Suwannee County
224 Pine Avenue
Live Oak, FL 32064

Set No. ______

Project Manual

Suwannee County, Florida

Suwannee County Water Treatment Plant

Bid Documents

Project No. 2013-72

October 2013

Prepared By:

ARCADIS U.S., Inc.
14025 Riveredge Drive
Suite 600
Tampa, FL 33637
Telephone: 813-903-3100
40039001.0000
## Table of Contents

### Technical Specifications

**Suwannee County WTP**  
Table of Contents  
40039002.0000  
TOC-i

### Specifications

<table>
<thead>
<tr>
<th>Division</th>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>11 13</td>
<td>Advertisement for Bids</td>
<td>00 11 13-1</td>
</tr>
<tr>
<td>00</td>
<td>21 13</td>
<td>Instruction to Bidders</td>
<td>00 21 13-1</td>
</tr>
<tr>
<td>00</td>
<td>41 13</td>
<td>Bid Form</td>
<td>00 41 13-1</td>
</tr>
<tr>
<td>00</td>
<td>43 14</td>
<td>Bid Bond</td>
<td>00 43 14-1</td>
</tr>
<tr>
<td>00</td>
<td>45 13</td>
<td>Bidder Qualification Statement</td>
<td>00 45 13-1</td>
</tr>
<tr>
<td>00</td>
<td>45 19</td>
<td>Non-collusion Affidavit</td>
<td>00 45 19-1</td>
</tr>
<tr>
<td>00</td>
<td>52 13</td>
<td>Agreement</td>
<td>00 52 1-1</td>
</tr>
<tr>
<td>00</td>
<td>61 13.13</td>
<td>Performance Bond</td>
<td>00 61 13.13-1</td>
</tr>
<tr>
<td>00</td>
<td>61 13.16</td>
<td>Payment Bond</td>
<td>00 61 13.16-1</td>
</tr>
<tr>
<td>00</td>
<td>72 13</td>
<td>General Conditions</td>
<td>00 72 13-1</td>
</tr>
<tr>
<td>00</td>
<td>73 01</td>
<td>Supplementary Conditions</td>
<td>00 72 01-1</td>
</tr>
<tr>
<td>01</td>
<td>11 13</td>
<td>Summary of Work</td>
<td>01 11 13-1</td>
</tr>
<tr>
<td>01</td>
<td>22 13</td>
<td>Measurement and Payment</td>
<td>01 22 13-1</td>
</tr>
<tr>
<td>01</td>
<td>25 00</td>
<td>Substitution Procedures</td>
<td>01 25 00-1</td>
</tr>
<tr>
<td>01</td>
<td>29 73</td>
<td>Schedule of Values</td>
<td>01 29 73-1</td>
</tr>
<tr>
<td>01</td>
<td>31 13</td>
<td>Project Coordination</td>
<td>01 31 13-1</td>
</tr>
<tr>
<td>01</td>
<td>31 19</td>
<td>Pre-Construction Conference</td>
<td>01 31 19-1</td>
</tr>
<tr>
<td>01</td>
<td>31 20</td>
<td>Progress Meetings</td>
<td>01 31 20-1</td>
</tr>
<tr>
<td>01</td>
<td>32 16</td>
<td>Progress Schedule</td>
<td>01 32 16-1</td>
</tr>
<tr>
<td>01</td>
<td>33 00</td>
<td>Submittal Procedures</td>
<td>01 33 00-1</td>
</tr>
<tr>
<td>01</td>
<td>45 29</td>
<td>Testing Laboratory Services Furnished by Contractor</td>
<td>01 45 29-1</td>
</tr>
<tr>
<td>01</td>
<td>51 05</td>
<td>Temporary Utilities</td>
<td>01 51 05-1</td>
</tr>
<tr>
<td>01</td>
<td>52 13</td>
<td>Contractor's Field Office and Sheds</td>
<td>01 52 13-1</td>
</tr>
<tr>
<td>01</td>
<td>57 05</td>
<td>Temporary Controls</td>
<td>01 57 05-1</td>
</tr>
<tr>
<td>01</td>
<td>65 00</td>
<td>Product Delivery Requirements</td>
<td>01 65 00-1</td>
</tr>
<tr>
<td>01</td>
<td>66 00</td>
<td>Product Storage and Handling Requirements</td>
<td>01 66 00-1</td>
</tr>
<tr>
<td>01</td>
<td>75 11</td>
<td>Checkout and Startup Procedures</td>
<td>01 75 11-1</td>
</tr>
<tr>
<td>01</td>
<td>77 19</td>
<td>Close Out Requirements</td>
<td>01 77 19-1</td>
</tr>
<tr>
<td>01</td>
<td>78 23</td>
<td>Operation and Maintenance Data</td>
<td>01 78 23-1</td>
</tr>
<tr>
<td>01</td>
<td>78 39</td>
<td>Project Record Documents</td>
<td>01 78 39-1</td>
</tr>
<tr>
<td>01</td>
<td>78 43</td>
<td>Spare Parts and Extra Materials</td>
<td>01 78 43-1</td>
</tr>
<tr>
<td>01</td>
<td>79 23</td>
<td>Instruction of Operations and Maintenance Personnel</td>
<td>01 79 23-1</td>
</tr>
</tbody>
</table>
### TECHNICAL SPECIFICATIONS

**DIVISION 3 - CONCRETE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>03 00 05</td>
<td>Concrete</td>
<td>03 00 05 -1</td>
</tr>
</tbody>
</table>

**DIVISION 4 - MASONRY**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>04 00 05</td>
<td>Masonry</td>
<td>04 00 05 -1</td>
</tr>
</tbody>
</table>

**DIVISION 5 - METALS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>05 05 33</td>
<td>Anchor Systems</td>
<td>05 05 33 -1</td>
</tr>
</tbody>
</table>

**DIVISION 9 - FINISHES**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>09 91 00</td>
<td>Painting</td>
<td>09 91 00 -1</td>
</tr>
</tbody>
</table>

**DIVISION 10 - SPECIALTIES**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 44 00</td>
<td>Fire Protection Specialties</td>
<td>10 44 00 -1</td>
</tr>
<tr>
<td>10 56 01</td>
<td>Metal Storage Shelving</td>
<td>10 56 01 -1</td>
</tr>
</tbody>
</table>

**DIVISION 13 - SPECIAL CONSTRUCTION**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 34 23</td>
<td>Pre-Engineered Wood Building System</td>
<td>13 34 23 -1</td>
</tr>
</tbody>
</table>

**DIVISION 21 – FIRE SUPPRESSION**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 30 00</td>
<td>Packaged Fire Pump System</td>
<td>21 30 00 -1</td>
</tr>
</tbody>
</table>

**DIVISION 26 - ELECTRICAL**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 00 05</td>
<td>Electrical Work</td>
<td>26 00 05-1</td>
</tr>
<tr>
<td>26 24 19</td>
<td>Motor Control Centers</td>
<td>26 24 19-1</td>
</tr>
<tr>
<td>26 32 13</td>
<td>Engine Generators</td>
<td>26 32 13-1</td>
</tr>
<tr>
<td>26 36 23</td>
<td>Automatic Transfer Switches</td>
<td>26 36 23-1</td>
</tr>
</tbody>
</table>

**DIVISION 31 - EARTHWORKS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 20 00</td>
<td>Earth Moving</td>
<td>31 20 00 -1</td>
</tr>
</tbody>
</table>

Suwannee County WTP

Table of Contents

40039002.0000  TOC-ii
## SUWANNEE COUNTY CATALYST SITE
### WATER TREATMENT PLANT DESIGN

### TABLE OF CONTENTS (Continued)

#### TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Division</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIVISION 32 – EXTERIOR IMPROVEMENTS</td>
<td>Fencing</td>
<td>32 31 00 -1</td>
</tr>
<tr>
<td></td>
<td>Lawns and Meadows</td>
<td>32 92 00 -1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Division</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIVISION 33 – UTILITES</td>
<td>Buried Piping Installation</td>
<td>33 05 05 -1</td>
</tr>
<tr>
<td></td>
<td>Packaged Potable Water Pump Station</td>
<td>33 12 23 -1</td>
</tr>
<tr>
<td></td>
<td>Pre-Stressed Concrete Aboveground Water Storage Tanks</td>
<td>33 16 13 -1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Division</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIVISION 40 – PROCESS INTEGRATION</td>
<td>Exposed Piping Installation</td>
<td>40 05 05 -1</td>
</tr>
<tr>
<td></td>
<td>Pipe Hangers and Supports</td>
<td>40 05 07 -1</td>
</tr>
<tr>
<td></td>
<td>Ductile Iron Process Pipe</td>
<td>40 05 19 -1</td>
</tr>
<tr>
<td></td>
<td>Thermoplastic Process Pipe</td>
<td>40 05 31 -1</td>
</tr>
<tr>
<td></td>
<td>Process Valves, Four-Inch Diameter and Larger</td>
<td>40 05 53 -1</td>
</tr>
<tr>
<td></td>
<td>Chlorine Piping, Valves, and Specials</td>
<td>40 24 33 -1</td>
</tr>
<tr>
<td></td>
<td>Instrumentation and Control for Process Systems</td>
<td>40 60 05 -1</td>
</tr>
<tr>
<td></td>
<td>B Data sheets - Panel Instruments and Devices</td>
<td>40 60 05 - 28</td>
</tr>
<tr>
<td></td>
<td>C Data sheets - Primary Sensors and Field Instruments</td>
<td>40 60 05 - 38</td>
</tr>
<tr>
<td></td>
<td>D Instrument Index</td>
<td>40 60 05 - 49</td>
</tr>
<tr>
<td></td>
<td>E Autodialer I/O List</td>
<td>40 60 05 - 50</td>
</tr>
<tr>
<td></td>
<td>Process Control Descriptions for Process Systems</td>
<td>40 60 96 – 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Division</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIVISION 43 – PROCESS GAS-LIQUID HANDLING-PURIFICATION-STORAGE EQUIPMENT</td>
<td>Centrifugal Vertical Lineshaft Well Pumps</td>
<td>43 21 13 -1</td>
</tr>
<tr>
<td></td>
<td>Double Wall HDPE Chemical Tanks</td>
<td>43 41 43 -1</td>
</tr>
<tr>
<td></td>
<td>Hydropneumatic Tanks</td>
<td>43 42 21 -1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Division</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIVISION 46 – WATER AND WASTEWATER EQUIPMENT</td>
<td>Chemical Injectors</td>
<td>46 33 41 -1</td>
</tr>
<tr>
<td></td>
<td>Skid-Mounted Peristaltic Metering Pump System</td>
<td>46 33 44 -1</td>
</tr>
<tr>
<td></td>
<td>Submersible Tank Mixing Equipment</td>
<td>46 41 23 -1</td>
</tr>
</tbody>
</table>

++ END OF TABLE OF CONTENTS ++
SECTION 01 11 13
SUMMARY OF WORK

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Table of Articles for this Section is:

<table>
<thead>
<tr>
<th>Article</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Section Includes</td>
</tr>
<tr>
<td>1.2</td>
<td>Location and Description of Work</td>
</tr>
<tr>
<td>1.3</td>
<td>Other Construction Contracts</td>
</tr>
<tr>
<td>1.4</td>
<td>Work By Others</td>
</tr>
<tr>
<td>1.5</td>
<td>Work By Owner</td>
</tr>
<tr>
<td>1.6</td>
<td>Owner-furnished Equipment and Materials</td>
</tr>
<tr>
<td>1.7</td>
<td>Assigned Procurement Contracts</td>
</tr>
<tr>
<td>1.8</td>
<td>Sequence and Progress of Work</td>
</tr>
<tr>
<td>1.9</td>
<td>Contractor’s Use of Site</td>
</tr>
<tr>
<td>1.10</td>
<td>Easements and Rights-of-Way</td>
</tr>
<tr>
<td>1.11</td>
<td>Notices to Owners and Authorities of Properties Adjacent to the Work</td>
</tr>
<tr>
<td>1.12</td>
<td>Salvage of Equipment and Materials</td>
</tr>
<tr>
<td>1.13</td>
<td>Partial Utilization by Owner</td>
</tr>
</tbody>
</table>

1.2 LOCATION AND DESCRIPTION OF WORK

A. The Work is located at 175th Road and US 90, approximately 0.25 miles west of the intersection of I-10 and US 90, west of 169th Road as shown.

