic or metallic oxide.
3. Design and fabrication:
   a. 100 ohms at 0 DegC.
   b. Spring loaded.
   c. Lead wire compensation: Three- or four-wire.
   d. Accuracy: +/-0.5 DEGF or +0.5 PCT of measured temperature, whichever is greater.
   e. Sheath diameter: 1/4 IN.

C. Thermowells:
1. Acceptable manufacturers:
   a. Rosemount.
   b. Burns Engineering, Inc.
   c. Aschcroft.
2. Materials:
   b. Head: Cast iron.
3. Design and fabrication:
   b. Lagging extension sufficient to provide wrench clearance above lagging.
   c. Seal welded on applications where process pressure exceeds 450 psi.
   d. Test thermowells shall be supplied with watertight cap and chain.
D. Temperature Transmitters:

1. Acceptable manufacturers:
   a. Rosemount, Model 3144.
   b. Foxboro, I/A series.
   c. Honeywell STT 3000.

2. Materials:
   a. Housing: Aluminum.

3. Design and fabrication:
   a. Smart transmitter utilizing microprocessor based electronics.
   b. Input: RTD.
   c. Transmitter inaccuracy shall be in accordance with the following:
      1) 100 ohm platinum RTD input: +/-0.25 DEGF +0.02 PCT of span whichever is greater.
   d. Stability:
      1) Any of the following drift limits are acceptable:
         a) Greater of: 0.1 PCT of reading or 0.1 DEGC per 12 months.
         b) 0.05 PCT of input reading plus 0.043 PCT of span per 12 months.
         c) 0.05 PCT of maximum span per 12 months.
   e. Ambient temperature effects (including digital, D/A conversion, and cold junction effects):
      1) Any of the following effects per 50 DEGF change are acceptable:
         a) One-half reference inaccuracy plus 0.18 DEGF.
         b) Effects in accordance with the following inputs:
            1) 100 platinum RTD input: +/-0.08 DEGC +0.025 PCT of (reading +200).
   f. Ambient temperature limits:
      1) -40 to 185 DEGF.
      2) Integral LCD meter: -4 to 158 DEGF.
   g. Output: 4-20 mA DC signal linearly proportional to temperature.
   h. Power supply: 24 Vdc.
   i. Adjustable span.
   j. Adjustable zero.

E. Temperature Switches:

1. Acceptable manufacturers:
   a. Ashcroft.
   b. United Electric.

2. Design and fabrication:
   a. Contact rating:
      1) 1 amp inductive at 125 Vdc.
      2) 5 amp inductive at 120 Vac.
   b. Switch accuracy: 1 PCT or better.

2.4 FLOW TRANSMITTERS

A. Magnetic Flow Meters (Inline):

1. Acceptable manufacturers:
   a. ABB (WaterMaster).
   b. Endress + Hauser (ProMag).
   c. Rosemount (8700 Series).

2. Design and fabrication:
   a. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
   b. High input impedance pre-amplifiers.
      1) Minimum impedance: $10^{10}$ ohms.
   c. Provide flanged end connections per ASME B16.5. Meter body shall be rated to same pressure as the flanges.
d. Grounding requirements:
   1) Nonmetallic or lined pipe:
      a) Inlet and outlet grounding rings of same material as electrode or as
         recommended by manufacturer to meet process requirements.
   2) Conductive piping:
      a) Conductive path between the meter and the piping flanges.
   e. Provide cable between magnetic flow meter and transmitter.
      1) Cable shall be potted and fitted by manufacturer at the factory.
   f. Pulsed DC magnetic field excitation.
   g. Automatic zero.
   h. Adjustable low flow cutoff.
   i. Minimum signal lock (empty tube zero) to prevent false measurement when tube is
      empty.
   j. Inaccuracy: +/- 0.4 PCT of rate.
   k. 4-20 mA DC HART isolated output into maximum 800 ohms.
   l. Power supply: 117 V +/-10 PCT, 60 Hz.
   m. Indication of flow rate and totalized flow at transmitter.
   n. Meter operable as specified in liquids with 5.0 micro mho/cm or more conductivity.
   o. Transmitter electronics shall use microprocessor based architecture and be configured
      using parameters.

2.5 THERMAL MASS FLOWMETERS:

   1. Acceptable manufacturer:
      a. Endress + Hauser (Proline T-mass).
      b. Fluid Components International LLC.
      c. Kurz Instruments, Inc.

   2. Design and fabrication:
      a. Materials:
         1) All wetted surfaces: 316 stainless steel.

   3. Design and fabrication:
      a. Microprocessor based electronics with field adjustable instrument performance
         parameters and build-in testing and diagnostics and nonvolatile memory.
      b. Provide digital LCD display at transmitter.
      c. Precisely matched RTDs and a heating element.
      d. Turndown ratio: 10:1 to 100:1.
         1) Accuracy: +/-1 PCT of reading + 0.5 PCT of calibrated full scale.
      e. Repeatability: +/-0.5 PCT of reading.
      f. Operating temperature:
         1) Sensor: -40 - 248 DEGF.
         2) Transmitter electronics: 0 - 149 DEGF.
      g. Process connection: 1 IN NPT.
      h. Field adjustable insertion length.
      i. Output: Isolated 4-20 mA.
      j. Power supply: 115 Vac, 60 Hz.
      k. Provide with suitable length of cable between sensor and transmitter.

2.6 DIFFERENTIAL PRESSURE (LEVEL) TRANSMITTER:

   1. Acceptable manufacturers:
      a. Emerson Rosemount 3051L.
      b. Endress + Hauser (Deltabar S).
      c. Siemens (Sitrans P500).

   2. Specifications:
      a. General:
         1) Measurement Principle: Differential-pressure (hydrostatic) based on the height of
            the liquid head.
            a) Uses a process isolating diaphragm.
2) Minimum/Maximum Span: ± 0.15 to 300 PSIG.
3) Accuracy: ± 0.075 PCT of span.

b. Process Connection:
1) Isolation Diaphragm: 4 IN.
2) Flange Rating: Class 150.

c. Display and Configuration:
1) Integral Display for live measurement and configuration.
2) Adjustable zero and span.
3) Damping: Adjustable from 0 to 32 seconds.
4) Output variables: Level; optional: Volume, Mass.
5) Output Units: PSI, feet (FT), inches (IN), meters (M), or millimeters (MM).

d. Electrical:
1) Signal Power: Loop-powered, 2-wire, 24vdc.
2) Current Output: Analog 4-20 Ma into a 400 ohm loop.
3) Optional Communication: HART.
4) Configuration: With remote hand-held configurator.
5) Cable entry: 1/2 IN NPT connection.

e. Materials of Construction:
1) Process flanges and adapters: 316 Stainless steel.
2) Wetted O-rings: Viton.
3) Vent/Drain valves: 316 Stainless steel.
4) Isolation Diaphragm: 316 Stainless steel.
a) Fill Fluid: Silicon.
5) Housing: Polyurethane-covered aluminum or cast aluminum.

f. Environment:
1) Ambient Temperature: -40 to 158 DEGF (-40 to 70 DEGC).
2) Humidity: Up to 99 PCT.
3) Process Temperature: -4 to 185 DEGF (-20 to 85 DEGC); depends on fill fluid.
4) Process Pressure: 0 to 35 PSIG.
5) Protection: Refer to Area Classification Drawings.

2.7 ACCESSORIES

A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.

1. Materials, shall be as follows:
   b. Mounting brackets:
      1) Standard: 316 Stainless steel.
      2) Corrosive areas: Aluminum.
   c. Mounting plates, angles:
      1) Standard: Carbon steel.
      2) Corrosive areas: Aluminum.
   d. Instrument pipe stands:
      2) Corrosive areas: Aluminum.

B. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install instrument mounting pipe stands level and plumb.
C. Keep foreign matter out of the system.

D. Plug all open ends and connections to keep out contaminants.

E. Threaded Connection Seals:
   1. Use Tite-Seal or acceptable alternate.
   2. Use of lead base pipe dope or Teflon tape is not acceptable.
   3. Do not apply Tite-Seal to tubing threads of compression fittings.

F. Temperature Elements:
   1. Assemble in the following sequence:
      a. Remove temperature sensor sheaths and terminal blocks from the head and nipple assembly.
      b. Connect nipple and head to thermowell installed in the pipe.
      c. Insert sheath and terminal block until it seats in the thermowell.
      d. Connect to the head.

G. Instrument Mounting:
   1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
   2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
   3. Mount instruments level, plumb, and support rigidly.
   4. Mount to provide:
      a. Protection from heat, shock, and vibrations.
      b. Accessibility for maintenance.
      c. Freedom from interference with piping, conduit and equipment.

3.2 TRAINING

A. Provide on-site training in accordance with Specification Section 01 75 00.

END OF SECTION
SECTION 40 94 43

PROGRAMMABLE LOGIC CONTROLLER (PLC) CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with the WWTP contractor.

B. Qualifications:

1. Installation supervisor shall have had experience in overseeing installation and startup of at least three (3) similar installations.

2. Programmer(s) shall have had experience in programming PLCs for at least two (2) projects of similar size and complexity.

3. Any remote monitoring and data communication between the digester PLC/HMI and the plant PLC/HMI as a result of execution of Specification Section 40 96 52 shall be accomplished through:

   Automatic System Company
   2740 Ford St
   Ames, IA
   515-232-4770

4. No other programming company will be considered.

5. This is not the responsibility of the ESAD contractor but it is expected that there will be some coordination between contractors to allow for transparent communication between systems.

1.3 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.