B. The work to be performed by the CONTRACTOR generally includes furnishing of all labor, equipment, materials, tools and services required to construct, test, and startup the proposed Suwannee County Water Treatment Plant. The specific areas of work include, but are not limited to items 1-11 listed below, along with associated site work, yard piping, valves, support systems and appurtenances, structural, painting, electrical, instrumentation, tie-ins to existing systems, and testing.

1. Installation of two well pumps, associated piping, valves, and appurtenances at the two supply wells located on the water treatment plant site (supply wells to be installed by others).

2. Installation of one 0.5 million gallon ground storage tank, tank mixing system, associated piping, valves and appurtenances.
3. Installation of a pre-engineered potable water pump skid, consisting of two horizontal split case pumps, associated piping, valves and appurtenances housed in a new pre-engineered building.
4. Installation of a 7,2000 gallon (minimum) hydropneumatic tank downstream of the potable water pump skid, associated piping, valves and appurtenances.
5. Installation of a sodium hypochlorite disinfection system to include skid mounted chemical feed pumps, chemical storage tank, and containment piping to two chemical injection points for pre and post disinfection.
6. Installation of a pre-engineered fire flow protection pump skid, consisting of a single diesel-powered pump and a small jockey pump housed in a NFPA-rated enclosure, associated piping, valves and appurtenances.
7. Installation of generator and diesel fuel storage tank to provide back-up power to the facility.
8. Installation of 4” to 12” diameter yard piping and valves for the raw water, potable water, fire protection and drainage systems.
9. Construction of a pre-engineered building to house the potable water pump skids and chemical storage and feed systems.
10. Construction of an access road and installation of site fencing and site lighting for the water treatment plant parcel.

C. The CONTRACTOR shall perform system startup and testing. The CONTRACTOR shall be responsible for coordinating and completing the overall system startup and testing. The CONTRACTOR is responsible for providing all labor equipment and materials for conducting systems startup and testing. The CONTRACTOR is responsible for ensuring that all provisions for the Contract Documents have been properly executed and successfully completed.

D. The Contract Documents indicate existing conditions only where they impact the proposed facility modifications and equipment installation. It is the CONTRACTOR’S responsibility to field verify existing and proposed equipment locations and notify the ENGINEER of any conflicts prior to construction. The contract documents have been developed to indicate the final location of equipment, piping, conduits and miscellaneous items associated with this project. The CONTRACTOR is responsible for developing and updating a construction schedule, which will allow installation of equipment in phases and partial startup, testing and final certification of portions of the project.

E. CONTRACTOR’S Duties:
1. Cooperate with the ENGINEER, other contractors for other projects, and the COUNTY.
2. Except as specifically noted, provide and pay for:
   a. Labor, materials and equipment.
   b. Tools, construction equipment, and machinery.
   c. Water and utilities required for construction.
d. Other facilities and services necessary for the proper execution and completion of the Work.

3. Secure and pay for, as necessary for the proper execution and completion of the Work, and as applicable at time of receipt of bids:
   a. Permits.
   b. Government fees.
   c. Licenses.

4. Give required notices in writing.

5. Comply with codes, ordinances, rules, regulations, orders, and other legal requirements of public authorities that bear on performance of Work.

6. Promptly submit written notice to ENGINEER of observed variance of Contract Documents from legal requirements.

7. Enforce strict discipline and good order among employees. Do not employ persons lacking the required skills for their assigned task.

8. The CONTRACTOR shall furnish personnel and equipment that will be efficient, appropriate, and large enough to secure a satisfactory quality of work and a rate of progress that will ensure the completion of the work within the time stipulated.

9. The CONTRACTOR shall be responsible for restoring all disturbed property, resulting from his construction activities, or the activities of his sub-consultant, at no additional cost to the COUNTY.

10. The CONTRACTOR shall confine his activities to the site(s) designated by the COUNTY for the Work or for materials storage.

F. Contracting Method: Work shall be constructed under one prime contract.

1.3 OTHER CONSTRUCTION CONTRACTS

A. Other construction contracts have been or will be awarded by Owner that are in close proximity to or border on the Work of this Contract. Work under these other contracts is briefly described as follows:
   1. Test Production Well and Monitoring Well Installation (Project No. 2013-12) – This project includes installation of two large capacity test production wells, two monitoring wells, boreholes geophysical logging, geologic and water quality sampling, specific capacity testing, and 72 hour constant rate testing at the water treatment plant site. The test wells will serve as the raw water wells for the water treatment plant site. Expected project completion date is October, 2013.

1.4 WORK BY OTHERS (NOT USED)

1.5 WORK BY OWNER (NOT USED)

1.6 OWNER-FURNISHED EQUIPMENT AND MATERIALS (NOT USED)
1.7 ASSIGNED PROCUREMENT CONTRACTS (NOT USED)

1.8 SEQUENCE AND PROGRESS OF WORK

A. Sequencing:
   1. Incorporate sequencing of the Work into the Progress Schedule.

1.9 CONTRACTOR’S USE OF SITE

A. Contractor will have full use of the Site for storage and operations of workers.

B. Move stored products that interfere with operations of Owner, other contractors, and others performing work for Owner.

C. Site access shall be directed by the Owner and Engineer.

1.10 EASEMENTS AND RIGHTS-OF-WAY

A. Easements and rights-of-way will be provided by Owner in accordance with the General Conditions. Confine construction operations within Owner’s property, public rights-of-way, easements obtained by Owner, and the limits shown. Use care in placing construction tools, equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid damaging property and interfering with traffic. Do not enter private property outside the construction limits without permission from the owner of the property.

B. On Private Property:
   1. General limits of easements are shown on the Drawings.

C. Within Highway and Railroad Rights-of-Way: Permits will be obtained by Owner, other than work permits to be obtained by Contractor. All Work performed and all operations of Contractor within the limits of railroad and highway rights-of-way shall conform to requirements of railroad or highway owner and applicable work permits, or authority having jurisdiction over right-of-way. Comply with Section 01 14 33, Work in Highway Rights-of-Way.

1.11 NOTICES TO OWNERS AND AUTHORITIES OF PROPERTIES ADJACENT TO THE WORK

A. Notify owners of adjacent property and utilities when prosecution of the Work may affect their property, facilities, or use of property.

B. When it is necessary to temporarily obstruct access to property, or when utility service connection will be interrupted, provide notices sufficiently in advance to enable affected persons to provide for their needs. Conform notices to Laws and
Regulations and, whether delivered orally or in writing, include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.

C. Notify utility owners and other concerned entities at least 48 hours prior to cutting or closing streets or other traffic areas or excavating near Underground Facilities or exposed utilities.

1.12 SALVAGE OF EQUIPMENT AND MATERIALS (NOT USED)

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Items listed starting in Article 1.4 of this Section refer to and are the same pay items listed in the Bid Form and constitute all pay items for completing the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant services, CONTRACTOR’s or ENGINEER’s field offices, layout surveys, Project signs, sanitary requirements, testing, safety provisions and safety devices, submittals and record drawings, water supplies, power and fuel, traffic maintenance, removal of waste, security, coordination with OWNER’s operations, information technology (including hardware, software, and services) required during construction, bonds, insurance, or other requirements of the General Conditions, Supplementary Conditions, General Requirements, and other requirements of the Contract Documents. Compensation for all services, items, materials, and equipment shall be included in prices stipulated for lump sum and unit price pay items listed in this Section and included in the Contract.

B. Each lump sum and unit bid price shall include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR’s overhead and profit for each separately identified item.

1.2 ENGINEER’S ESTIMATE OF QUANTITIES

A. ENGINEER’s estimated quantities for items of Unit Price Work, as included in the Contract, are approximate only and are included solely for purpose of comparing Bids and pricing. OWNER does not expressly or by implication agree that nature of materials encountered below the ground surface or actual quantities of material encountered or required will correspond with the quantities included in the Contract at the time of award and reserves right to increase or decrease quantities or to eliminate quantities as OWNER may deem necessary. Except as provided in Article 1.3, below, the CONTRACTOR or the OWNER will not be entitled to any adjustment in a unit bid price as a result of any change in an estimated quantity and agrees to accept the aforesaid unit bid prices as complete and total compensation for any additions caused by changes or alterations in the WORK directed by the OWNER.
1.3 ADJUSTMENT OF UNIT PRICES FOR INCREASE OR DECREASE OF ESTIMATED QUANTITIES

A. For bid items paid for on a unit price basis, increases or decreases in the quantity of an item of the WORK will be determined by comparing the total payable quantity of the WORK with the ENGINEER's estimated quantity as shown in the Bid Form.

B. Not withstanding any other provision of the Contract Documents, if the total payable quantity of any unit price item of the WORK, which has an as bid computed total value of five (5) percent or more of the sum of the as-bid computed total values of all items bid, varies from the ENGINEER's estimate of quantity therefore by more than twenty five (25) percent above or below the estimated quantity, the unit price of that item will be a subject of review by the ENGINEER. If warranted, an equitable adjustment will be made by means of a Change Order to credit the OWNER with any reduction in cost or to compensate the CONTRACTOR for any increase in cost resulting from the change in quantity. Said equitable adjustment will be based on any increase or decrease in costs due solely to the variation above 125 percent or below 75 percent of the ENGINEER’s estimated quantity.

C. The ENGINEER’s review for possible adjustment will be made at a time the ENGINEER deems reasonable and proper.

D. Payment for any unit price item of the WORK, which has an as bid computed total value of less than five (5) percent of the sum of the as bid computed total values of all items bid, will be made at the unit price bid regardless of an increase or decrease in quantity.

1.4 RELATED PROVISIONS

A. Payments to CONTRACTOR: Refer to General Conditions and Agreement.

B. Changes in Contract Price: Refer to General Conditions.

C. Schedule of Values: Refer to Section 01 29 73, Schedule of Values.

1.5 GENERAL CONSTRUCTION

A. Item 1 – General Construction:
   1. Measurement and Payment: Lump sum payment for Item 1 will be full compensation for completing the Work, as shown or indicated under Division 01 through Division 49. Additional work items that CONTRACTOR may be ordered by ENGINEER to perform are described below.
   2. The lump sum price bid shall include all mobilization and demobilization, bonds and insurance, labor, materials, tools, equipment and services for the completion of ALL other work required to in the Contract Documents but not
limited to: site grading including cut, hauling, fill and compaction; excavation, storage, handling, and disposal; clearing and grubbing; backfill and compaction; equipment and material storage; design and fabrication of pre-engineered building; packaged fire pump system; packaged potable water pump system; chemical feed system; well pumps; concrete foundations; equipment pads; anchor systems; painting; tanks; tank mixing equipment; mechanical piping, valves and fittings; ventilation and HVAC; installation and start-up of emergency generator set and all accessories; conduit; wires; controls; panelboards; cabinets; outlets; analyzers; level sensors; pressure sensors; pressure gauges; flow meters; uninterrupted power source; transmitters; surge protectors; power supplies; site lighting; lightning protection; calibration and testing; manufacturer’s representative; site erection; shell access roads; dewatering; handling and placing of yard pipe and fittings (potable, non-potable, chemical feed lines and drain); making of flanged and restrained joints; stone bedding; pipe supports; temporary utilities; temporary fencing; temporary sanitary facilities; ditch grading; material, equipment, and system testing; disinfection; flushing; handling and placing of valves; handling and setting of boxes; trench support; subgrade preparation; placement, maintenance and removal of E&SC measures; site restoration; final grading; sodding; security gates and fencing; equipment shop drawings, checkout, startup, and personnel training; operation and maintenance manual preparation; record drawing preparation; and any other ancillary equipment or incidental items required for the proper operation of the items included in this project.

B. Item 2 – Owner’s Contingency Allowance:
1. Measurement: Includes a stipulated amount available as reserve for sole use by OWNER to cover unanticipated costs.
2. Payment: Payment for Work authorized under Item 2 will be full compensation for providing all Work authorized under the contingency allowance, complete as shown, indicated, or directed by ENGINEER. Work authorized under contingency allowance may be included in subsequent Application(s) for Payment, as applicable, following authorization of and performance of contingency allowance Work.

C. Item 3 – Permitting Allowance:
1. Measurement: Includes a stipulated amount available as reserve for sole use by OWNER to cover permitting fees.
2. Payment: Payment for Work authorized under Item 3 will be full compensation for providing all fees authorized under the permitting allowance, complete as shown, indicated, or directed by ENGINEER. Work authorized under permitting allowance may be included in subsequent Application(s) for Payment, as applicable, following authorization of and performance of permitting allowance Work.
PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope: Section includes:
   1. Administrative and procedural requirements for selecting products for the Project.
   2. Procedural requirements for product substitutions.
   3. Procedural requirements for substitute construction methods or procedures, when construction methods or procedures are specified.

1.2 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
   1. “Products” includes materials, equipment, machinery, components, fixtures, systems, and other goods incorporated in the Work. Products do not include machinery and equipment used for preparing, fabricating, conveying, erecting, or installing the Work. Products include OWNER-furnished goods incorporated in the Work where use of such goods is specifically required in the Contract Documents.

1.3 PRODUCT SUBSTITUTIONS

A. Requests for approval of substitute products or items will be considered for a period of 45 days after the Effective Date of the Agreement. After end of specified period, requests will be considered only in case of unavailability of a specified product or other conditions beyond CONTRACTOR’s control.

B. Procedure:
   1. Submit number of copies of request for substitution as specified for Shop Drawings and other submittals in Section 01 33 00, Submittal Procedures.
   2. Submit separate request for each substitution.
   3. Submit substitution request using forms attached to this Section by completing all information requested on the forms, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with request the following:
      a. Product identification, including manufacturer’s name and address.
b. Manufacturer’s literature with product description, performance and test data, and reference standards with which product complies.
c. Samples, if appropriate.
d. Name and address of similar projects on which product was used, and date of installation.

1.4 SUBSTITUTE CONSTRUCTION METHODS OR PROCEDURES

A. Where construction methods or procedures are specified, for a period of 60 days after the Effective Date of the Agreement, ENGINEER will consider CONTRACTOR’s written requests for substitute construction methods or procedures specified.

B. Procedure:
1. Submit number of copies of request for substitution as specified for Shop Drawings and other submittals in Section 01 33 00, Submittal Procedures.
2. Submit separate request for each substitution.
3. Submit substitution request using forms attached to this Section by completing all applicable information requested on the forms, and enclose with the forms supplementary information as required. In addition to requirements of the General Conditions and information required on substitution request forms, include with request the following:
   a. Detailed description of proposed method or procedure.
   b. Itemized comparison of the proposed substitution with the specified method or procedure.
   c. Drawings illustrating method or procedure.
   d. Other data required by ENGINEER to establish that proposed substitution is equivalent to specified method or procedure.

1.5 CONTRACTOR’S REPRESENTATION AND ACCEPTANCE

A. In submitting request for substitution, CONTRACTOR represents that:
   1. CONTRACTOR has investigated proposed substitution and determined that it is equivalent to item, product, method, or procedure specified, as applicable.
   2. CONTRACTOR will provide the same or better guarantees or warranties for proposed substitution as for the specified product, manufacturer, method, or procedure, as applicable.
   3. CONTRACTOR waives all Claims for additional costs or extension of time related to proposed substitution that subsequently may become apparent.

B. A proposed substitution will not be accepted for review if:
   1. Approval would require changes in design concept or a substantial revision of the Contract Documents.
   2. Approval would delay completion of the Work or the work of other contractors.
3. Substitution request is indicated or implied on a Shop Drawing or other submittal, or on a request for interpretation or clarification, and is not accompanied by CONTRACTOR’s formal request for substitution.

C. If ENGINEER does not approve the proposed substitute, CONTRACTOR shall provide the specified product, manufacturer, method, or procedure, as applicable.

D. Approval of a substitution request will not relieve CONTRACTOR from requirement for submitting Shop Drawings as set forth in the Contract Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SUPPLEMENTS

A. The forms listed below, following the “End of Section” designation, are part of this Specification Section:
   1. Substitution Request Form (two pages).
   2. Product Substitution Checklist (one page).

++ END OF SECTION ++
**SUBSTITUTION REQUEST**

<table>
<thead>
<tr>
<th>Project:</th>
<th>Substitution Request Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>To:</td>
<td>From:</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Re:</td>
<td>Date:</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineer Proj. No.:</td>
<td>Contract For:</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specification Title:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Section:</td>
<td>Page:</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Article/Paragraph:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Proposed Substitution:        |                                      |
|                               |                                       |
| Manufacturer:                 | Address:                              |
|                               | Phone:                                |
| Trade Name:                   | Model No.:                            |
| Installer:                    | Address:                              |
|                               | Phone:                                |

History:  
- New product  
- 1-4 years old  
- 5-10 years old  
- More than 10 years old

Differences between proposed substitution and specified product:  

- Point-by-point comparative data attached — REQUIRED BY THE CONTRACT DOCUMENTS

<table>
<thead>
<tr>
<th>Reason for not providing specified item:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Similar Installation:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project:</td>
<td>Engineer:</td>
</tr>
<tr>
<td>Address:</td>
<td>Owner:</td>
</tr>
<tr>
<td>Date Installed:</td>
<td></td>
</tr>
</tbody>
</table>
| Proposed substitution affects other parts of Work:  
- No  
- Yes; explain                                   |

| Savings to Owner for accepting substitution: |       |
| (attach detailed, itemized estimate)         |       |
| Proposed substitution changes Contract Time: |       |
| (clarify whether change is to Substantial Completion, Milestone, or time for readiness for final payment) |       |

<table>
<thead>
<tr>
<th>Supporting Data Attached:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Drawings</td>
<td></td>
</tr>
<tr>
<td>Product Data</td>
<td></td>
</tr>
<tr>
<td>Samples</td>
<td></td>
</tr>
<tr>
<td>Tests</td>
<td></td>
</tr>
<tr>
<td>Reports</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The undersigned certifies:
• Representations in the General Conditions and in Section 01 25 00, Substitution Procedures, regarding substitutions are valid.
• Same warranty will be furnished for proposed substitution as for specified product.
• Same maintenance service and source of replacement parts, as applicable, is available.
• Proposed substitution will have no adverse effect on other trades and will not affect or delay Progress Schedule.
• Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are waived.
• Proposed substitution does not affect dimensions and functional clearances.
• Payment will be made for Engineer’s review and changes, if any, to the design and Contract Documents, and construction costs caused by the substitution.
• Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: ________________________________

Signed by: ________________________________

Firm: __________________________________________

Address: __________________________________________

Telephone: __________________________________________

Attachments: □

ENGINEER’S REVIEW AND ACTION (FOR ENGINEER’S USE ONLY)

□ Substitution approved.
□ Substitution approved as noted.
□ Substitution rejected - Use specified materials.
□ Substitution Request received too late - Use specified materials.

Signed by: ________________________________

Date: ________________________________

Additional Comments: □ Contractor □ Subcontractor □ Supplier □ Manufacturer □ Engineer
□ Other:

Adapted from CSI Form No. 13.0B, 2004 edition
# PRODUCT SUBSTITUTION CHECKLIST

**Date:** ____________________________  
**Engineer Proj No.:** ____________________________  
**Filing No.:** ____________________________  
**Re:** ____________________________  
**Manufacturer’s Project No.:** ____________________________  
**Contract For:** ____________________________  

## Product Equivalence:

- [ ] Is the submitted product equivalent to the specified item? ____________________________  
- [ ] Does it serve the same function? ____________________________  
- [ ] Does it have the same dimensions? ____________________________  
- [ ] Does it have the same appearance? ____________________________  
- [ ] Will it last as long? ____________________________  
- [ ] Does it comply with the same codes, and standards and performance requirements? ____________________________  
- [ ] Has the product been used locally, and where are the projects? ____________________________  
- [ ] Has a problem occurred with the product, and what was the remedy? ____________________________  

## Effect on the Project:

- [ ] Will the substitution affect other aspects of the construction? ____________________________  
- [ ] Are any details affected and are changes required? ____________________________  
- [ ] What is the cost of the changes? ____________________________  
- [ ] Who pays for the required changes? ____________________________  
- [ ] Is construction time affected? ____________________________  

## Effect on the Warranty:

- [ ] How does the proposed warranty differ from the specified warranty? ____________________________  
- [ ] Does the manufacturer have a track record of standing behind the warranty? ____________________________  

---

Adapted from CSI Form No. 20.3, 1998 edition
PART 1 – GENERAL

1.1 DESCRIPTION

A. Submit to ENGINEER for acceptance a Schedule of Values that allocates cost to each item of the Work. Schedule of Value list of line items shall correspond to each aspect of the Work, establishing in detail the portion of the Contract Price allocated to each major component of the Work.

B. Upon request of ENGINEER, support values with data that substantiate their correctness.

C. Submit preliminary Schedule of Values to ENGINEER for initial review. CONTRACTOR shall incorporate ENGINEER’s comments into the Schedule of Values and resubmit to ENGINEER. ENGINEER may require corrections and re-submittals until Schedule of Values is acceptable.

D. Schedule of Values and the Progress Schedule updates specified in Section 01 32 16, Progress Schedule, shall be basis for preparing each Application for Payment. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.

E. Include in Schedule of Values unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by ENGINEER.

F. Include in Schedule of Values itemized list of Work for each major part of the Contract, for each payment item specified in Section 01 22 13, Measurement and Payment, and shall be grouped under the following areas:

1. Installation of two well pumps, associated piping, valves, and appurtenances (supply wells to be installed by others).
2. Installation of one 0.5 million gallon ground storage tank, tank mixing system, associated piping, valves and appurtenances.
3. Installation of a pre-engineered potable water pump skid, consisting of two horizontal split case pumps, associated piping, valves and appurtenances.
4. Installation of a 7,000 gallon (minimum) hydropneumatic tank, associated piping, valves and appurtenances.
5. Installation of a sodium hypochlorite disinfection system to include skid mounted chemical feed pumps, chemical storage tank, a free chlorine residual...
analyzer, and piping to two chemical injection points for pre and post disinfection.

6. Installation of a pre-engineered fire flow protection pump skid, consisting of a single diesel-powered pump and a small jockey pump housed in a NFPA-rated enclosure, associated piping, valves and appurtenances.

7. Installation of generator and diesel fuel storage tank to provide back-up power to the facility.

8. Installation of 4” to 12” diameter piping and valves for the raw water, potable water, fire protection and drainage systems.

9. Construction of a pre-engineered building to house the potable water pump skids and chemical storage and feed systems.

10. Construction of an access road and installation of site security fencing and site lighting for the water treatment plant parcel.

G. Requirements for preliminary Schedule of Values and Schedule of Values are:

1. Schedule of Values shall show division of Work between CONTRACTOR and Subcontractors. Line items for Work to be done by Subcontractor shall include the word, “(SUBCONTRACTED)”.

2. Schedule of Values shall include breakdown of costs for materials and equipment, installation, and other costs used in preparing the Bid by CONTRACTOR and each Subcontractor. List purchase and delivery costs for materials and equipment for which CONTRACTOR may apply for payment as stored materials.

3. Include separate amounts for each Specification Section in the Contract Documents by structure, building, and work area.

4. Identify each line item with number corresponding to the associated Specification Section number. List sub-items of major products or systems, as appropriate or when requested by ENGINEER.

5. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.

6. Include in each line item a directly proportional amount of CONTRACTOR’s overhead and profit. Do not include overhead and profit as separate item(s).

7. Include separate line item for each allowance, and for each unit price item

8. Include line item for bonds and insurance.

9. Include items for the General Conditions, permits (when applicable), construction Progress Schedule, and other items required by ENGINEER. Include such items in Applications for Payment on schedule accepted by ENGINEER

10. Line items for Site maintenance such as dust control, compliance with storm water pollution prevention plans and permits, spill prevention control and countermeasures plans, and for construction photographic documentation; temporary utilities and temporary facilities, field offices, temporary controls,
field engineering, and similar Work shall be included in the Schedule of Values and proportioned in Applications for Payment throughout duration of the Work.

11. Include separate line items under each appropriate payment item for mobilization and demobilization. Document for ENGINEER the activities included in mobilization and demobilization line items.

12. Include costs for submittals, operations and maintenance manuals, field testing, training of operations and maintenance personnel, and similar Work.

13. Coordinate Schedule of Values with resource loading of the Progress Schedule, in accordance with Section 01 32 16, Progress Schedule.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:

1. Submit to ENGINEER four copies of Schedule of Values.

2. Content of Schedule of Values submittals shall conform to Article 1.1 of this Section.

3. Time Frames for Submittals:
   a. Submit preliminary Schedule of Values within ten days of date that the Contract Times commence running in accordance with the Notice to Proceed.
   b. Submittal of the Schedule of Values shall be in accordance with the General Conditions. ENGINEER will not accept Applications for Payment without an acceptable Schedule of Values.
   c. When required by ENGINEER, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ END OF SECTION +
PART 1 – GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall coordinate the Work, including testing agencies whether hired by CONTRACTOR, OWNER, or others; Subcontractors, Suppliers, and others with whom coordination is necessary, in accordance with the General Conditions, Supplementary Conditions, and this Section, to complete the Work within the Contract Times and in accordance with the Contract Documents.