2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   b. Annotated hard copies of PLC software programs.

      1) Submit program for logic in ladder diagram format as used for the specific PLC system.

      2) Annotate program listing to include the following:

         a) Written description of each rung's function.

         b) Reference to control loop number for each rung where applicable.

         c) Reference to instrumentation tag number of I/O devices for each rung where applicable.

3. Provide written descriptions completely defining all function blocks used in program.

4. Provide list of all addresses referenced in logic diagram with description of data associated with each address.
c. Results of factory testing procedures.
d. Drawings containing the following information:
   1) Arrangement Drawings for PLC system components.
   2) Panel and enclosure plans, sections and details.
   3) Access opening locations and required clearances for each panel and enclosure.
   4) Enclosure internal wiring and terminal blocks.
e. Catalog cut sheets containing information on PLC components to be submitted as part
   of this Specification Section submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are
   acceptable. Except where specifically noted otherwise, or-equal manufacturers will be
   considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call
   out or-equal consideration is requested. See General Condition Article 7.04.
   1. Rockwell Automation, Allen-Bradley CompactLogix L3 Series.
   2. No “or-equal” or substitutions accepted.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. The PLC system shall accomplish the control requirements of the Contractor’s design.
B. PLC programming shall be documented and factory tested.
C. The PLC system shall operate in ambient conditions of 32 to 140 DEGF temperatures and 5 to
   95 PCT relative humidity without the need for purging or air conditioning.
D. Environmental Controls:
   1. Furnish circulation fans in solid state control system enclosures.
   2. Over-temperature switches shall be utilized to provide special cooling if required to
      maintain operating temperatures within the manufacturer's specified range.
   3. Air conditioning applications shall include means of preventing moisture condensation.
E. All PLC control system components shall be capable of meeting or exceeding electromagnetic
   interference tests per IEEE C37.90.2.
F. Incorporate the Following Minimum Safety Measures:
   1. Watchdog function to monitor:
      a. Internal processor clock failure.
      b. Processor memory failure.
      c. Loss of communication between processor and I/O modules.
      d. Processor ceases to execute logic program.
   2. Safety function wiring: Emergency shutdown switches shall not be wired into the
      controller.
   3. Safe wiring:
      a. Unless otherwise specified, activation of alarms and stopping of equipment shall result
         from the de-energization of control circuits, rather than the energization of control
         circuits.
      b. Low voltage control signal wires:
         1) Place in conduit segregated for that purpose only.
         2) Twisted shielded wire pair.
         3) Not located in the same conduit or bundle with power wiring.
   4. Initial safety conditions:
      a. Utilize program module to dictate output states in a known and safe manner prior to
         running of control program.
      b. Utilize program each time PLC is re-initiated and the control program activated.
5. Monitoring of internal faults and display:
   a. Internal PLC system status and faults shall be monitored and displayed.
      1) Monitored items shall include:
         a) Memory ok/loss of memory.
         b) Processor ok/processor fault.
         c) Scan time overrun.
   6. Control of programs: Protect access to PLC program loading with password protection or
      with locked, key operated selector switches.
   7. Design PLC system with high noise immunity to prevent occurrence of false logic signals
      resulting from switching transients, relay and circuit breaker noise or conducted and
      radiated radio frequency interference.
   8. Operator intervention:
      a. Logic system failure shall not preclude proper operator intervention.
      b. Safety shutdown of equipment or a system shall require manual operator intervention
         before the equipment or system operation may be reestablished.

2.3 COMPONENTS

A. PLC System Central Processor Unit (CPU):
   1. CPU shall provide communications with other control systems and man-machine interfaces
      as specified.
   2. Memory:
      a. Battery-backed RAM.
      b. EEPROM program back-up:
         1) Automatically download to RAM in the event RAM is corrupted.
   3. Memory battery backup shall be capable of 60 days memory retention with fresh battery.
      a. Provide visual indication of battery status and alarm low battery voltage.
      b. Memory battery backup shall be capable of 14 days memory retention after the "Battery
         Low" indicating LED is on.
   4. Plug-in card design to allow quick field replacement of faulty devices.
      a. Provide unit designed for field replacement and expansion of memory without requiring
         rewiring or use of special tools.
   5. 20 PCT minimum spare useable memory capacity after all required programming is in place
      and operating.
   6. Capable of executing all control functions required by the Specifications and Drawings.
      a. As directly selectable algorithms requiring no user knowledge of programming
         languages.
   8. On-line reconfigurable.
   9. Lighted status indicators for "RUN" and "FAILURE".
   10. Maximum scan times:
      a. Program scan: 5 mSec/K.
      b. I/O scan: 100 mSec.
   11. Capable of manual or automatic control mode transfer from the operating console stations or
      from within the control strategy.
      a. Transfer shall be bumpless and balanceless.

B. Input/output (I/O) Modules:
   1. Provide plug-in modular-type I/O racks with cables to connect to all other required PLC
      system components.
   2. Provide I/O system with:
      a. I/O solid state boards with status lights indicating I/O status.
      b. Electric isolation between logic and field device.
      c. Capability of withstanding low energy common mode transient to 1000 V without
         failure.
      d. Incorporate noise suppression design.
      e. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
f. Capable of being removed and inserted into the I/O rack under power, without affecting any other I/O modules in the rack.

g. Install 20 PCT spare I/O modules.

3. Input/output connection requirements:
   a. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the I/O enclosure.
   b. Prewire I/O modules to terminal blocks.
   c. Provide terminal blocks with continuous marking strip.
   d. Size terminals to accommodate all active data base points and spares.
   e. Provide terminals for individual termination of each signal shield.
   f. Field wiring shall not be disturbed when removing or replacing an I/O module.

4. Discrete I/O modules:
   a. Interface to ON/OFF devices.
   b. I/O status indicator on module front.
   c. Voltage rating to match circuit voltage.
   d. Output module current rating:
      1) Match maximum circuit current draw.
      2) Minimum 1.0 continuous A/point for 120 Vac applications.
   e. Isolated modules for applications where one (1) module interfaces with devices utilizing different sources of power.

5. Discrete outputs shall be fused:
   a. Provide one (1) fuse per common or per isolated output.
   b. Provide blown fuse indication.
   c. External fusing shall be provided if output module does not possess internal fusing.
   d. Fuses provided external to output model shall:
      1) Be in accordance with module manufacturer's specifications.
      2) Be installed at terminal block.

6. Provide surge suppressors directly across the coils of all inductive devices which are energized by PLC outputs.
   a. Install the surge suppressor at location of the inductive device.

7. Analog I/O modules:
   a. Input modules to accept signals indicated on Drawings or Specifications.
   b. Minimum 12 bit resolution.
   c. I/O chassis supplied power for powering connected field devices.
   d. Differential inputs and outputs.
   e. User configurable for desired fault-response state.
   f. Provide output signals as indicated on Drawings and Specifications.
   g. Individual D/A converter for each output module.
   h. Individual A/D converter for each input module.

C. Power Supply Units:
   1. Provide regulated power units:
      a. Designed to operate with PLC system and shall provide power to:
         1) All components of PLC system.
         2) All two-wire field instruments.
         3) Other devices as indicated on Drawings or Specifications.
      b. Capable of supplying PLC system when all of the specified spare capacity is utilized.
      c. Each power supply shall be sized such that it will carry no more than 75 PCT of capacity under normal loads.

   2. Electrical service to PLC system is 105 to 125 V, 60 Hz, +1 PCT, 1 PH power.

   3. Separate AC circuit breakers shall be provided for each power supply.

   4. If the PLC system is field expandable beyond the specified spare capacity, and if such expansion requires power supply modification, note such requirements in the submittals and allow room for power supply modification in the PLC system enclosure.

   5. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
6. Power distribution:
   a. Immune to transients and surges resultant from noisy environment.
   b. Shall provide constant voltage level DC distribution to all devices.

7. Provide uninterruptible power supply (UPS) to sustain full power to UPS powered loads listed below for a minimum of 15 minutes following loss of primary power and to ensure that the transient power surges and dips do not affect the operation of the PLC system.

UPS powered loads:
   1) All rack mounted PLC components.
   2) Local operator consoles.
   3) All power supplies furnished with the PLC and associated loads.

b. Input:
   1) 120 Vac +10 PCT.
   2) 60 Hz.
   3) Line fuse protection.

c. Output:
   1) 120 Vac (5 PCT.
   2) 60 Hz.
   3) Short circuit protected.
   4) Instantaneous transfer time.

d. UPS shall be a double conversion unit with alarming built in.
   1) Alarms:
      a) UPS fault.
      b) UPS Bypassed.
      c) On UPS power.

e. IEEE C62.41 Class A voltage surges of 6000 V attenuated to less than 50 V on the output.

f. Battery: Maintenance free lead acid.

D. PLC System Enclosure:

1. Component placement:
   a. Mount all controller components vertically within the enclosure to allow maximum convection cooling.
   b. Either install power supplies above all other equipment with at least 10 IN of clearance between the power supply and the enclosure top, or adjacent to other components, but with sufficient spacing for circulation of cooling air.
   c. Do not place I/O racks directly above the CPU or power supply.
   d. Locate incoming line devices (isolation or constant voltage transformers, local power disconnects, surge suppressors, etc.) so as to keep power wire runs within an enclosure as short as possible.
   e. If items such as magnetic starters, contactors, relays, and other electromagnetic devices must be located within the same enclosure as the PLC system components, place a barrier with at least 6 IN of separation between the magnetic area and the control area.
   f. Place circulating fans close to major heat generating devices.
   g. Segregate input/output modules into groups of identical type.