B. In accordance with the General Conditions as may be modified by the Supplementary Conditions, CONTRACTOR shall cooperate with and coordinate the Work with other contractors, utility service companies, OWNER’s employees working at the Site, and other entities working at the Site, in accordance with Section 01 11 13, Summary of Work.

C. CONTRACTOR will not be responsible or liable for damage unless damage is through negligence of CONTRACTOR, or Subcontractors, Supplier, or other entity employed by CONTRACTOR.

D. Attend and participate in all project coordination and progress meetings, and report on the progress of the Work and compliance with the Progress Schedule.

E. Maintain sufficient competent personnel, drafting and CADD equipment, and supplies at the Site for preparing layout drawings, coordination drawings, and record documents. With the Contract Documents and Shop Drawings, use such coordination drawings as tools for coordinating the Work of various trades. Where such coordination drawings are to be prepared by mechanical, electrical, plumbing, or heating-ventilating-air conditioning Subcontractors and other Subcontractors, ensure that each Subcontractor maintains required personnel and facilities at the Site.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01 31 19
PRE-CONSTRUCTION CONFERENCE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. A pre-construction conference will be held for the Project.
   2. CONTRACTOR shall attend the conference prepared to discuss all items on
      the agenda.
   3. ENGINEER will distribute an agenda, preside at conference, and prepare and
      distribute minutes to all conference participants and others as requested.

B. Purpose of conference is to designate responsible personnel, establish working
   relationships, discuss preliminary schedules submitted by CONTRACTOR, and
   review administrative and procedural requirements for the Project. Matters requiring
   coordination will be discussed and procedures for handling such matters will be
   established.

C. Date, Time and Location: Conference will be held after execution of the Contract and
   before Work starts at the Site. ENGINEER will establish the date, time, and location
   of conference and notify the interested and involved parties.

D. Prior to the conference, submit the following preliminary schedules in accordance
   with the General Conditions:
   1. Progress Schedule.
   2. Schedule of Submittals.
   3. Schedule of Values.

E. CONTRACTOR shall provide information required and contribute appropriate items
   for discussion. CONTRACTOR shall bring to the conference the following, with
   sufficient number of copies for each attendee:
   1. Preliminary Progress Schedule, as submitted to ENGINEER.
   2. Preliminary Schedule of Submittals, as submitted to ENGINEER.
   3. Preliminary Schedule of Values, as submitted to ENGINEER.
   4. List of emergency contact information, in accordance with Article 1.4 of this
      Section.
1.2 **REQUIRED ATTENDANCE**

A. Representative of each entity attending the conference shall be authorized to act on that entity’s behalf.

B. Contractor Attendance: Conference shall be attended by CONTRACTOR’s project manager, Site superintendent, project managers for major Subcontractors, and major equipment Suppliers as CONTRACTOR deems appropriate.

C. Other attendees will be representatives of:
   1. OWNER, if available.
   2. ENGINEER.
   3. Authorities having jurisdiction over the Work, if available.
   4. Utility owners, as applicable.
   5. Others as requested by OWNER, CONTRACTOR, or ENGINEER.

1.3 **AGENDA**

A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revisions to this agenda, if any, will be furnished to CONTRACTOR prior to conference.
   1. Procedural and Administrative:
      a. Personnel and Teams:
         1) Designation of roles and personnel.
         2) Limitations of authority of personnel, including personnel who will sign Contract modifications and make binding decisions.
         3) Lists of proposed Subcontractors and manufacturers (where applicable).
         4) Authorities having jurisdiction.
      b. Procedures for communications and correspondence.
      d. Subcontractors.
      e. The Work and Scheduling:
         1) Scope of the Work.
         2) Contract Times, including Milestones (if any).
         3) Phasing and sequencing.
         4) Preliminary Progress Schedule.
         5) Critical path activities.
      f. Safety:
         1) Responsibility for safety.
         2) Designation of Contractor’s safety representative.
         3) Emergency procedures and accident reporting.
         4) Emergency contact information.
         5) Confined space entry procedures.
6) Hazardous materials communication program.
7) Impact of Project on public safety.

g. Permits.
h. Review of insurance requirements and insurance claims.
i. Coordination:
   1) Project coordination, and coordination among contractors.
   2) Coordination with Owner’s operations.
   3) Progress meetings.

j. Products and Submittals:
   1) Preliminary Schedule of Submittals.
   2) Shop Drawings, Samples, and other submittals.
   3) Product options, “or equals”, and substitutions.
   4) Construction photographic documentation.

k. Contract Modification Procedures:
   1) Requests for interpretation.
   2) Clarification notices.
   3) Field Orders.
   4) Proposal requests.
   5) Change Order proposals.
   6) Work Change Directives.
   7) Change Orders.
   8) Procedure for filing Claims.

l. Payment:
   1) Owner’s Project financing and funding.
   2) Owner’s tax-exempt status.
   3) Preliminary Schedule of Values, and procedures for measuring for payment.
   4) Retainage.
   5) Progress payment procedures.
   6) Prevailing wage rates and payrolls.

m. Testing and inspections, including notification requirements.

n. Disposal of demolition materials.

o. Record documents.

p. Preliminary Discussion of Contract Closeout:
   1) Procedures for Substantial Completion.
   2) Contract closeout requirements.
   3) Correction period.
   4) Duration of bonds and insurance.

2. Site Mobilization (if not covered in a separate meeting):
   a. Working hours and overtime.
   b. Field offices, trailers, and staging areas.
   c. Temporary facilities.
   d. Temporary utilities and limitations on utility consumption (where applicable).
e. Utility company coordination (if not done as a separate meeting).
f. Access to Site, access roads, and parking for construction vehicles.
g. Maintenance and protection of traffic.
h. Use of premises.
i. Protection of existing property.
j. Security.
k. Temporary controls, such as sediment and erosion control, noise control,
dust control, storm water control, and other such measures.
l. Site barriers and temporary fencing.
m. Storage of materials and equipment.
n. Reference points and benchmarks; surveys and layouts.
o. Site maintenance during the Project.
q. Restoration.

3. General discussion and questions.

4. Next meeting.

5. Site visit, if required.

1.4 EMERGENCY CONTACT INFORMATION

A. CONTRACTOR shall provide list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, provide updated emergency contact information list at the next progress meeting.

B. CONTRACTOR’s list of emergency contact information shall include:
   1. CONTRACTOR’s project manager’s office, field office, and cellular numbers.
   2. CONTRACTOR’s Site superintendent’s office, field office, and cellular numbers.
   3. CONTRACTOR’s foreman’s field office, and cellular numbers.
   4. Major Subcontractors’ and Suppliers’ office, and cellular numbers of project manager and foreman (when applicable).

C. Additional Emergency Contact Information:
   1. OWNER’s office and cellular telephone numbers.
   3. OWNER’s central 24-hour emergency telephone number, if applicable.
   4. ENGINEER’s project manager’s office and cellular telephone numbers.
   5. Resident Project Representative’s office, field office, and cellular telephone numbers for each RPR.
   6. Utility companies’ 24-hour contact telephone number(s), including gas, water, sewer, oil, telephone, cable television/telecommunications, and other companies or concerns having utilities in the vicinity of the Work.
   7. Highway and street owners’ 24-hour telephone number(s).
   8. Emergency telephone numbers, including: “Emergency: Dial 911”, and seven-
digit telephone numbers for the hospital, ambulance, police, and fire department nearest to the Site. Provide names of each of these institutions.

9. Other involved entities as applicable.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. Progress meetings will be held throughout the Project. CONTRACTOR shall attend each progress meeting prepared to discuss in detail all items on the agenda.
2. ENGINEER will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.

B. Date and Time:
1. Regular Meetings: Every two weeks on a day and time agreeable to OWNER, ENGINEER, and CONTRACTOR.
2. Other Meetings: As required.

C. Place: CONTRACTOR’s field office at the Site or other location mutually agreed upon by OWNER, CONTRACTOR, and ENGINEER.

D. Handouts: CONTRACTOR shall bring to each progress meeting a minimum of four copies of each of the following:
1. List of Work accomplished since the previous progress meeting.
2. Up-to-date Progress Schedule.
3. Up-to-date Schedule of Submittals.
4. Detailed “look-ahead” schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the OWNER, Project, and Site.
5. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

1.2 REQUIRED ATTENDANCE

A. Representatives present for each entity shall be authorized to act on that entity’s behalf.
B. Required Attendees:

1. CONTRACTOR:
   a. Project manager.
   b. Site superintendent.
   c. Safety representative.
   d. When needed for the discussion of a particular agenda item, representatives of Subcontractors and Suppliers shall attend meetings.

2. ENGINEER:
   a. Project manager or designated representative, as required.
   b. Resident Project Representative.
   c. Others as required by ENGINEER.

3. OWNER’s representative(s), as required.

4. Testing and inspection agencies, as required.

5. Others, as appropriate.

1.3 AGENDA

A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revised agenda, if any, will be furnished to CONTRACTOR prior to first progress meeting. Progress meeting agenda may be modified by ENGINEER during the Project as required.

1. Review, comment, and amendment (if required) of minutes of previous progress meeting.

2. Review of progress since the previous progress meeting.

3. Planned progress through next progress meeting.

4. Review of Progress Schedule
   a. Contract Times, including Milestones (if any).
   b. Critical path.
   c. Schedules for fabrication and delivery of materials and equipment.
   d. Corrective measures, if required.

5. Submittals:
   b. Review revisions to Schedule of Submittals.

6. Contract Modifications
   a. Requests for interpretation.
   b. Clarification notices.
   c. Field Orders.
   d. Proposal requests.
   e. Change Order proposals.
   f. Work Change Directives.
   g. Change Orders.
   h. Claims.

7. Applications for progress payments.

8. Problems, conflicts, and observations.
9. Quality standards, testing, and inspections.
10. Coordination between parties.
11. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.
12. Safety.
13. Permits.
15. Record documents status.
16. Punch list status, as applicable.
17. Other business.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
**PART 1 – GENERAL**

1.1 **DESCRIPTION**

A. **Scope:**
   1. CONTRACTOR shall prepare and submit Progress Schedules and related documents in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section, unless otherwise accepted by ENGINEER.
   2. Maintain and update Progress Schedules and related documents.
   3. Progress Schedule shall be resource-loaded CPM Progress Schedule.
   4. ENGINEER’s acceptance of the Progress Schedule or related documents, and comments or opinions concerning activities in the Progress Schedule and related documents shall not control CONTRACTOR’s independent judgment concerning means, methods, techniques, sequences and procedures of construction, unless the associated means, method, technique, sequence, or procedure is directed by the Contract Documents. CONTRACTOR is solely responsible for complying with the Contract Times.

B. **Use of Float:**
   1. Float belongs to the Project and may be used by OWNER or CONTRACTOR to accommodate changes in the Work, or to mitigate the effect of events that delay performance or conformance with the Contract Times.
   2. Changes or delays that influence Activities that have float and that do not extend the Critical Path are not justification for an extension of the Contract Times.

C. **Factors Affecting the Progress Schedule:**
   1. In preparing the Progress Schedule, take into consideration submittal requirements and submittal review times, time for fabricating and delivering materials and equipment, Subcontractors’ work, availability and abilities of workers, availability of construction equipment, weather conditions, restrictions in operations at the Site and coordination with OWNER’s operations, and other factors that have the potential to affect completion of the Work within the Contract Times.
   2. Comply with sequencing requirements indicated in the following:
      a. Section 01 11 13, Summary of Work.
1.2 DEFINITIONS

A. The following terms are defined for this Section and supplement the terms defined in the General Conditions and Supplementary Conditions:

1. Activity: An element of the construction work that has the following specific characteristics: consumes time, consumes resources, has a definable start and finish, is assignable, and is measurable.

2. Constraint: An imposed date on the Progress Schedule or an imposed tie between Activities. The Contract Times are Constraints.

3. CPM Progress Schedule: Computerized Progress Schedule in Critical Path Method (CPM) format which accounts for the entire Work, defines the interrelationships between elements of the Work, reflects the uncompleted Work, and indicates the sequence with which the Work has been completed, indicates the sequence in which uncompleted Work will be completed, and indicates the duration of each Activity.

4. Critical Path: The continuous chain of Activities with the longest duration for completion within the Contract Times.

5. Early Start: The earliest possible date an Activity can start according to the assigned relationships among Activities.