2. Termination requirements:
   a. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the enclosure.
   b. Prewire I/O modules to terminal blocks.
   c. Size terminals to accommodate all active database points and spares.
   d. Provide terminals for individual termination of each signal shield.
   e. Field wiring shall not be disturbed when removing or replacing an I/O module.

E. PLC System Software and Programming:

1. Provide all hardware and programming required to provide communication between the PLC and the man-machine interface.
2. Provide programming to accomplish all control and monitoring requirements of the Drawings and Specifications.
3. Provide two (2) copies of control logic program on CD.
4. IBM compatible software.
5. Full documentation capability.
   a. Provide description for each rung.
6. On/off line programming.
7. Offline simulation prior to download.
8. Two-step commands requiring operator verification prior to deletion of any programming.

2.4 ACCESSORIES
   A. Provide all accessories required to furnish a complete PLC control system to accomplish the requirements of the Drawings and Specifications.

2.5 MAINTENANCE MATERIALS
   A. Furnish Owner with the following extra materials:
      1. One (1) spare I/O card of each card type for every 10 cards or fraction thereof installed.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install PLC control system in accordance with manufacturer's written instructions.

3.2 DEMONSTRATION
   A. Demonstrate system in accordance with Specification Section 01 75 00.

END OF SECTION
SECTION 40 96 52
CONFIGURATION REQUIREMENTS: HUMAN MACHINE INTERFACE (HMI) AND REPORTS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Qualifications:
   1. Programmer(s) shall have had experience in software configuration and installation for at least two (2) projects of similar size and complexity.
   2. Coordinate all interfacing work with the WWTP contractor.
C. System Integrator shall use the plant standard and established color and display design scheme (based on Wonderware) for any new development so the new and old graphics are seamless.
D. Any new reports shall follow the same format as the existing.

1.3 DEFINITIONS
A. HMI: Human Machine Interface.
B. I/O: Input/Output.
C. OLE: Object Linking and Embedding, a document standard developed by Microsoft that enables the creation of an object with one application and the linking or embedding of the object in a second application.
D. OPC: "OLE for Process Control"; a software standard utilizing a client/server model that makes interoperability possible between automation/control applications and field systems/devices.
E. PC: Personal Computer.
F. PLC: Programmable Logic Controller.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that submitted products meet the requirements of the established standards of quality.
      b. Graphic screen displays; provide in actual colors utilized.
      c. Sample reports.

1.5 GENERAL FUNCTIONAL REQUIREMENTS
A. Available Process Values:
   1. All process alarm, equipment status, and process variable values shall be available at any HMI.
2. If communications to a particular I/O point has failed for any reason, then wherever that data is displayed, the software shall post a visual indication that the point is not valid.

B. Provide comprehensive on-line help for all development functions.

C. Manual Entry of Data:
   1. All PC-based HMIs must allow manual entry of surrogate data and other variables, which must then be available for display and use in reports.
      a. Operator-entered commands from any of the operator workstations must be logged by the computer servers.

D. System Failure:
   1. Failure of any PLC, remote I/O hardware, or network communication link must be individually alarmed at HMIs.
   2. Unless otherwise specified, each alarm must be specific to a single point of failure.

E. Software licensing shall allow all plant HMIs to be active simultaneously.

F. All process related functions, calculations, timers, and numeric manipulations, shall be accomplished in the PLC hardware and not in the HMI.
   1. The HMI shall function as a monitoring system, not as a process controller.
   2. The HMI shall transfer data to the PLC system and the PLC system shall perform all control algorithms.

1.6 SECURITY

A. Fully integrate security into the SCADA system to allow only users with appropriate security levels access to individual parts of the system.

PART 2 - PRODUCTS

2.1 SPECIFIC SOFTWARE FUNCTIONAL DESCRIPTIONS

A. Specific functional requirements for various software control blocks within the computer system are as follows.

B. Descriptions are general and are not intended to fully indicate the complete functionality of the system.
   1. Monitoring of process values:
      a. Process values derived from analog process variable signals must be historically archived.
         1) Store all historical data with time and date of occurrence.
         2) Make values available for use in reports.
         3) Assign high and low alarms to process values as defined below and otherwise deemed appropriate.
      b. Provide capability for Existing plant computer server(s) to retrieve real-time values from the PLC system at adjustable time periods.

C. Utilize graphic screen displays at the HMI(s) to provide monitoring and control functionality.
   1. Hierarchy of HMI screens is in descending order as follows:
      c. Pop-up/control screens.

D. HMI operator interface functionality shall include:
   1. Indication of process variables.
   2. Configuration of control loop parameters (e.g., setpoints, gains, etc.).
   3. Adjustment of controller output.
   4. Display of real time and historical process trends.
   5. Selector switch and pushbutton station controls.
7. Graphic representation of plant operations with interactive status and measurement symbols.
8. Annunciation.

E. Graphics:
1. Utilize dynamic variables with unique tags per graphic.
2. Dragging the mouse over designated process areas of screen shall allow the operator to select predetermined processes or equipment and drill down to site-specific detail screens.
3. Critical "overview" information such as tank levels, flows and pressures shall be indicated through data fields or animation effects such as level fills or color change.
4. All monitored and or controlled process equipment shall be animated or color-highlighted to indicate status changes.
   a. For example, a pump "running" condition shall be signified by the pump color changing to bright red.
5. Tank and vessel levels shall be indicated with a tabular data field and by graphic "fill" simulating a rising or falling level within the tank or vessel.
6. Provide the ability to "drill down" to detail screens or graphics.
   a. Clicking on a device or process area shall generate a detail graphic or pop-up window to access specific data or control functions.
   b. All operator adjustments (e.g., set point adjustment, mode selection) shall be accomplished via a pop-up display, and shall not be allowed on the process screen.
7. Standard symbol library:
   a. User defined.
   b. Must not require software programming.
8. Single keystroke access from graphic to group display or other custom graphic displays.
9. Capable of being edited by moving, copying, or grouping user defined areas of screen.
10. Utilize a navigation bar.
    a. Navigation bar utilized on every screen.
    b. Navigation bar to include navigation functions, active alarm notification, security functions, current date/time display, "PRINT SCREEN" pushbutton, and other functions as required and as agreed upon at the Screen Configuration Review Meetings.

F. Detail Display:
1. Provide separate display for each point.
   a. Representations of each analog and digital point shall be single user configured faceplate.
   b. Display shall include alphanumeric representations of all variables and parameters for single loops including but not limited to:
      1) Alarm points.
      2) Limits.
      3) Constants.
      4) Interconnections to other loops.
      5) Calculating functions.

G. Trend Displays:
1. Real time historical trend displays.
2. Real time on-line trend displays.
3. Capable of displaying multiple points per display.
4. Operator shall be able to select any desired sample time interval.
5. Provide flexibility and easy access to real time and historical trend information for any variable TAG defined within the SCADA application.
   a. As a minimum, provide the following:
      1) Provide capability for the user to define trend scenarios.
      2) Provide a button to open a dialog window to select multiple variable TAGS and save them as a trend scenario for future use.
H. PLC Hardware/HMI Status Screen:
   1. Provide a status screen to depict status conditions and diagnostic information for all major
      networked equipment.
   2. Depict communication status for all networked communicating devices, such as PLC
      processors, Ethernet switches, PCs, and radios.

I. Alarm Monitoring:
   1. Provide standard alarm screen functionality to ensure flexibility and quick access to live
      alarms, alarm history and alarm grouping parameters.
      a. As a minimum, include the following features and functionality:
         1) An Alarm Screen header bar to head all alarm pages and reside below the
            Navigation Bar.
         2) Buttons to dynamically switch between Alarm Summary and Alarm History.
         3) A menu to allow user to select and open historical alarm archives.
            a) Utilize a time-date stamp file structure.
         4) Pull-down menu bar to select operator configured alarm groups.
         5) Capability to sort alarms by priority and to define priority for all system alarms.
         6) Capability to filter or group alarms.
   2. Analog alarms:
      a. The SCADA software shall monitor analog and discrete variables and calculated
         conditions, and determine if the variable is in an alarm condition.
      b. For each Analog Tag, an alarm for each of the following conditions shall be assignable:
         1) Low-low.
         2) Low.
         3) High.
         4) High-high.
         5) Deviation low.
         6) Deviation high.
         7) Rate of change.
      c. Provide adjustable dead bands and delay timers for all analog alarms.
   3. Present alarms in order of:
      a. Priority.
      b. Time of occurrence.
      c. Non-acknowledged presented ahead of acknowledged.
   4. Utilize single keystroke or pushbutton to:
      a. Acknowledge alarms.
   5. Alarm list presented to operator shall include:
      a. Time of occurrence.
      b. Time of acknowledgement.
      c. Description.
      d. Acknowledgement status.
   6. Alarm list printed by either of the following:
      a. On command.
      b. Periodically.
   7. Audible alarming capability for user selected alarms.
   8. Control of programs:
      a. Protect access to configuration via password protection.

**PART 3 - EXECUTION**

3.1 CONFIGURATION REQUIREMENTS

A. Provide all programming and configuration required for all HMIs furnished under this Contract.
3.2 CONFIGURATION STANDARDS AND CONVENTIONS

A. Integrator shall use the existing "Software Configuration Standards and Conventions" Document already in place for the original plant HMI development. If new standards must be developed to cover unusual or new items, please follow the procedure listed below:

1. Submit for review and approval prior to commencing with software configuration.
2. Describe and define such items as:
   a. Proposed graphic display process colors/representations.
   c. Font type and size.
   d. Alarm handling conventions.
   e. Methods for navigation between displays.
   f. Address usage/naming conventions.
   g. Security setup.
3. Prior to submitting the initial draft document, the Contractor must meet with the Owner to review any of the Owner’s existing standards and conventions.
4. In addition to submitting the initial document for review, submit an updated version of the document as part of the Operation and Maintenance Manuals.
   a. Revise this document to include any additional standards that are established throughout the configuration process.

B. It is the intent of these Specifications to provide the end user with state-of-the-art functionality.

   1. Minimum standards are as follows:
      a. Depict the actual process equipment configuration as accurately as possible.

3.3 SCREEN CONFIGURATION REVIEW MEETINGS

A. Conduct a minimum of one configuration conference with the Owner to review and discuss system configuration programming and related topics.

1. The purpose of the conference will be to discuss, in detail, how each I/O point will be handled and the types, quantities, hierarchies, and functioning of display screens.
2. Review of the Owner’s existing systems, standards, conventions, file and tag naming requirements, font type and size requirements, and reporting requirements must be part of each conference.
3. Review the navigation bar to be utilized.
4. Conferences will be held in at a site designated by the Owner.
5. Each screen will be reviewed at each conference.
   a. If required, to review all screens, each conference will occur on multiple days.
6. Submit 10 color copies of printed screens via shop drawing submittal process 10 calendar days before each conference.
7. Bring equipment to project screens on wall or provide multiple monitors for viewing by attendees.

B. Proposed graphic screens and report formats must be reviewed with the Owner throughout the configuration process.

3.4 DEMONSTRATION

A. Demonstrate system in accordance with Specification Section 01 75 00.

END OF SECTION
DIVISION 43

PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Coordinate all mechanical seal systems specified to ensure pump and seal compatibility.

1.3 DEFINITIONS
A. The abbreviations used in this section are defined as follows:
   1. AOR: Allowable Operating Range.
   2. BEP: Best Efficiency Point.
   3. NPSH3: Net Positive Suction Head for 3 PCT head loss.
   4. POR: Preferred Operating Range.
   5. TDH: Total Dynamic Head.
   6. TEFC: Totally Enclosed Fan Cooled.
B. Pump Service Category: Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Performance data and curves with flow (GPM), head (FT), horsepower, hydraulic efficiency, rotating speed (rpm), AOR, BEP, POR, NPSH3.
   3. Certifications:
      a. Certified pump performance curves as described in the SOURCE QUALITY CONTROL Article.
      b. Verification of Primary and Secondary conditions in POR and AOR.
   4. Test reports:
      a. Factory hydrostatic test.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester -General Requirements.
C. Informational Submittals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester -General Requirements.
   2. Certifications:
      a. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.
1.5 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
1. Pumps:
   a. See individual pump Specification Sections.
2. Mechanical seals:
   a. Chesterton.
   b. John Crane.
   c. Garlock.
3. Seal water station:
   a. Chesterton.
   b. John Crane.
   c. AESSEAL.

2.2 CENTRIFUGAL PUMP DESIGN
A. Provide units with increasing head characteristics from the end run out portion of the curve to shut off condition.

2.3 ACCESSORIES
A. See Specification Section 01 61 03.
B. Each Unit:
1. Lifting eye bolts or lugs.
2. Plugged gage cock connection at suction and discharge nozzles.
3. Tapped and plugged openings for casing and bearing housing vents and drains.
4. Fittings for properly adding flushing lubricant.
5. Pressure relief fittings for grease lubrication.
C. Mechanical Seals:
1. Provide as specified in the narrow-scope pump sections.
2. Provide rotating balanced O-ring type.
3. Provide water lubrication - cooling.
4. Materials:
   a. Metal parts except springs: 316 stainless steel.
   b. Springs: Hastelloy C.
   c. Seal faces: Unfilled carbon graphite versus silica-free Grade 99.5 ceramic.
   d. Elastomers: Viton.
D. Seal Water Station:
1. Provide one (1) unit per pump with manual shut-off valve on all pumps with seals.
2. Features:
   a. Pressure regulating.
   b. Flow regulating.
   c. Cleanable flow tube(s) while in service.
   d. Hose barb connection.
   e. Liquid filled pressure gage.
3. Materials of construction:
   a. Flowmeter tubes: Polysulfone.
   b. Unit body: Polyoxymethylene.
PUMPING EQUIPMENT: BASIC REQUIREMENTS

4. Service:
   a. Temperatures up to 150 DEGF.
   b. Pressure up to 140 PSIG.
5. Connection:
   a. Hose barb threaded to pump.
   b. Hose barb to seal water unit.
   c. Reinforced polyurethane hose:
      1) Minimum size: 3/8 IN ID.
      2) Minimum pressure rating:
         a) At 180 DEGF: 115 PSI.
         b) At 73 DEGF: 200 PSI.
      3) Minimum wall thickness: 1/8 IN.
   d. Non-potable water to shut-off valve: See Section 40 05 00 with isolation ball valve.
6. Mounting:
   a. To pump or pipe flange with stainless steel bracket.
   b. Maximum distance from non-potable water to shut-off ball valve to seal water station and seal water station to pump seal, 2 FT each direction.

2.4 FABRICATION
   A. Pump Support:
      1. Design base to support weight of drive, shafting and pump.
      2. Comply with HI vibration limitations.
      3. Mount horizontal pump, motor and coupling on single piece drip lip type baseplate.
      4. Mount vertical pumps on single piece pedestal baseplate.
      5. Fabricate to withstand all operating loads transmitted from the pump and drive.

2.5 SOURCE QUALITY CONTROL
   A. Verification primary design condition in POR.
   B. Verification secondary design condition in AOR.
   C. Factory hydrostatic test all pumps at 150 PCT of shut-off head for a minimum of 5 minutes.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. See Specification Section 01 61 03.
   B. Floor or Pad-Mounted Units (Non-Submersible):
      1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
      2. Assure no unnecessary stresses are transmitted to equipment flanges.
      3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform gasket compression.
      4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.
      5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
      6. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
7. Assemble connecting piping with gaskets in place and minimum of four (4) bolts per joint installed and tightened.
   a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
   b. Realign as necessary, install flange bolts and make equipment connection.
8. Field paint units as defined in Specification Section 09 96 00.
9. Provide pressure gage, visible from grade or operating floor, on discharge of all pumps and on suction and discharge of all non-submersible units.

3.2 FIELD QUALITY CONTROL

A. Provide services of equipment manufacturer's field service representative(s) to:
   1. Inspect equipment covered by this Specification Section.
   2. Supervise pre-start adjustments and installation checks.
   3. Conduct initial start-up of equipment and perform operational checks.
   4. Instruct Owner's personnel for the specified minimum number of hours at jobsite per Specification Section 01 30 00 on operation and maintenance of each of following pumping equipment:
      a. Section 43 21 01 - Pumping Equipment: Seal Water System; 8 HRS.
      b. Section 43 23 20 - Pumping Equipment: End Suction Centrifugal Pumps, 8 HRS.
      c. Section 43 23 57 - Pumping Equipment: Progressive Cavity, 8 HRS.
      d. Section 43 25 51 - Pumping Equipment: Helical Screw Centrifugal Non-Clog Pumps, 8 HRS.

END OF SECTION
SECTION 43 21 01
PUMPS: WATER SEAL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Furnish specific electrical ladder or elementary wiring diagrams verifying interlock arrangements between water seal pumps, individual water seal valves, and pump motors.
      c. Furnish water system isometric drawing acknowledging valves, piping, equipment, and related work.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   1. Feed pumps:
      b. Aurora Pump.

2.2 MANUFACTURED UNITS
A. Water Seal System (65ESAD-T02, 65ESAD-CV11, 65ESAD-NPWP03, and 65ESAD NPWP04):
   1. Integrated operating system designed by Contractor.
   2. Single source coordination responsibility through the pump manufacturer.
3. System to include but not necessarily be limited to:
   a. Water seal pumps.
   b. Tank.
   c. Level control and valves.
   d. Intake and discharge piping, valves and appurtenances.

B. Performance and Configuration Requirements:
   1. NPW Seal Water System Pumps 65ESAD-NPWP03 & 65ESAD-NPWP04.
      a. Provide pad-mounted centrifugal pumps.
      b. Each pump capable of providing seal water to all equipment requiring this utility.

C. Pump Construction:
   1. Casing:
      a. Furnish pump constructed of cast iron.
      b. Design casing with tapped and plugged holes:
         1) Priming.
         2) Vent.
         3) Drain.
   2. Impeller:
      a. Bronze single suction-type enclosed impeller.
      b. Statically and dynamically balanced.
      c. Accurately machined and assembled.
      d. Ensure vibration limit prescribed by HI.
   3. Seal:
      a. Mechanical shaft seals:
         1) Carbon steel rings and ceramic seats.
         2) Ensure positive method of lubricating seal faces by pumped liquid.

D. Water Seal Equipment:
   1. Tank:
      a. Open-topped nominal HDPE tank sized for application.
      b. Equip with overflow, suction tap and bottom valved drain sized for application.
   2. Level Control and Valves:
      a. Furnish with integrally mounted float-type non-modulating, two (2) position open-close control.

E. Provide piping connections and valves in accordance with PID.

F. Miscellaneous Hardware and Spare Parts:
   1. Machine bolts, nuts, and cap screws of high strength application with hex heads.
      a. Do not use hardware requiring special tools or wrenches.
   2. Provide spare parts for each pump as follows:
      a. Two (2) sets of shaft sleeves.
      b. Two (2) sets of bearings.
      c. Two (2) sets of gaskets.
      d. Three (3) sets of packing or one (1) mechanical seal.