6. Early Finish: The earliest date an Activity can finish according to the assigned relationships among the Activities.

7. Late Finish: The latest date an Activity can finish without extending the Contract Times.

8. Late Start: The latest date an Activity can start without extending the Contract Times.

9. Float: The time difference between the calculated duration of the Activity chain and the Critical Path.

10. Total Float: The total number of days that an Activity (or chain of Activities) can be delayed without affecting the Contract Times.

11. Network Diagram: A time-scaled logic diagram depicting the durations and relationships of the Activities.

12. Work Areas, Area, or System: A logical breakdown of the Project elements or a group of Activities which, when collectively assembled, are readily identifiable on the Project (for example, yard piping, a structure or building, a treatment process, or other logical grouping).

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Progress Schedule Preparer:

   a. CONTRACTOR shall retain services of a scheduling consultant or shall self-prepare and maintain the Progress Schedule using qualified employee with experience in scheduling, and experienced with the scheduling software required for this Project, and experience serving as Progress
Schedule preparer on construction projects of similar type, size, and scope to this Project.

b. Progress Schedule preparer shall have not less than five years experience using the schedule software required on construction projects of similar type, size, and scope as this Project.

c. Prior to engaging a scheduling consultant or using a qualified employee, submit to ENGINEER the following:
   1) Name and address of proposed Progress Schedule preparer and the names of personnel who will be assigned to scheduling the Project.
   2) Information sufficient to demonstrate that proposed Progress Schedule preparer and scheduling personnel to be assigned to the Project possess qualifications complying with requirements of this Section. For each person assigned, submit list of similar type, size, contract value of projects, names and contact information of engineer or architect and owner.

d. Engineer’s Review of Qualifications:
   1) ENGINEER will respond to CONTRACTOR whether proposed scheduling personnel are acceptable within 14 days after ENGINEER’s receipt of complete qualifications.
   2) If qualifications are not acceptable, submit qualifications of acceptable personnel within 14 days of receipt of ENGINEER’s non-acceptance.
   3) ENGINEER’s acceptance or non-acceptance of qualifications does not release CONTRACTOR from its obligations under the Contract Documents.

### 1.4 SUBMITTALS

A. Quantity of each submittal required and timing of submittals are in this Section.

B. Informational Submittals: Submit the following:
   1. Ninety-day Bar Chart:
      a. Preliminary 90-day bar chart.
      b. Acceptable 90-day bar chart.
   2. Initial Progress Schedules:
      a. Preliminary Progress Schedule with associated Network Diagrams, and narrative report.
      b. Acceptable Progress Schedule with associated Network Diagrams, and narrative report.
      c. Preliminary resource-loaded Progress Schedule and associated reports.
      d. Acceptable resource-loaded Progress Schedule and associated reports.
      e. Submit each Progress Schedule submittal with letter of transmittal complying with requirements of Section 01 33 00, Submittal Procedures.
   3. Progress Schedule Updates.
      a. Progress Schedule updates shall comply with requirements of this
Section, and shall include updated Progress Schedule, narrative report, and updated Network Diagram when relationships among Activities are changed.

b. Submit updated Progress Schedule at each progress meeting. If a Progress Schedule remains unchanged from one progress meeting to the next, submit a written statement to that effect. For monthly Progress Schedule submittals, bring to progress meeting the number of copies of the updated Progress Schedule specified in Section 01 31 19.23, Progress Meetings.

4. Look-Ahead Schedules
   a. Submit 30-day look-ahead schedule at each progress meeting.

5. Time Impact Analyses: Submit in accordance with this Section.

6. Recovery Schedule: Submit in accordance with this Section.

7. Qualifications:
   a. Progress Schedule preparer, and other personnel that will assist Progress Schedule preparer in preparing and maintaining the Progress Schedule.

1.5 INITIAL PROGRESS SCHEDULES

A. Type and Organization of Progress Schedules:
   1. Prepare Progress Schedule using Primavera P6 software, unless other scheduling software is acceptable to ENGINEER.
   2. Sheet Size: 22 inches by 34 inches, unless otherwise accepted by ENGINEER.
   3. Time Scale: Indicate first date of each work week.
   5. Progress Schedules shall be CPM Progress Schedules.
   6. Organization:
      a. Indicate on the separate Schedule of Submittals dates for submitting and reviewing Shop Drawings, Samples, and other submittals.
      b. Group deliveries of materials and equipment into a separate sub-schedule that is part of the Progress Schedule.
      c. Group construction into Work Area sub-schedules (that are part of the Progress Schedule) by Activity.
      d. Clearly indicate the Critical Path on the Progress Schedule.
      e. Organize each Work Area sub-schedule by Specification Section number.

B. Preliminary Progress Schedule:
   1. Within 30 days after the Contract Times commence running, CONTRACTOR shall submit to ENGINEER the preliminary Progress Schedule covering the entire Project, with associated Network Diagrams.
   2. Submit four copies of preliminary Progress Schedule and associated reports and schedule-related documents to accompany the preliminary Progress Schedule, in accordance with the Submittals Article of this Section. Submit in accordance with Section 01 33 00, Submittal Procedures.
3. ENGINEER will conduct a timely review of the preliminary Progress Schedule.
4. Preliminary Progress Schedule shall comply with the Contract Documents relative to Progress Schedules, but need not be resource-loaded.

C. Initial Acceptance of Progress Schedule:
   1. At least 45 days after the Contract Times commence running, a scheduling conference attended by CONTRACTOR, Progress Schedule preparer, ENGINEER, and others as appropriate will be held at the Site to review for acceptability to ENGINEER the preliminary Progress Schedule and associated Network Diagram and other reports and schedule-related documents required. CONTRACTOR shall have an additional 15 days to make corrections and adjustments and to complete and resubmit the Progress Schedule and associated Network Diagram. Other than bonds and insurance, mobilization, and approved Shop Drawings (and acceptance of other submittals, as applicable) required for fabricating or purchasing materials and equipment to be incorporated into the Work, no progress payment will be made to CONTRACTOR until acceptable Progress Schedule, Network Diagram, and other reports and schedule-related documents required are submitted to ENGINEER.
   2. Submit four copies each of acceptable Progress Schedule with Network Diagram, reports, and other schedule-related documents required to accompany the initial acceptable Progress Schedule, in accordance with the Submittals Article of this Section. Submit in accordance with Section 01 33 00, Submittal Procedures.
   3. The Progress Schedule will be acceptable to ENGINEER if it provides an orderly progression of the Work to completion within the Contract Times, in accordance with the Contract Documents. 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’s full responsibility therefor.
   4. Initially-accepted Progress Schedule shall be identified as the baseline Progress Schedule.

D. Resource-Loaded Progress Schedule:
   1. Within 10 days after ENGINEER’s acceptance of the Progress Schedule, submit to ENGINEER resource-loaded Progress Schedule complying with resource-loading requirements in this Section.
   2. Submit four copies each of the preliminary and the acceptable resource-loaded Progress Schedules and associated reports to accompany the initial submittals of resource-loaded Progress Schedules in accordance with the Submittals Article of this Section. Submit in accordance with Section 01 33 00, Submittal Procedures.
3. Resource-loaded Progress Schedules will be reviewed by ENGINEER within 10 days of ENGINEER’s receipt, and ENGINEER’s comments will be transmitted to CONTRACTOR.

4. Make revisions required in accordance with ENGINEER’s comments and resubmit to ENGINEER within 10 days of CONTRACTOR’s receipt of ENGINEER’s comments.

5. Resource-loaded Progress Schedule accepted by ENGINEER shall be the basis for determining the amount of each CONTRACTOR progress payment.

E. If the Progress Schedule reflects completion date(s) different than the Contract Times, the Contract Times are not thereby voided, nullified, or affected. The Contract Times govern. Where the Progress Schedule reflects completion date(s) that are earlier than the Contract Times, ENGINEER may accept such Progress Schedule with CONTRACTOR to specifically understand that no Claim for additional Contract Times or additions to the Contract Price shall be brought against OWNER resulting from CONTRACTOR’s failure to complete the Work by the earlier date(s) indicated on the accepted Progress Schedule.

1.6 PROGRESS SCHEDULE UPDATES

A. Updates:

1. Update the Progress Schedule each month. If during progress of the Work events develop that necessitate changes in the initially accepted Progress Schedule (e.g., baseline Progress Schedule), identify updated Progress Schedules sequentially as Progress Schedule Revision 1, 2, 3, and continuing in sequence as required. Number the Progress Schedule submittals in accordance with Section 01 33 00, Submittal Procedures.

2. CONTRACTOR’s Progress Schedule update shall include a narrative report in accordance with this Section. Narrative report shall include description of current progress and status of each Area of the Project, a description of progress for the period, a description of the Critical Path, a discussion of current or potential delays, Change Orders (pending and approved in since the previous Progress Schedule update), and other problems associated with maintaining the Work on schedule.

3. The update to the Progress Schedule shall be based on retained logic. Progress override logic is not allowed.

4. Required scheduling software, and schedule organization, format, and content for updated Progress Schedules are identical to that required in this Section for initial Progress Schedules.

5. Submit to ENGINEER four hard copies of the updated Progress Schedule, Network Diagram, narrative report, and other schedule-related reports and documents required, and two compact discs (CD) each with a complete software backup copy of the Progress Schedule.
6. Submit updated Network Diagrams when revisions are proposed to the logic. Indicate in the narrative report delays that have occurred since the previous updated Progress Schedule. ENGINEER will not recommend payment by OWNER of progress payments until updated Progress Schedule is received, reviewed, and accepted by ENGINEER. Payment for out-of-sequence Work is not allowed.

B. Monthly Schedule Meeting:
   1. During the month, utilizing the previous month’s 30-day look-ahead schedule. CONTRACTOR shall record the percent complete, start and finish dates of each scheduled Activity with the remaining duration for each Activity started but not completed, including Activities associated with procurement of materials and equipment.
   2. On the same day each month, at least one week prior to a progress meeting, CONTRACTOR, Progress Schedule preparer, ENGINEER, and others as appropriate shall meet at the Site and tour the Work to review and update the schedule and progress information gathered by CONTRACTOR during the month. After acceptance of CONTRACTOR’s updated data, Progress Schedule preparer shall use this information to update the Progress Schedule.

1.7 NETWORK DIAGRAMS (PERT CHARTS)

A. Network Diagrams, General:
   1. Prepare and submit Network Diagrams, as generated using the scheduling software on paper of the size indicated for Progress Schedules in this Section.
   2. Group Network Diagrams by Area and show the order and interdependence of Activities and sequence and quantities in which the Work will be accomplished.
   3. Do not use match lines on Network Diagrams. Depict interrelationships to or from Activities outside the Area shown using an Activity symbol with Activity number and description.
   4. In preparing Network Diagrams, comply with the basic concept of precedence diagramming method (PDM) network scheduling to show how start of a given Activity depends on completion of preceding Activities, and how the Activity’s completion may affect the start of subsequent Activities.
   5. Level of schedule detail shall define the day-to-day Activities of the Work.

B. Network Diagram Content:
   1. Clearly indicate the Critical Path and distinguish the Critical Path from other paths on the network.
   2. Organize Network Diagrams by grouping into major Work Areas, including one for procurement of materials and equipment, and by specific Activity within each Area.
   3. Logic diagrams shall include the following:
a. Activity number.
b. Activity description.
c. Activity duration (in work days).
d. Critical Path denoted.
e. Float for each Activity.
f. Activity or System designation.
g. Coded Area designation.
h. Responsibility code (e.g., CONTRACTOR, Subcontractor, trade, operation, Suppliers, or other entity responsible for accomplishing an Activity).
i. Shift number (if more than one shift per day is to be employed).

C. Network Diagram Revisions:
1. General:
   a. When conditions develop that require revisions to logic or durations of the Network Diagram associated with the initially accepted Progress Schedule (e.g., baseline Progress Schedule), identify updates to the Network Diagram in the same manner required in this Section for Progress Schedule updates.
   b. Revision of the logic or durations from the baseline Progress Schedule initially accepted by ENGINEER shall be submitted to ENGINEER for acceptance.
   d. Incorporate into the Progress Schedule revisions to logic or duration accepted by ENGINEER, and include in monthly narrative report both a description of revisions and listing of Activities affected by revisions.
   e. Changes resulting from Change Orders and other additions or deletions, shall be fully incorporated into the Progress Schedule and Network Diagram on the first update after the associated Change Order is approved by OWNER, including adjustments to the Contract Price.
2. Submit revised Network Diagrams with updated Progress Schedule submittals.

1.8 RESOURCE LOADING REPORTS

A. Resource Loading:
   1. After ENGINEER’s initial acceptance of the Progress Schedule, CONTRACTOR shall assign resources for personnel labor-hours, materials, and equipment to each construction Activity within each responsibility code. Submit resource schedule reports with each updated Progress Schedule.

1.9 NARRATIVE REPORT

A. Prepare and include with the preliminary Progress Schedule and each subsequent Progress Schedule submittal, written narrative report describing the schedule-related requirements of the Contract Documents and CONTRACTOR’s plan and schedule.
for complying with such requirements. Narrative report shall describe the methods of sequencing and operation, resources to be employed, time frames for the construction of each of the major Systems on the Project, and time frames for complying with the Contract Times and CONTRACTOR’s interim schedule milestones.

1.10 TIME IMPACT ANALYSIS

A. Time Impact Analyses, General:

1. Prepare and submit a time impact analysis when one or more of the following occurs: a Change Order proposal is prepared, a Work Change Directive is issued that will affect the Progress Schedule, or when delays are experienced. Time impact analysis shall illustrate the influence of each Change Order, Work Change Directive, or delay, as applicable, on the Contract Times and schedule milestones.

2. Each time impact analysis shall include a sketch (fragnet) demonstrating how CONTRACTOR proposes to incorporate the changes in the Work or, as applicable, delays into the Progress Schedule. Fragnet shall include all logic, resource changes, and additions required as result of said Change Order, Work Change Directive, or delay.

3. Fragnet shall show all CPM logic revisions for the Work associated with the Change Order, Work Change Directive, or delay and its relationship to other Activities in the Network Diagram.

4. Time impact analysis shall demonstrate the time impact, based on date the Change Order or Work Change Directive was given to CONTRACTOR, or as applicable the date the delay was implemented; the status of the Work at that point in time; and the Activity duration of affected Activities. Activity duration used in the time impact analysis shall be those included in the latest update of the Progress Schedule accepted by ENGINEER, closest to the time of the start of the delay or start of the Change Order or Work Change Directive, as adjusted by mutual, written agreement of the parties and ENGINEER.

5. Timing of Time Impact Analysis:

a. Submit each time impact analysis within 5 days after the following, as applicable:
   1) Start of the delay.
   2) After the submittal of Change Order proposal.
   3) After CONTRACTOR receipt of Work Change Directive.

b. When CONTRACTOR does not submit time impact analysis for a specific change or delay, within the specified period of time for such submittal, such non-submittal shall be construed that no extension of the Contract Times is required.

B. Evaluation by Engineer and Acceptance:
1. ENGINEER’s evaluation of each time impact analysis comprised of complete information will be completed in timely manner after ENGINEER’s receipt. Changes in the Contract Times will be made only by Change Order.

2. When mutual agreement is reached between the parties on effect of the change or delay in the Project, incorporate into the next Progress Schedule update the associated fragnets illustrating the influence of changes and delays.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide submittals in accordance with the General Conditions as modified by the Supplementary Conditions, and this Section.
2. Provide submittals well in advance of need for the material or equipment, or procedure (as applicable), in the Work and with ample time required for delivery of material or equipment and to implement procedures following ENGINEER’s approval or acceptance of the associated submittal. Work covered by a submittal will not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.
3. CONTRACTOR is responsible for dimensions to be confirmed and corrected at the Site, for information pertaining solely to the fabrication processes and to techniques of construction, and for coordinating the work of all trades. CONTRACTOR’s signature of submittal’s stamp and letter of transmittal shall be CONTRACTOR’s representation that CONTRACTOR has met his obligations under the Contract Documents relative to that submittal.

B. Samples:
1. Conform submittal of Samples to the General Conditions as modified by the Supplementary Conditions, this Section, and the Specification Section in which the Sample is specified.
2. Furnish at the same time Samples and submittals that are related to the same unit of Work or Specification Section. ENGINEER will not review submittals without associated Samples, and will not review Samples without associated submittals.
3. Samples shall clearly illustrate functional characteristics of product, all related parts and attachments, and full range of color, texture, pattern, and material.

1.2 TYPES OF SUBMITTALS

A. Submittal types are classified as follows: 1) Action Submittals, 2) Informational Submittals, 3) Closeout Submittals, and 4) Maintenance Material submittals. Type of each required submittal is designated in the respective Specification Sections; when type of submittal is not specified in the associated Specification Section, submittal will be classified as follows:
1. Action Submittals include:
   a. Shop Drawings.
   b. Product data.
   c. Delegated design submittals, which include documents prepared, sealed, and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier for materials and equipment to be incorporated into the completed Work. Delegated design submittals do not include submittals related to temporary construction unless specified otherwise in the related Specification Section. Delegated design submittals include: design drawings, design data including calculations, specifications, certifications, and other submittals prepared by such design professional.
   d. Samples.
   e. Testing plans, procedures, and testing limitations.

2. Informational Submittals include:
   a. Certificates.
   b. Design data not sealed and signed by a design professional retained by CONTRACTOR, Subcontractor, or Supplier.
   c. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, potential Hazardous Environmental Condition, and similar reports.
   d. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.
   e. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.
   f. Field or Site quality control submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site.
   g. Supplier reports.
   h. Sustainable design submittals (other than sustainable design closeout documentation).
   i. Special procedure submittals, including health and safety plans and other procedural submittals.
   j. Qualifications statements.

3. Closeout Submittals include:
   a. Maintenance contracts.
   b. Operations and maintenance data.
   c. Bonds, such as maintenance bonds and bonds for a specific product or system.
   d. Warranty documentation.
   e. Record documentation.
   f. Sustainable design closeout documentation.
   g. Software.

4. Maintenance Material Submittals include:
a. Spare parts.
b. Extra stock materials.
c. Tools.

5. When type of submittal is not specified and is not included in the list above, ENGINEER will determine the type of submittal.

B. Not Included in this Section: Administrative and procedural requirements for following are covered elsewhere in the Contract Documents:
1. Requests for interpretations of the Contract Documents.
2. Change Orders, Work Change Directives, and Field Orders.
3. Applications for Payment
4. Progress Schedules.
5. Photographic documentation.
6. Reports and documentation required in accordance with applicable permits
7. Site survey data.

1.3 SUBMITTALS REQUIRED IN THIS SECTION

A. Informational Submittals: Provide the following:
1. Schedule of Submittals:
   a. Timing:
      1) Provide submittal within time frames specified in the Contract Documents.
      2) Provide updated Schedule of Submittals with each submittal of the updated Progress Schedule.
   b. Content: In accordance with the General Conditions as modified by the Supplementary Conditions, and this Section. Requirements for content of preliminary Schedule of Submittals and subsequent submittals of the Schedule of Submittals are identical. Identify on Schedule of Submittals all submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Indicate submittals that are on the Project’s critical path. Indicate the following for each submittal:
      1) Date by which submittal will be provided to ENGINEER.
      2) Whether submittal will be for a substitution or “equal”. Procedures for substitutions and “or equals” are specified in the General Conditions and the Division 01 Specifications.
      3) Date by which ENGINEER’s response is required. At least 14 days shall be allowed from ENGINEER’s receipt of each submittal. Allow increased time for large or complex submittals.
      4) For submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of other contractors.
c. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules.

d. Coordinate Schedule of Submittals with the Progress Schedule.

e. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate submittals on the Project’s critical path, or that places extraordinary demands on ENGINEER for time and resources, is unacceptable. Do not include submittals not required by the Contract Documents.

f. In preparing Schedule of Submittals:
   1) Considering the nature and complexity of each submittal, allow sufficient time for review and revision.
   2) Reasonable time shall be allowed for: ENGINEER’s review and processing of submittals, for submittals to be revised and resubmitted, and for returning submittals to CONTRACTOR.
   3) Identify and accordingly schedule submittals that are expected to have long anticipated review times.

1.4 PROCEDURE FOR SUBMITTALS

A. Submittal Identification System: Use the following submittal identification system, consisting of submittal number and review cycle number.

1. Submittal Number: Shall be separate and unique number correlating to each individual submittal required. CONTRACTOR shall assign submittal number as follows:
   a. First part of submittal number shall be the applicable Specification Section number, followed by a hyphen.
   b. Second part of submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate and unique submittal provided under the associated Specification Section.
   c. Typical submittal number for the third submittal provided for Section 40 05 19, Ductile Iron Process Pipe, would be “40 05 19-003”.

2. Review Cycle Number: Shall be a letter designation indicating the initial submittal or re-submittal associated with each submittal number:
   a. “A” = Initial (first) submittal.
   b. “B” = Second submittal (e.g., first re-submittal).
   c. “C” = Third submittal (e.g., second re-submittal).

3. Examples:

<table>
<thead>
<tr>
<th>Example Description</th>
<th>Submittal Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial (first) review cycle of the third submittal provided under Section 40 05 19,</td>
<td>40 05 19-003- A</td>
</tr>
<tr>
<td>Ductile Iron Process Pipe</td>
<td></td>
</tr>
<tr>
<td>Second review cycle (first re-submittal) of third submittal provided under Section</td>
<td>40 05 19-003- B</td>
</tr>
<tr>
<td>40 05 19, Ductile Iron Process Pipe</td>
<td></td>
</tr>
</tbody>
</table>
B. Letter of Transmittal for Submittals:
   1. Provide separate letter of transmittal with each submittal. Each submittal shall be for one Specification Section.
   2. At beginning of each letter of transmittal, provide a reference heading indicating: CONTRACTOR’s name, OWNER’s name, Project name, Contract name and number, transmittal number, and submittal number.
   3. For submittals with proposed deviations from requirements of the Contract Documents, letter of transmittal shall specifically describe each proposed variation.

C. Contractor’s Review and Stamp:
   1. Contractor’s Review: Before transmitting submittals to ENGINEER, review submittals to:
      a. assure proper coordination of the Work;
      b. determine that each submittal is in accordance with CONTRACTOR’s desires;
      c. verify that submittal contains sufficient information for ENGINEER to determine compliance with the Contract Documents.
   2. Incomplete or inadequate submittals will be returned without review.
   3. Contractor’s Stamp and Signature:
      a. Each submittal provided shall bear CONTRACTOR’s stamp of approval and signature, as evidence that submittal has been reviewed by CONTRACTOR and verified as complete and in accordance with the Contract Documents.
      b. Submittals without CONTRACTOR’s stamp and signature will be returned without review. Signatures that appear to be computer-generated will be regarded as unsigned and the associated submittal will be returned without review.
      c. CONTRACTOR’s stamp shall contain the following:

“Project Name: ____________________________________________
Contractor’s Name: _________________________________________
Date: ____________________________________________________

-------------- Reference --------------

Item/Submittal Title: _________________________________________
Specifications:
   Section: ____________________________
   Page No.: __________________________
   Paragraph No.: _____________________
Drawing No.: ________________ of _____________
Location of Work: ________________________________

Submittal No. and Review Cycle: ________________________________

Coordinated by Contractor with Submittal Nos.: ________________________________

____________________________________________________________________

I hereby certify that the Contractor has satisfied Contractor’s obligations under the Contract Documents relative to Contractor’s review and approval of this submittal.

Approved By (for Contractor): ________________________________

D. Submittal Marking and Organization:
   1. Mark on each page of submittal and each individual component submitted with submittal number and applicable Specification paragraph.
   2. Arrange submittal information in same order as requirements are written in the associated Specification Section.
   3. Each Shop Drawing sheet shall have title block with complete identifying information satisfactory to ENGINEER.
   4. Package together submittals for the same Specification Section. Do not provide required information piecemeal.

E. Format of Submittal and Recipients:
   1. Action Submittals and Informational Submittals: Furnish in accordance with Table 01 33 00-A, except that submittals of Samples shall be as specified elsewhere in this Section:

   
<table>
<thead>
<tr>
<th>Address for Deliveries</th>
<th>Contact Person</th>
<th>E-mail Address</th>
<th>No. of Hardcopies</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Engineer: ARCADIS-US, Inc.</td>
<td>Melinda Shaw</td>
<td><a href="mailto:melinda.shaw@arcadis-us.com">melinda.shaw@arcadis-us.com</a></td>
<td>Two</td>
<td>One Electronic Version</td>
</tr>
<tr>
<td>14025 Riveredge Drive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tampa, FL  33637</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Resident Project Representative:</td>
<td>Garry Williams</td>
<td><a href="mailto:garry.williams@arcadis-us.com">garry.williams@arcadis-us.com</a></td>
<td>One</td>
<td></td>
</tr>
<tr>
<td>At the Site.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   2. Samples:
      a. Securely label or tag Samples with submittal identification number. Label or tag shall include clear space at least three inches by three inches in size for affixing ENGINEER’s review stamp. Label or tag shall not cover, conceal, or alter appearance or features of Sample. Label or tag shall not be separated from the Sample.
      b. Submit number of Samples required in Specifications. If number of Samples is not specified in the associated Specification Section, provide at least three identical Samples of each item required for ENGINEER’s
Samples will not be returned to CONTRACTOR. If CONTRACTOR requires Sample(s) for CONTRACTOR’s use, notify ENGINEER in writing and provide additional Sample(s). CONTRACTOR is responsible for furnishing, shipping, and transporting additional Samples.

c Deliver one Sample to ENGINEER’s field office at the Site. Deliver balance of Samples to ENGINEER at address listed in Table 01 33 00-A, unless otherwise directed by ENGINEER.