2.3 COATINGS
   A. Provide manufacturer’s standard factory applied prime and finish coatings rated for wet and corrosive area to all equipment.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. See Section 43 21 00.
3.2 COATINGS

A. Field paint all piping, valves and appurtenances in accordance with Specification Section 09 96 00.

3.3 FIELD QUALITY CONTROL

A. See Section 43 21 00.

END OF SECTION
SECTION 43 23 20

PUMPING EQUIPMENT: END SUCTION CENTRIFUGAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.

B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE

A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

   1. End-suction centrifugal pumps:
      a. Fairbanks-Morse.
      b. Aurora.
      c. Worthington.

2.2 MATERIALS

A. Hot Water Pumps (65ESAD-HWP03, 65ESAD-HWP04):
   1. Pump Volute: Cast iron, ASTM A48, Class 30 (minimum).
   4. Impellers: Bronze, ASTM B584 (836), 304 SS, or 316 SS.
   7. Shaft Sleeve: Bronze, ASTM B584 (831) or 316 SS.
   8. Mechanical Seal: See Section 43 21 00 Pumping Equipment Basic Requirements.
2.3 EQUIPMENT

A. Performance and Configuration Requirements:
   1. Design parameters per Contractor.
   2. Maximum pump speed: 1800 RPM.
   3. Drive type: Constant speed.
   4. Drive configuration: Flexible coupled.

2.4 ACCESSORIES

A. See Specification Section 43 21 00.

2.5 FABRICATION

A. General:
   1. Pump casing strength to withstand 150 PCT of shutoff head.
   2. Single end suction suction type pump fabrication.
   3. Fabricate casing for impeller removal without disturbing suction and discharge piping,
      beyond piping disassembly/mechanical couplings.
   4. Tap and plug openings for minimum 1/2-IN IPS suction and discharge gage connections.
      a. Tap in discharge nozzle shall serve as a vent when gage is not used.

B. Frame:
   1. Flexible coupled frame mounted pump and motor are to be mounted on a single base plate.

C. Shaft:
   1. Pumps shall have shaft design of 0.002 IN deflection at the seal face with the pump running
      under maximum load condition with no leakage. Alignment shall be checked with
      Hydraulic Institute Standards to ensure no strain is transmitted from the shaft to the pump.

D. Suction and Discharge:
   1. ANSI Class 150, 125 LBS rated flanged nozzles for suction and discharge.

E. Furnish anti-friction type bearings rated for minimum ABMA L-10 life of 20,000 HRS at 24 HR
   continuous operation per ABMA.

F. Provide oil or grease lubrication.

G. Mechanical seals.

H. Furnish rigid, one piece cast bearing housing with catch reservoir.

I. Provide pump case with case rings at impeller skirt.
   1. Lock ring in place with pin.

J. Statically and dynamically balance impellers per Hydraulic Institute Standards.

2.6 MAINTENANCE MATERIALS

A. Extra Materials:
   1. Furnish Owner the Following Extra Parts for each Pump:
      a. Shaft sleeve: One (1) each.
      b. Bearing sets: One (1) set.
      c. Full gasket kits: One (1) set.
      d. Mechanical seals: One (1) set.

2.7 COATINGS

A. Provide manufacturer’s standard factory applied prime and finish coatings rated for wet and
   corrosive area.
B. Provide manufacturer’s standard factory applied prime and finish coatings rated for wet and corrosive area.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 43 21 00.

3.2 FIELD QUALITY CONTROL

A. See Specification Section 43 21 00.

END OF SECTION
SECTION 43 23 57
PUMPING EQUIPMENT: PROGRESSIVE CAVITY

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes products, materials and execution requirements to establish a minimum
      standard of quality for the design and construction of the work.
   B. Not all requirements presented in this specification may be applicable to the Contractor’s final
      design. If applicable to the final design elements, incorporate the applicable standard of quality
      requirements provided in this specification.

1.2 QUALITY ASSURANCE
   A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
   A. Shop Drawings:
      1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General
         Requirements.
      2. Product Technical data including:
         a. Acknowledgement that products submitted meet requirements of the established
            standards of quality.
      3. Source quality control test reports.
   B. Operation and Maintenance Manuals:
      1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General
         Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
   A. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
   A. Subject to compliance with the Contract Documents, the following manufacturers are
      acceptable. Except where specifically noted otherwise, or-equal manufacturers will be
      considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call
      out or-equal consideration is requested. See General Condition Article 7.04.
      1. Progressive cavity pumps:
         a. Moyno.
         b. Netzsch.
         c. Seepex.

2.2 MATERIALS
   A. Sludge Transfer Pump (65ESAD-TP02):
      1. Pump body: Cast iron, ASTM A48 Class 35.
      2. Rotor: AISI 4150 steel with chrome plating.
      3. Stator: Buna-N or nitrile rubber.
      5. Stuffing box gland: Ductile iron.
2.3 EQUIPMENT
A. Performance and Configuration Requirements:
   1. Maximum speed: 200 RPM.
   2. Drive configuration: Direct coupled.
   3. Maximum pressure per stage: 40 PSI.

2.4 ACCESSORIES
A. See Section 43 21 00.

2.5 FABRICATION
A. Pump Body:
   1. Provide body containing two (2) inspection ports 180 degrees apart.
   2. Cradle mount pump to permit suction port to be rotated at 90 degree increments
      perpendicular to pump centerline.
B. Rotor: Harden to minimum Rockwell C-57.
C. Stator:
   1. Construct by bonding rubber-type material to inside of a steel tube.
   2. Minimum 65 durometer hardness (Shore A).
D. Drive Train:
   1. Include crown gear-type or pin-type universal joints, seals, connecting rod, driveshaft, and
      shaft bearings.
   2. Connect rotor drive shaft by a connecting rod equipped with two (2) crowned gear-type or
      pin-type factory grease lubricated and positively sealed universal joints.
      a. Joint unconditionally guaranteed by manufacturer to meet 10,000 HR operation at the
         required performance conditions.
   3. Use universal joints to transmit thrust and torque while allowing the rotor to move through
      an eccentric path.
   4. Joint shall be positively sealed and encased in a series 300 stainless steel cover to protect it
      from tramp metal and glass.
   5. Mount drive shaft in two (2) ball or tapered roller bearings.
   6. Bearing ABMA L-10 life: 50,000 HRS at design operating conditions specified.
   7. Provide fittings for grease or oil lubrication of bearings.
   8. Stuffing box:
      a. Design for either grease lubrication or water seal.
      b. Permit gland adjustment and repacking without dismantling pump.
E. Suction and Discharge: Provide ANSI, Class 150 LB rated flanged.
F. Base Plate: Provide common base plate for pump, drive and motor.

2.6 SOURCE QUALITY CONTROL
A. Testing:
   1. Perform Level I test for each pump as defined by HI standards to assure conformance to
      manufacturer's commercial performance criteria.
   2. Perform hydrostatic test for each pump in compliance with HI standards.
   3. Perform required net inlet pressure test as defined by HI standards to verify compliance with
      specified performance criteria for the specified viscosity and pump speed.
      a. For variable speed pumps, perform tests for the maximum, minimum, and three (3)
         intermediate speeds equally spaced between the maximum and minimum.

2.7 MAINTENANCE MATERIALS
A. Furnish Owner the following extra parts for each pump category:
   1. One (1) shaft sleeve.
   2. One (1) rotor.
3. One (1) stator.
4. One (1) connecting rod with bushings.
5. One (1) set of connecting rod joint assemblies.

2.8 COATINGS
1. Provide manufacturer’s standard factory applied prime and finish coatings rated for wet and corrosive area.

PART 3 - EXECUTION
3.1 INSTALLATION
A. See Section 43 21 00.

3.2 FIELD QUALITY CONTROL
A. See Section 43 21 00.

END OF SECTION
SECTION 43 25 51
PUMPING EQUIPMENT: HELICAL SCREW CENTRIFUGAL NON-CLOG

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this Specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Manufacturer must have a minimum of 5 years experience manufacturing pumps for similar applications.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Source quality control test reports.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester -General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.
   1. Helical Screw Centrifugal Non-Clog Pumps:
      a. WEMCO.
      b. Hidrostal.

2.2 MATERIALS
A. Recirculation Pumps (65ESAD-RP03, 65ESAD-RP04):
   4. Shaft:
      a. Stainless steel, ANSI, Series 300 or 400.
b. Carbon steel C1035 is acceptable if not contacting pumped fluid.

5. Wear rings: Corrosion and wear resistant materials.
6. O-rings: Nitrile (Buna-N) or fluorocarbon (Viton).
8. Lower ring seal: Tungsten-carbide or Silicon-carbide both faces.
9. Upper ring seal: Tungsten-carbide or Silicon-carbide both faces.
10. Seal metal parts: Stainless steel.

2.3 EQUIPMENT

A. Performance and Configuration Requirements (65ESAD-RP03 and 65ESAD-RP04):
   1. Design parameters per Contractor.
   2. Maximum pump speed: 1250 RPM.
   a. Drive configuration: V-belt drive.
   b. Minimum solids passage: 3 IN.

2.4 COMPONENTS

A. General:
   1. Provide pumps capable of handling digester sludge.
   2. Where watertight sealing is required, precision machined and fitted mating surfaces with O-rings.
   3. Provide with heavy duty lift lugs or hoisting bail designed for lifting the entire pump and motor assembly.