3. Closeout Submittals:
a. Provide the following Closeout Submittals in accordance with Table 01 33 00-A: maintenance contracts; bonds for specific products or systems; warranty documentation; and sustainable design closeout documentation. On documents such as maintenance contracts and bonds, include on each document furnished original signature of entity issuing the document.

b. Operations and Maintenance Data: Submit in accordance with Section 01 78 23, Operations and Maintenance Data.

c. Record Documentation: Submit in accordance with Section 01 78 39, Project Record Documentation.

d. Software: Submit number of copies required in Specification Section where the software is specified. If number of copies is not specified, provide two copies on compact disc in addition to software loaded on to OWNER’s computer(s) or microprocessor(s).


F. Distribution:
1. Distribution of Hardcopies: ENGINEER will distribute each reviewed submittal requiring ENGINEER’s written response as follows:

a. CONTRACTOR: two copies (except closeout submittals and maintenance material submittals).

b. Resident Project Representative: One copy (except closeout submittals and maintenance material submittals).

c. ENGINEER’s File: Two hard copies and one electronic version.

G. Resubmittals: Refer to the General Conditions for requirements regarding resubmitting required submittals.

1.5 ENGINEER’S REVIEW

A. Timing: ENGINEER’s review will conform to timing accepted by ENGINEER in the accepted Schedule of Submittals.
B. Submittals not required in the Contract Documents will not be reviewed by ENGINEER and will not be recorded in ENGINEER’s submittal log. All hardcopies of such submittals will be returned to CONTRACTOR.

C. Action Submittals, Results of ENGINEER’s Review: Each submittal will be given one of the following dispositions:
1. Approved: Upon return of submittal marked “Approved”, order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER’s approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents.
2. Approved as Corrected: Upon return of submittal marked “Approved as Corrected”, order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER’s approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents, provided it is in accordance with corrections indicated.
3. Approved as Corrected – Resubmit: Upon return of submittal marked “Approved as Corrected – Resubmit”, order, ship, or fabricate materials and equipment included in the submittal (pending ENGINEER’s approval or acceptance, as applicable, of source quality control submittals) or otherwise proceed with the Work in accordance with the submittal and the Contract Documents, provided it is in accordance with corrections indicated. Provide to ENGINEER record re-submittal with all corrections made. Receipt of corrected re-submittal is required before materials or equipment covered in the submittal will be eligible for payment.
4. Revise and Resubmit: Upon return of submittal marked “Revise and Resubmit”, make the corrections indicated and re-submit to ENGINEER for approval.
5. Not Approved: This disposition indicates material or equipment that cannot be approved. Upon return of submittal marked “Not Approved”, repeat initial submittal procedure utilizing approvable material or equipment.

D. Informational Submittals, Results of ENGINEER’s Review:
1. Each submittal will be given one of the following dispositions:
   a. Accepted: Information included in submittal conforms to the applicable requirements of the Contract Documents, and is acceptable. No further action by CONTRACTOR is required relative to this submittal, and the Work covered by the submittal may proceed, and products with submittals with this disposition may be shipped or operated, as applicable.
   b. Not Accepted: Submittal does not conform to applicable requirements of the Contract Documents and is not acceptable. Revise submittal and re-
submit to indicate acceptability and conformance with the Contract Documents.

E. Closeout Submittals, Results of ENGINEER’s Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Closeout Submittals will not receive a written response from ENGINEER. Disposition as “accepted” will be recorded in ENGINEER’s submittal log. When Closeout Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR.

F. Maintenance Material Submittals, Results of ENGINEER’s Review: Dispositions and meanings are the same as specified for Informational Submittals. When acceptable, Maintenance Material Submittals will not receive a written response from ENGINEER. Disposition as “accepted” will be recorded in ENGINEER’s submittal log. When Maintenance Material Submittal is not acceptable, ENGINEER will provide written response to CONTRACTOR, and CONTRACTOR is responsible for costs associated with transporting and handling of maintenance materials until compliance with the Contract Documents is achieved.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall employ and pay for services of independent testing laboratory to perform specified services.
2. Inspection, sampling, and testing shall be as specified in the Specifications including but not limited to:
   a. Section 03 00 05, Concrete.
   b. Section 04 00 05, Masonry.
   c. Section 05 05 33, Anchor Systems.
   d. Section 09 91 00, Painting.
   e. Section 31 20 00, Earth Moving.
   f. Section 33 05 05, Buried Piping Installation.
   g. Section 33 16 13, Pre-Stressed Concrete Tanks.
   h. Section 40 05 05, Exposed Piping Installation.
   i. Section 43 42 21, Hydropneumatic Tanks.
   j. Other tests in the Contract Documents that are not specifically assigned to others.
3. CONTRACTOR shall pay for:
   a. Tests not specifically indicated in the Contract Documents as being OWNER’s responsibility.
   b. Tests made for CONTRACTOR’s convenience.
   c. Repeat tests required because of CONTRACTOR’s negligence or defective Work, and retesting after failure of test for the same item to comply with the Contract Documents.
4. Testing laboratory is not authorized to approve or accept any portion of the Work or defective Work; rescind, alter, or augment requirements of Contract Documents; and perform duties of CONTRACTOR.

1.2 REFERENCES

A. Standards referenced in this Section are:

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Testing Laboratory:
      a. Comply with applicable requirements of ASTM E329.
      b. Testing laboratory shall be licensed to operate in the same state as the Site. Where applicable, laboratory shall be certified by the authority having jurisdiction for the types of testing required.
      c. Testing equipment used by laboratory shall be calibrated at maximum intervals of twelve months by devices of accuracy traceable to one of the following: NIST SRM, ISO/IEC 17025, certified by state or local bureau of weights and measures, or values of natural physical constants generally accepted in the engineering and scientific community.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Quality Control Submittals and Test Reports: Testing laboratory shall promptly submit to CONTRACTOR results of testing and inspections, including:
      a. Date issued.
      b. Project title, number, and name of the Site.
      c. Testing laboratory name and address.
      d. Name and signature of inspector or person obtaining samples.
      e. Date of inspection or sampling.
      f. Record of temperature and weather.
      g. Date of test.
      h. Identification of material or product tested, and associated Specification Section.
      i. Location in the Project.
      j. Type of inspection or test.
      k. Results of tests and observations regarding compliance with the Contract Documents.
   2. Qualifications Statements:
      a. Testing Laboratory:
         1) Qualifications statement indicating experience and facilities for tests required under the Contract Documents.
         2) Copy of report of inspection of facilities during most recent NIST inspection tour. Include memorandum of remedies of deficiencies reported during inspection.
         3) Copy of certificate of calibration for each instrument or measuring device proposed for use, by accredited calibration agency.
1.5 TESTING LABORATORY DUTIES

A. Testing laboratory shall:
   1. Cooperate with CONTRACTOR and provide qualified personnel promptly on notice.
   2. Perform required inspections, sampling, and testing of materials and methods of construction; comply with applicable reference standards and the Contract Documents; and ascertain compliance with requirements of the Contract Documents.
   3. Promptly notify ENGINEER and CONTRACTOR of irregularities or deficiencies in the Work that are observed during performance of services.
   4. Promptly submit to CONTRACTOR copies of reports of inspections and tests.
   5. Perform additional tests and services, as required by CONTRACTOR.

1.6 CONTRACTOR’S RESPONSIBILITIES

A. CONTRACTOR shall:
   1. Cooperate with testing laboratory personnel.
   2. Provide to testing laboratory preliminary representative samples of materials and products to be tested, in required quantities.
   3. Promptly submit to ENGINEER copies of results of tests and inspections received from testing laboratory.
   4. Provide to laboratory the preliminary design mix proposed for concrete and other material mixes to be tested by testing laboratory.
   5. Provide labor and facilities:
      a. For access to the Work to be tested, and where required, to Suppliers’ operations.
      b. For obtaining and handling samples at the Site.
      c. For facilitating inspections and tests.
      d. For testing laboratory’s exclusive use for storing and curing of test samples.
      e. Forms for preparing concrete test beams and cylinders.
   6. Notify laboratory and ENGINEER sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.
   7. Arrange with laboratory and pay for additional services, sampling, and testing required for CONTRACTOR’s convenience.

PART 2 – PRODUCTS (NOT USED)
PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall provide all temporary utilities required for the Project.
   1. Make all arrangements with utility service companies for temporary services and obtain required permits and approvals for temporary utilities.
   2. Pay all utility service costs, including cost of electricity, water, fuel, and other utility services required for the Work.
   3. Continuously maintain adequate utilities for all purposes during the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities through Substantial Completion and removal of temporary field offices and sheds.
   4. Should OWNER occupy part of the Project prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by OWNER will be shared proportionately between OWNER and CONTRACTOR as mutually agreed to by the parties.
   5. Maintain, including cleaning, temporary utilities and continuously provide consumables as required.
   6. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and requirements of Project.
   7. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

B. Provide the following temporary utilities:
   1. Electricity
   2. Lighting.
   3. Telephone and communications.
   5. Water.
   7. First-aid facilities.
   8. Fire protection.

1.2 REQUIREMENTS FOR TEMPORARY UTILITIES AND TEMPORARY FACILITIES

A. Electrical:
1. Provide temporary electrical service required for the Work, including continuous power for temporary field offices and sheds. Provide temporary outlets with circuit breaker protection and ground fault protection.

B. Lighting.
   1. Minimum lighting shall be five foot-candles for open areas and ten foot-candles for stairs and shops. Provide minimum of one, 300-watt lamp every 15 feet in indoor Work areas. Provide night security lighting of five foot-candles, minimum, within 50 feet of all parts of the Site during hours of darkness, controlled by photocell.

C. Telephone and Communications.
   1. Provide temporary telephone and communications required for CONTRACTOR’s operations at the Site and for summoning emergency medical assistance.

D. Heating, Ventilating, and Enclosures.
   1. Provide sufficient temporary heating, ventilating, and enclosures to ensure safe working conditions and prevent damage to existing facilities and the Work.
   2. Except where otherwise specified, temporary heating shall maintain temperature of the area served between 50 degrees F and maximum design temperature of building or facility and its contents.
   3. Maintain temperature of areas occupied by OWNER’s personnel or electronic equipment, including offices, lunch rooms, locker rooms, toilet rooms, and rooms containing computers, microprocessors, and control equipment, between 65 degrees F and 80 degrees F with relative humidity less than 75 percent.
   4. Required temperature range for storage areas and certain elements of the Work, including preparation of materials and surfaces, installation or application, and curing as applicable, shall be in accordance with the Contract Documents for the associated Work and the Supplier’s recommended temperature range for storage, application, or installation, as appropriate.
   5. Provide temporary ventilation sufficient to prevent accumulation in construction areas and areas occupied by OWNER of hazardous and nuisance levels or concentrations of dust and particulates, mist, fumes or vapors, odors, and gases, associated with construction.
   6. Provide temporary enclosures and partitions required to maintain required temperature and humidity.

E. Water.
   1. Provide temporary water facilities including piping, valves, meters if not provided by owner of existing waterline, backflow preventers, pressure regulators, and other appurtenances. Provide freeze-protection as required.
   2. Provide water for temporary sanitary facilities, field offices, Site maintenance and cleaning and, when applicable, disinfecting and testing of systems.
3. Continuously maintain adequate water flow and pressure for all purposes during the Project, until removal of temporary water system.

F. Sanitary Facilities.
1. Provide suitably-enclosed chemical or self-contained toilets for CONTRACTOR’s employees and visitors to the Site. Location of temporary toilets shall be acceptable to OWNER.
2. Provide supply of potable drinking water and related facilities and consumables for all personnel using the Site.
3. Provide suitable temporary washing facilities for employees and visitors.