B. Impeller:
   1. Single passage clog free screw centrifugal non-clog-type dynamically balanced impeller in accordance with HI standards.
   2. Impeller flange or impeller shall contain a spiral groove on the rear face so that any solids in the pumped media are discharged from the space between the backplate and the rear of the impeller.

C. Shaft:
   1. Design pump shaft of sufficient size to transmit full driver output.
   2. Use shaft which is accurately machined and constructed with sufficient materials.
   3. Design shaft for a maximum deflection of 0.002 IN measured at the stuffing box.

D. Shaft Seal:
   1. Seal shaft with two independent, tandem mounted seals running in an oil filled chamber.
   2. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced.
   3. Hold interface in contact by its own spring system.

E. Bearings:
   1. Support shaft on upper and lower permanently lubricated bearings with a minimum ABMA L-10 life of:
      a. P01-05 and P01-06: 100,000 HRS.
      b. P2-80 and P2-81: 50,000 HRS.

F. Motors:
   1. Squirrel-cage induction motor suitable for 460 Vac, 3-phase power.
   2. NEMA B design.
   3. Stator windings insulated with moisture resistant Class H insulation rated for 180 DEGC, with Class F insulation for slot and phase laminations.
   4. Motor shall be designed for continuous duty handling pumped media of 105 DEGF and capable of no less than 10 evenly spaced starts per hour.
   5. Thermal temperature switches embedded for motor winding temperatures. Assure motor is capable of running dry for extended periods without damage to motor or seal, 30 minutes.
6. The motor horsepower provided shall be adequate for all points on the pump curve and non-overloading throughout the curve.

G. Integrally Mounted Pump Sensors:
1. Thermal switches (3 in series) or thermistors for stator temperature monitoring.
2. Pt100 sensor for temperature measurement in the stator windings (3 sensors).
3. Pt100 sensor for main bearing temperature.
4. Pt100 sensor for support bearing temperature.
5. Leakage sensor in the stator housing.
6. Leakage sensor in the oil fill between seals.

H. Dry Pit Applications:
1. Provide a fabricated heavy duty support stand designed for the pump furnished. Provide stand with openings sized to allow: Access for dismantling and easy access to fastening hardware.
2. Provide ANSI 125 LB pump suction and discharge flanges.

2.5 ACCESSORIES
A. See Specification Section 43 21 00.

2.6 SOURCE QUALITY CONTROL
A. Secure from the pump manufacturer the following inspections and tests on each pump before shipment from factory:
   1. Check impeller, motor rating and electrical connections for compliance with this Specification Section.
B. Factory test of head (FT) versus flow (GPM) for one pump of each service category as specified in Specification Section 43 21 00.

2.7 COATINGS
A. Provide manufacturer’s standard factory applied prime and finish coatings rated for wet and corrosive area.

PART 3 - EXECUTION

3.1 INSTALLATION
A. See Specification Section 43 21 00.

3.2 FIELD QUALITY CONTROL
A. See Specification Section 43 21 00.

END OF SECTION
SECTION 46 73 26
EGG SHAPED ANAEROBIC DIGESTER

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. The multi-discipline Engineering and Architectural Design, materials and equipment
      procurement, construction, startup and demonstration of Egg Shaped Digester (ESAD) No. 2.
   2. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Welding procedures, welders and welding operators shall be qualified and certified in
   accordance with the requirements of the ASME Code, Section IX.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established
         standards of quality.
B. Informational Submittals:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester-General Requirements.
   2. Welder qualifications and welding procedures.
   3. Hydro-pneumatic testing procedures and testing results.
   4. Start up and commissioning documentation.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN REQUIREMENTS
A. Tank shape, except for the gas dome and other connections, shall be free of discontinuities or
   abrupt changes in cross section, and shall consist of cone and double curved surfaces.
B. Design, fabricate, erect, inspect and test tank in accordance with API Standard 620,
   "Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage
   1. Comply with the recommendations of Appendix D of API 620, "Suggested Good Practice
      Regarding Supporting Structures."
C. Material selection shall comply with the rules of API 620.
D. Provide steel tank, shell and parts with a minimum thickness of 1/4 IN, including 1/16 IN
   corrosion allowance.
   1. No corrosion allowance is required for the ESAD vessel support skirt.
2.2 DESIGN CRITERIA

A. ESAD No. 2 Operating Conditions:
   1. ESAD No. 2 will be operated in parallel to the existing ESAD.
   2. Feed will be split approximately evenly between the two digesters.

B. Sludge and Gas Characteristics and Tank Feed Temperatures for existing ESAD and proposed ESAD (total):

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<th>CURRENT</th>
<th>FUTURE</th>
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<td>Carbon Dioxide (CO₂):</td>
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C. ESAD No. 2 Physical Configuration, Structural and Mechanical Design:

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<td>Seismic Use Group</td>
<td>Risk Category III</td>
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<td>Soil Classification</td>
<td>Site Class D</td>
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<td>Seismic Coefficient Ss</td>
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<td>Ground Snow Load, PSF</td>
<td>25, Exposure Factor 1.0</td>
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<tr>
<td>Stairway Live Load, PSF</td>
<td>100, Importance Factor 1.1</td>
</tr>
</tbody>
</table>
2.3 FABRICATION

A. Fabricate tank with pressed double curvature plates free of abrupt changes in the meridional profile.

B. Fabrication techniques which do not provide a uniform plate curvature or which create butt joint misalignment are not allowed.

C. Thickness of the shell pressure boundary: Minimum 1/4 IN except the lower cylinder bottom plate which is a minimum 3/8 IN thick.

D. Bridge and other structural components: Minimum 3/16 IN thick.

E. Cylindrical Gas Dome:
   1. Approximate 12 FT DIA x 6 FT-6 IN high, welded to the top conical section of the digester.
   2. Stiffened to allow the top plate surface to serve as an operating platform.
   3. Handrail per OSHA requirements.

F. Support Skirt:
   1. Welded to the digester vessel and constructed with a compression ring, base plate and anchor bolts for connection to the concrete ring wall foundation.
   2. Install the anchor bolts on the interior of the skirt.

G. Mixing System:
   1. Utilize vertical draft tube system within the tank with pumped flow from Recirculation pump.
   2. Equip with jet pump nozzle located at the bottom and the top of draft tube.
   3. Designed to provide 4-6 vessel turnovers per day.
   4. No moving parts allowed inside the digester tank.
   5. Utilize 316 stainless steel support and anchorage components for draft tube stability.
   6. Provide hardened jet nozzle at the top and bottom of each the draft tube.
      a. Furnish a deflector cone around the bottom draft tube jet nozzle.

H. Foam Suppression System:
   1. Design system to utilize recirculated sludge flow to act as scum suppression.
   2. Provide hardened jet nozzle above high liquid level.
   3. Size nozzle to provide a minimum of 500 GPM of recirculated sludge for every 255 FT² of surface area at the operating level of the digester.
   4. Design scum suppression system that it is capable of being operated independently from the draft tube mixing system.
   5. Utilize 316 stainless steel support and anchorage components for system support and stability.

I. Internal Sludge Discharge System:
   1. Designed to assure digester operates at a constant liquid level.
   2. Utilize standpipe design with top flare section.
   3. Equip with positive method of flushing standpipe from the operating platform of the digester.
J. Interconnecting Walkway with Sludge/Gas Holding Tank:
1. See Specification Section 01 30 05 for required structural analysis related to support of
   interconnecting walkway.
2. Furnish connecting bridge from the top of ESAD No. 2 to the top of the existing Sludge/Gas
   Holding Tank.
3. All external piping must be supported independently of the tank to prevent the transfer of
   piping external loads to the tank shell or nozzles.

2.4 APPURTENANCES

A. Gas Dome Appurtenances:
1. One, minimum 24 IN DIA manhole
2. One, minimum 12 IN DIA non-sparking viewport with double squeegee type glass wiper
   and cover plate.
3. Two combination pressure and vacuum relief valves with flame arrestors and dedicated
   isolation plug valves.
   a. Size such that one valve is a one hundred percent backup for the first valve.
   b. Use of a biogas 3-Way safety selector valve is acceptable

B. Nozzles:
1. Provide integral nozzles on tank for all process and instrument tank connections.
2. Same material as tank shell.

C. Access Manhole:
1. Provide one minimum 30 IN DIA access manhole located as low as possible in the bottom
   cone.
2. Locate to avoid interference with piping and equipment.
3. Include a cover plate, bolt, gasket set and security chain to pin the cover plate in the open
   position.

2.5 TANK INSULATION

A. System Description:
1. Provide tank insulation system consisting of surface preparation and prime paint applied to
   the steel shell, urethane foam, and protective coatings.
   a. Refer to Specification Section 09 96 00 for surface preparation and prime paint.

B. Materials:
1. Furnish closed cell spray applied urethane foam to thickness as required by Contractor’s
   specific heat loss calculations.
   a. Provide foam complying with the following requirements:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum density, ASTM D1622</td>
<td>2.4 – 3.2 LBS/FT³</td>
</tr>
<tr>
<td>Maximum thermal conductivity, per ASTM C518</td>
<td>R-Value (aged) minimum 6.00 per IN.</td>
</tr>
<tr>
<td>Minimum closed cell content</td>
<td>90 PCT</td>
</tr>
<tr>
<td>Minimum compressive strength, per ASTM D1621</td>
<td>45 PSI</td>
</tr>
<tr>
<td>Minimum tensile strength, per ASTM D1623</td>
<td>65 PSI</td>
</tr>
<tr>
<td>Maximum water vapor permeability, per ASTM E96</td>
<td>1 IN thickness @ 74 DEGF = 1.82</td>
</tr>
</tbody>
</table>

2. Protect the foam insulation above the support skirt intersection with vessel shell that is
   exposed to the weather with a weather barrier coating designed for application over urethane
   foam to provide protection from ultraviolet light degradation, moisture and weather erosion.
   a. Furnish a permanently elastic material that is not susceptible to age hardening or
      cracking and it shall possess good adhesion to polyurethane foam.
3. Protect the foam insulation below the support skirt intersection with vessel shell with a coating specifically developed as an ignition and thermal barrier for protecting foam plastic insulation.
   a. Furnish coating providing a 15 minute fire rating based on NFPA 286 testing and be an IBC code compliant thermal barrier.
   b. Coating requirements:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Off-white</td>
</tr>
<tr>
<td>Recommended thickness</td>
<td>14 MILS dry film thickness (DFT)</td>
</tr>
<tr>
<td>Nominal Coverage Rate</td>
<td>76 FT² per GAL at 14 MILS DFT</td>
</tr>
</tbody>
</table>

4. The exterior of the steel support skirt shall be insulated with metal panel insulation.
5. Insulation is required on the gas dome.

2.6 SUPPORT SKIRT INSULATION

A. Insulate the exterior of the tank support skirt with a metal panel system using Owner selected panel color.

B. Provide foam backed vertical standing seam aluminum panel insulation.
   1. Utilize polyisocyanurate foam, laminated to the metal panels with a non-flammable contact adhesive, with a foil vapor barrier on both sides.
   2. Fabricate the metal panels of 0.024 IN thick embossed aluminum, 24 IN wide.

C. Design panels to attach circumferentially to skirt on approximately 3 FT vertical centers with 1/4 IN DIA steel cables.
   1. Tension the cables with turnbuckles.

D. Attach panels to cables with straps so that straps are entrapped in panel seams by seam folding machine.

E. Seal top edge of panels with a rolled aluminum angle or under the skirt compression ring.

PART 3 - EXECUTION

3.1 WELDING AND ERECTION

A. Prepare edges or surfaces of the pieces to be joined by welding by flame cutting, plasma arc cutting, arc gouging, machining, shearing, grinding or chipping. Clean materials of detrimental oil, grease, scale and rust.
   1. The edges of the pieces may have a protective coating applied to them, which need not be removed before they are welded unless specifically prohibited by applicable standards.

B. Provide Contractor’s welding procedures that are appropriate for ESAD construction. Provide evidence welding procedures for this ESAD were successfully used on two previous similar ESADs.

C. Misalignment of butt joints associated with the tank shall not exceed the tolerances as outlined by API 620.

D. Flat spots in a vertical plane shall not exceed the plate flatness and waviness requirements of Paragraph 6.5.2.2 of the API code.

E. Remove weld spatter, burrs and slag by chipping, grinding or brushing.

F. Utilize full penetration welds at all vessel boundary butt welds.

G. All attachment welds shall be full length welds or seal welds to eliminate any unwelded joined surfaces.
3.2 COATINGS

A. Field paint exterior tank surfaces not receiving insulation and protective coating.
   1. See Specification Section 09 96 00 - High performance Industrial Coatings.

3.3 INSPECTION

A. In addition to inspection services undertaken by the Contractor, the Owner will hire an independent testing agency for inspection services.
   1. Inspection of welds for all vessels shall be in accordance with the applicable codes.
   2. All butt welds will be visually inspected as a minimum.

3.4 TESTING

A. At the end of tank erection and prior to painting or installing insulation, perform hydro pneumatic testing in accordance API Standard.
   1. Provide written hydro pneumatic test procedure.
   2. Furnish test blinds for all nozzles.
   3. Supervise testing and provide documentation of test results.
   4. Provide temporary pumping system to fill digester with plant effluent for testing.
      a. All costs for testing, including temporary pumping system, shall be paid by Contractor.
      b. Owner will provide water for testing and provide for water disposal.
   5. Initial filling sequence shall be in accordance with the recommendations from the Geotechnical Report.
   6. Fill tank with water to the highest operating level.
   7. Pressurize the vapor space above the liquid level to 80 PCT of the relief valve set point.
      a. All seams above the liquid level shall then be checked for leaks using a soap solution.
   8. Repair any leaks detected and re-test.

3.5 START UP AND COMMISSIONING

A. Start up and commissioning of the ESAD and all associated equipment and systems shall conform to Specification Section 01 75 00 – Facility Start-Up.

B. System Purge:
   1. Purge all digester gas piping, digester gas safety equipment, digester gas handling equipment, digester gas combustion equipment, digester gas storage equipment and the headspace within the ESAD.
      a. Use nitrogen or carbon dioxide gas.
      b. Conform to NFPA 54, Part 4, Section 4.3.
   2. Provide all materials, inert gas, and labor for purging.
   3. Place into operation or valve off to prevent entrance of air to the system after completion of purging.

C. Contractor’s authorized equipment manufacturer's field service representative(s) working in conjunction with the commissioning expert defined in the following Paragraph D shall:
   1. Inspect equipment to be installed by these Specifications.
   2. Supervise adjustments, perform modifications as necessary.
   3. Conduct start-up of equipment and perform operational checks.
   4. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for commissioning.

D. Contractor shall employ a startup and commissioning expert with a minimum of 15 (fifteen) years of experience in starting similar ESADs to provide start up assistance for a period of two weeks. During this time, the commissioning expert will assist the Owner and the Engineer in starting up ESAD systems and training of the Owner’s staff for operation and maintenance operations.

END OF SECTION
SECTION 46 73 35
DIGESTER GAS EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.

1.3 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. Calibration constants and pressure settings for devices requiring settings.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with the Contract Documents, the following manufacturers listed in subsequent sections of this specification are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

2.2 AUTOMATICALLY OPERATED DRIP TRAPS
A. Acceptable Manufacturer: Varec Series 246AT.
B. Fabrication:
   1. Automatically operated drip traps 1 IN NPT inlet and outlet connection and a 6 quart storage capacity.
   2. Rotating disc type drip traps with an air inlet port to permit free flow of condensate from bowl when draining.
   3. Gas cannot exit while draining or revolving operating handle.
   4. Cast aluminum unit with stainless steel shaft and springs.
   5. Time controlled electric actuator.
   6. Provide selector switch for “auto” or “hand” operation.
7. Working pressure: 5 PSIG.
8. Pipe discharge from trap to nearest equipment or floor drain.

2.3 ACCUMULATORS

A. Acceptable Manufacturer:
   1. Varec Series 233 Condensate and Drip Trap.

B. Fabrication:
   1. Unit constructed from fabricated steel with flanged end connections.
      a. Minimum storage capacity: 6 GAL of sediment and 6 GAL of condensate.
      b. Tangential inlet nozzle to cause a circular motion of gas entering accumulator.
   2. Piping connections shown on Drawings.
   3. 1 IN NPT blowout connection, 1 IN NPT drip trap connection, and 3/8 IN NPT connections
      for sight glass.
      a. 1/2 IN Pyrex glass tube sight glass with two (2) isolating valves to permit cleaning.
      b. Guard rods to protect glass tube and drain cock on lower valve.
   4. Removable top cover for interior access and an inspection pipe for content level
      measurements.

2.4 COMBINATION PRESSURE/VACUUM RELIEF VALVE AND FLAME ARRESTOR

A. Acceptable Manufacturer: Varec Series 5811B.

B. Design and Fabrication:
   1. Materials:
      a. Low copper cast aluminum valve body and stainless steel trim.
      b. Low copper cast aluminum flame arrestor housing with low copper aluminum
         extensible bank assembly flame and stainless steel sheets.
   2. Provide all-weather type unit.
   3. Pressure relief lead pallet weights for adjustment in increments of 1/4 IN water column.
   4. ASME B16.1, Class 125 FF flanged connections.
   5. Insulating jackets:
      a. Provide each assembly with insulated jacket to prevent freezing
      b. Suitable for a temperature range of -40 to 220 DEGF.
      c. Insulated jacket constructed with silicone impregnated woven glass cloth lining with a
         1 IN thick, 6 LB density fiber glass insulating material.
      d. Jacket to provide firm support to insulation preventing from shifting.
      e. Insulated jacket designed to provide uniform heat retention.

2.5 MANOMETERS

A. Fabrication:
   1. U-tube type manometers calibrated to read in inches and tenths of water column.
   2. Units with heavy wall annealed glass U-tube protected on three (3) sides by rigid steel
      channel body.
   3. Red mineral oil indicating fluid.
      a. Fluid specific gravity of 1.0 compared with water.
   4. Large bore U-tubes allowing for an essentially flat meniscus regardless of indicating fluid
      used.
      a. Easy removal of U-tube for cleaning or replacement without disturbing piping.
   5. Mount manometers on common stainless steel panel designed for wall mounting with edges
      extending to wall.
      a. Panel:
         1) Minimum 10 GA, Type 304 stainless steel.
         2) Stainless steel attachment hardware.
         3) Mount stainless steel isolation valves on panel and common atmospheric vent.
2.6 COATINGS

A. Provide all equipment with manufacturer’s standard factory applied prime and finish coatings rated for wet and corrosive area.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Insulate sludge and gas piping which is exposed to ambient conditions below 40 DEGF.
   1. Use minimum 2 IN thick insulation with aluminum jacket in compliance with Specification Section 40 42 00.

END OF SECTION
SECTION 46 73 41
DIGESTER - BOILER AND HEAT EXCHANGER

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes products, materials and execution requirements to establish a minimum standard of quality for the design and construction of the work.
B. Not all requirements presented in this specification may be applicable to the Contractor’s final design. If applicable to the final design elements, incorporate the applicable standard of quality requirements provided in this specification.

1.2 QUALITY ASSURANCE
A. Coordination: Coordinate all interfacing work with WWTP contractor.
B. Qualifications:
   1. The boiler model provided shall have a minimum of 5 successful installations at other wastewater treatment plants.
C. Boiler and heat exchanger shall be inspected, stamped and registered with ASME by an inspector holding a valid National Board Commission.

1.3 SYSTEM DESCRIPTION
A. Provide completely operable sludge heating system including but not limited to boilers, sludge heat exchanger, water circulation pumps with piping, valves and ancillary equipment including system controls with general arrangement as shown on Drawings.

1.4 SUBMITTALS
A. Shop Drawings:
   1. See Specification Section 01 30 05 - Egg Shaped Anaerobic Digester - General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
   3. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of the established standards of quality.
      b. General Product data, dimensions, weight, and operational requirements and settings.
      c. Manufacturer's installation instructions.
   4. Certification that boiler and heat exchanger were inspected, stamped, and registered with ASME.
B. Operation and Maintenance Manuals:
   1. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.

1.5 PRODUCTS DELIVERY, STORAGE, AND HANDLING
A. See Specification Section 01 30 05 - Egg Shaped Digester - General Requirements.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable. Except where specifically noted otherwise, or-equal manufacturers will be considered by the Engineer for approval if Contractor submits Shop Drawings which clearly call out or-equal consideration is requested. See General Condition Article 7.04.

1. Boiler and Heat Exchanger:
   a. Envirex.
   c. Hurst.
   d. Cleaver Brooks.

2.2 MATERIALS

A. Boilers:
   1. Fire tubes:
      a. No. 13 GA steel boiler tubing.
      b. Minimum wall: 0.095 IN.
   2. Tube sheets:
      a. Steel.
      b. Minimum thickness: 0.375 IN.
   3. Furnace tube:
      a. Seamless steel boiler tube.
      b. Refractory fitted at burner end.
   4. Insulation:
      a. Minimum 1-1/2 IN thick glass wool insulation.
   5. Unit enclosure:
      a. Steel, minimum 14 GA.

B. Sludge Heat Exchanger:
   6. Insulation: Blanket type, minimum 1-1/2 IN thick.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Boilers (65ESAD-BO30, 65ESAD-BO40):
   1. Boiler output rating Btu/HR: To be determined by Contractor;
   2. Minimum fired surface (SF): To be determined by Contractor.
   3. Design pressure (PSI): To be determined by Contractor.
   4. Expansion Tank Capacity (GAL): To be determined by Contractor.
   5. Operating temperature (DegF): To be determined by Contractor.

B. Sludge Heat Exchanger (65ESAD-HEX02):
   1. Sludge heating capacity Btu/HR: To be determined by Contractor.
   2. Minimum heated surface area (based on tube ID) SF: To be determined by Contractor.
   3. Minimum design pressure (PSI): To be determined by Contractor.
   5. Minimum number of sludge tubes: To be determined by Contractor.
   6. Digester operating temperature DEGF: 95.
7. Sludge recirculation:
   a. Flow rate GPM: To be determined by Contractor.
   b. Maximum sludge inlet temperature: 95 DEGF.
   c. Maximum sphere size: 3 IN.
   d. Maximum allowable pressure drop (PSI): To be determined by Contractor.

8. Heating water:
   a. Maximum water inlet temperature (DEGF): To be determined by Contractor.
   b. Maximum allowable pressure drop through unit (PSI): To be determined by Contractor.

2.4 FABRICATION

A. Boiler:
   1. Fire tube type designed and fabricated in accordance with ASME Section VIII.
   2. Head and back plate to be removable for boiler inspection without draining boiler.
   3. Back plate to have sight glass for visual flame check.
   4. Combustion air fan, either induced draft or forced draft type.
   5. Boiler accessories to include:
      a. Low water cut-off switch.
      b. Level Switch Low.
      c. Pressure relief valve (ASME rated).
      d. Expansion tank with water level sight glass.
      e. Make-up water regulator.
      f. Thermometer.
      g. Pressure gage.
      h. 2 IN NPT connections for building heat supply and return.

B. Boiler Burner:
   1. Fuel with natural gas.
   2. Burners to include the following:
      a. Gas pressure regulator.
      b. Adjustable gas orifice valves.
      c. Shut off valves.
      d. Pipe pilot supply from natural gas with shut-off valve.

C. Burner Controls:
   1. Burner controls shall include the following:
      a. 30-second pre-purge before start cycle, power failure or fuel switchover.
      b. Pilot established before gas admission to burner.
      c. Automatic relight after fuel interruption if fuel supply restored within 30 seconds.
      d. Infrared flame scanner solid state flame protection device approved by UL and FM.
      e. Control panel, boiler-mounted, containing all burner controls, blower motor relay,
         timers and other appurtenances, completely wired to controls and valves through a
         numbered terminal block.
         1) A wiring diagram shall be mounted in the panel.
      f. In event of flame failure, fuel supply valves shall be closed and alarm sounded.
      g. All electric gas valves shall be motorized and approved by UL and AGA.

D. Boiler Stack:
   1. Type: Factory-built modular, suitable for continuous operation at 1000 DEGF UL listed.
   2. Construction:
      a. Double wall.
      c. Annular space: 1 IN high temperature insulating material to maintain "man-safe"
         temperature limitation of 150 DEGF.
      d. Outer shell:
         1) 24 GA aluminized steel.
         2) Top section and velocity cone to be 304 stainless steel.
e. Liner joint: Overlapping tabbed end V-bands, sealed with silicone sealant.
3. Exhaust temperature: 450 DEGF.
4. Inside diameter: Sized per manufacturer recommendations and applicable codes.
5. Applicable prefabricated sections:
   a. Base drain section with cleanout and base support.
   b. Straight sections.
   c. 90 DEG tee.
   d. 45 DEG elbow.
   e. Variable length section.
   f. Full angle ring.
   g. Flashing and counter flashing.
   h. Velocity cone.
6. Height: Per manufacturer recommendations and applicable codes.

E. Sludge Heat Exchanger:
1. Elongated tube or spiral type heat exchangers are acceptable technologies.
2. Construct water bath exchanger or counterflow concentric sludge tubes and water jacket tube exchanger.
3. Join tube ends by independently removable and gasketed sludge and water special end castings, designed so that any leakage is to outside.
4. Sludge tube end casting shall be removable for inspection and cleaning without draining water jacket or contamination of heating water.
5. Support all tubes on each end by tube sheets.
6. Tubes shall be easily replaceable.
7. Insulate tube bundle.
8. Provide sheet metal enclosure for top and sides of each unit.
9. Valves:
   a. Furnish vent valve, relief valve, and drain valve for sludge and water systems.
   b. Relief valves to be lever operated.
   c. Thermostatic valve to control water recirculation rate at heat exchanger.
10. Thermometers:
    a. Furnish one (1) on each sludge and water inlet and outlet connection to heat exchanger.
    b. Sludge temperature range: 0 to 150 DEGF.
    c. Water temperature range: 0 to 260 DEGF.
    d. Include thermowells to permit removal without draining either the sludge or water tubes.
    e. Marked for intended service.
11. Shop assembled with openings sealed for shipment.

F. Digester Temperature Control:
1. Provide selector switches at sludge recirculation and water circulation pump starters to permit either automatic or manual control of digester temperature:
2. Automatic temperature control of digester contents within 0.5 DEGF, plus or minus, by means of thermoswitch inserted in sludge inlet casting on each heat exchanger.
3. Adjustable program timer to periodically start sludge recirculation pump.
4. Arrange controls so pumps will continue to operate until desired temperature of the digester content has been reached.
5. If digester heat is not required, sludge recirculation pump will shut down after a short preset period of operation.
6. Hot water circulation pump starter to be interlocked with sludge recirculation pump starter to:
   a. Ensure that sludge recirculation pump is operating prior to hot water circulation pump operation.
   b. Permit the sludge recirculation pump to operate continuously (manual mode) while the thermoswitch is operating the hot-water water circulation pump to maintain the required digester content temperature.
7. Sludge recirculation pump starter to interlock with the raw sludge pump starter to ensure operation of the sludge recirculation pump when raw sludge is pumped to the digester through the heat exchanger.

2.5 MAINTENANCE MATERIALS

A. Spare Parts:
   1. One (1) mechanical seal of each type used.
   2. One (1) set sludge tubes and gaskets.
   3. One (1) thermostatic valve.
   4. One (1) sludge temperature thermometer.
   5. One (1) water temperature thermometer.

2.6 COATINGS

A. Provide manufacturer’s standard factory applied prime and finish coatings rated for wet and corrosive area to boilers and heat exchangers

B. Field paint piping, valves and ancillary devices in accordance with Specification Section 09 96 00.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Tests:
   1. Pressure test installed system at system design pressure x 1.25 safety factor with water for 2 HRS and repair any leakage.

B. Employ and pay for services of authorized manufacturer's field service representative(s) to:
   1. Inspect equipment to be installed by these Specifications.
   2. Supervise adjustments, perform modifications as necessary.
   3. Conduct start-up of equipment and perform operational checks.
   4. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.
   5. Instruct Owner's personnel for 16 HRS at the jobsite on operation and maintenance of equipment specified herein.

END OF SECTION