G. First-aid Facilities.
1. Provide temporary first-aid stations at or immediately adjacent to the Site’s major work areas, and inside CONTRACTOR’s temporary field office. Locations of first-aid stations shall be determined by CONTRACTOR’s safety representative.
2. Provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 31 19.13, Pre-Construction Conference.

H. Fire Protection.
1. Provide temporary fire protection, including portable fire extinguishers rated not less than 2A or 5B in accordance with NFPA 10, Portable Fire Extinguishers, for each temporary building and for every 3,000 square feet of floor area under construction.
2. Comply with NFPA 241, Safeguarding Building Construction, Alteration, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for temporary systems may be new or used, but shall be adequate for purposes intended and shall not create unsafe conditions, and shall comply with Laws and Regulations.

B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.

PART 3 – EXECUTION
3.1 INSTALLATION

A. Install temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.

B. Location of Temporary Utilities and Temporary Facilities:
   1. Locate temporary systems for proper function and service.
   2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.
   3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.

C. Modify and extend temporary systems as required by progress of the Work.

3.2 USE

A. Maintain temporary systems to provide safe, continuous service as required.

B. Properly supervise operation of temporary systems:
   1. Enforce compliance with Laws and Regulations.
   2. Enforce safe practices.
   3. Prevent abuse of services.
   4. Prevent nuisances and hazards caused by temporary systems and their use.
   5. Prevent damage to finishes.
   6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.

C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

3.3 REMOVAL

A. Completely remove temporary utilities, facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore to preconstruction condition.

B. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.
C. When permanent utilities and systems that were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

++ END OF SECTION ++
SECTION 01 52 13

CONTRACTOR’S FIELD OFFICE AND SHEDS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide field office for CONTRACTOR’s use with at least the minimum facilities specified.
   2. Provide required storage and work sheds.
   3. Pay for required permits and utilities. Field offices and sheds shall comply with Laws and Regulations.

B. Location:
   1. Locate field offices and sheds in accordance with the Contract Documents and in accordance with the Site mobilization discussions at the preconstruction conference.

C. Furnish in field office one complete set of the Contract Documents for ready reference by interested parties. In addition to the reference set, comply with Section 01 78 39, Project Record Documents.

PART 2 – PRODUCTS

2.1 FIELD OFFICE AND SHEDS, FURNISHINGS, AND EQUIPMENT

A. Field Office and Furnishings:
   1. Construction: As required by CONTRACTOR and sufficient for Project meetings.
   2. Utilities and Services: Provide the following:
      a. Telephone service.
      b. Computer network and related facilities as required for CONTRACTOR needs.
      c. Utilities and related facilities for lighting and maintaining temperature.
   3. Furnishings:
      a. Conference Facilities: Provide conference area with conference table and chairs sufficient for six people. Conference facilities and furnishings shall be provided with suitable utilities, lighting, and temperature controls prior to the first progress meeting, unless otherwise approved by ENGINEER.
b. Other furnishings required by CONTRACTOR.

4. Provide on field office an exterior identification sign displaying CONTRACTOR’s company name. Maximum size of sign shall be four feet by eight feet. Sign shall be suitable for outdoor use for the duration of the Project.

5. Furnish and maintain at CONTRACTOR’s field office four protective helmets for use by visitors to the Site.

B. Storage and Work Sheds:

1. Provide storage and work sheds sized, furnished, and equipped to accommodate personnel, materials, and equipment involved in the Work, including temporary utility services and facilities required for environmental controls sufficient for personnel, materials, and equipment.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation:

1. Install field offices, sheds, and related facilities in accordance with Laws and Regulations.

2. Install materials and equipment, including prefabricated structures, in accordance with manufacturer’s instructions.

3.2 MAINTENANCE AND REMOVAL

A. Maintenance:

1. Clean and maintain field offices and sheds as required.

2. Provide consumables as required.

B. Removal:

1. Do not remove field offices and sheds until after Substantial Completion of the entire Work, unless otherwise approved by ENGINEER.

2. Remove field offices and sheds and restore areas prior to final inspection.

++ END OF SECTION ++
SECTION 01 57 05
TEMPORARY CONTROLS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide and maintain methods, equipment, and temporary construction as required to control environmental conditions at the Site and adjacent areas.
   2. Maintain controls until no longer required.
   3. Temporary controls include, but are not limited to, the following:
      a. Erosion and sediment controls.
      b. Noise controls.
      c. Dust control.
      d. Pest and rodent control.
      e. Control of water, including storm water runoff.
      f. Pollution control.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions and recommendations of jurisdictions having authority, including, but not limited to:
   1. Florida Department of Environmental Protection.
   2. Suwannee River Water Management District.
   3. Florida Department of Transportation.

PART 2 – PRODUCTS

2.1 MATERIALS FOR TEMPORARY EROSION AND SEDIMENT CONTROLS

A. Materials for temporary erosion and sediment controls shall be as shown or indicated on the Drawings.

B. Silt Fencing:
   1. Filter Cloth:
      a. Mirafi Envirofence, or equal.
      b. Height: 18 inches, minimum.
c. Securely fasten filter cloth to wire mesh using ties spaced at maximum intervals of two feet on centers at top and mid-height of wire mesh, as required and shown.

2. Wire Mesh: Support filter cloth with wire mesh complying with the following:
   a. Woven wire mesh, 14-gauge steel wire, maximum mesh size six-inch by six-inch.
   b. Height: To match filter cloth height.
   c. Fasten wire mesh to fence supports with wire ties or staples.

3. Fence Support Posts:
   a. Length: Three feet, minimum.
   b. Material: Metal or other acceptable material with "U" or "I" cross section, or minimum 1.25-inch by 1.25-inch hardwood.

C. Straw Bale Dike.
   1. Bales shall be firmly-packed, unrotted straw bound firmly with baling wire. Cross-sectional area on the small end of each bale shall be approximately 12 inches by 12 inches or larger.
   2. Posts shall comply with requirements for silt fencing support posts, or may be suitable reinforcing steel.

D. Mulch Materials and Soil Stabilization.
   1. Mulch shall be unrotted straw or salt hay.
   2. Soil stabilization emulsions, when used, shall be an inert, eco-friendly chemical manufactured for the specific purpose of erosion control and soil stabilization, applied with mulch or stabilization fibers.
   3. Wood-fiber or paper-fiber, when used, shall be 100 percent natural and biodegradable.
   4. Erosion control mat or netting shall be biodegradable. Acceptable materials include jute, excelsior, straw or coconut fiber, and cotton.

E. Protection of Storm Water Drainage Inlets and Catch Basins:
   1. Inlet Filter Bag:
      a. Product and Manufacturer: Provide one of the following for each drainage inlet or catch basin to be protected:
         1) Silt Sack, by Atlantic Construction Fabrics (ACF) Environmental
         2) Or equal.
      b. Inlet filter bag permeability shall be not less than 40 gallons per square foot of bag area exposed to the flow. Fabric shall be woven polypropylene with double stitching to prevent bursting.
      c. Inlet filter bags shall fit inside the drainage inlet or catch basin and shall be secured by the structure's grate or by other acceptable means.
      d. Inlet filter bags shall have means of removing inlet filter bag and the silt and sediment collected in the bag, without dumping filter bag's contents into the drainage inlet or catch basin.
2. Silt fence barrier, as shown.

F. Temporary Settlement Basin.
   1. Embankment Material: Comply with requirements for general fill in Division 31 Sections on earthwork, excavation, and fill.
   2. Provide outfall structure consisting of overflow weir and discharge pipe, and provide emergency spillway.
   3. Overflow Weir and Discharge Pipe: Suitably-sized piping of corrugated metal, high-density polyethylene, or other suitable material. Pipe may be new or used; if used, pipe shall be in good condition.

G. Filter Bag on Dewatering Pump Discharge:
   1. Provide filter bag on discharge of each dewatering pump drawing from an excavation. Filter bag is not required on pumps associated with dewatering wells.
   2. Products and Manufacturers: Provide one of the following:
      a. UltraTech Dewatering Bag, by Interstate Products.
      b. Filter Bag, by US Fabrics.
      c. Dewatering (Filter) Bag, Indian Valley Industries.
      d. DirtBag, by Atlantic Construction Fabrics (ACF) Environmental
      e. Or equal.
   3. Size filter bags for maximum flow of the pump. Filter bags shall be specifically fabricated for use as a dewatering pump filter bag.
   4. Provide sufficient spare filter bags for continuous dewatering operations.

H. Temporary Stone Construction Entrance:
   1. Stone: Tough, hard, durable stone complying with the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Total Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four-inch (100 mm)</td>
<td>100</td>
</tr>
<tr>
<td>3.5-inch (90 mm)</td>
<td>90 to 100</td>
</tr>
<tr>
<td>2.5-inch (65 mm)</td>
<td>25 to 60</td>
</tr>
<tr>
<td>1.5-inch (37.5 mm)</td>
<td>Zero to 15</td>
</tr>
</tbody>
</table>

   2. Geotextile: As recommended by geotextile manufacturer for separating stone from subgrade, for the vehicle weight and traffic frequency required.

PART 3 – EXECUTION

3.1 NOISE CONTROL

A. Noise Control – General:
1. CONTRACTOR’s vehicles and equipment shall minimize noise emissions to greatest degree practicable. Provide mufflers, silencers, and sound barriers when necessary.

2. Noise levels shall comply with Laws and Regulations, including OSHA requirements and local ordinances.

3. Noise emissions shall not interfere with the work of OWNER or others.

3.2 DUST CONTROL

A. Dust Control – General:
   1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, and other actions. To minimize airborne dust, apply water or use other methods subject to acceptance of ENGINEER and approval of authorities having jurisdiction.
   2. CONTRACTOR shall prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce on- and off-Site damage, nuisances, and health hazards associated with dust emissions. Control may be achieved by irrigation in which the Site shall be sprinkled with water until the surface is moist. Apply dust controls as frequently as required without creating nuisances such as excessive mud and ponding of water at the Site.
   3. Remove dust from roadways and access roads at maximum intervals of seven days by mechanical brooming or other method acceptable to ENGINEER.

3.3 PEST AND RODENT CONTROL

A. Pest and Rodent Control – General:
   1. Provide rodent and pest control as required to prevent infestation of the Site and storage areas.
   2. Employ methods and use materials that do not adversely affect conditions at the Site or on adjoining properties.
   3. In accordance with Laws and Regulations, promptly and properly dispose of pests and rodents trapped or otherwise controlled.

3.4 WATER CONTROL

A. Water Control – General:
   1. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the Site, and adjoining properties.
   2. Control fill, grading, and ditching to direct water away from excavations, pits, tunnels and other construction areas and to direct drainage to proper runoff courses to prevent erosion, damage, or nuisance.

B. Equipment and Facilities for Water Control: Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
C. Discharge and Disposal: Dispose of drainage water in manner to prevent flooding, erosion, and other damage to any and all parts of the Site and adjoining areas, and that complies with Laws and Regulations.

3.5 POLLUTION CONTROL

A. Pollution Control – General:
1. Provide means, methods, and facilities required to prevent contamination of soil, water, and atmosphere caused by discharge of noxious substances from construction operations.
2. Equipment used during construction shall comply with Laws and Regulations.

B. Spills and Contamination:
1. Provide equipment and personnel to perform emergency measures required to contain spills and to remove contaminated soils and liquids.
2. Excavate contaminated material and properly dispose of off-Site, and replace with suitable compacted fill and topsoil.

C. Protection of Surface Waters: Implement special measures to prevent harmful substances from entering surface waters. Prevent disposal of wastes, effluents, chemicals, and other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers.

D. Atmospheric Pollutants:
1. Provide systems for controlling atmospheric pollutants related to the Work.
2. Prevent toxic concentrations of chemicals and vapors.
3. Prevent harmful dispersal of pollutants into atmosphere.

E. Solid Waste:
1. Provide systems for controlling and managing solid waste related to the Work.
2. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.
3. Properly handle and dispose of solid waste.

3.6 EROSION AND SEDIMENT CONTROL

A. Installation and Maintenance of Erosion and Sediment Controls – General:
1. General:
   a. Provide erosion and sediment controls as shown and indicated on the Drawings and elsewhere in the Contract Documents. Provide erosion and sediment controls as the Work progresses into previously undisturbed areas.
b. Installation of erosion and sediment controls shall be in accordance with the applicable regulatory requirements indicated in Article 1.2 of this Section, unless otherwise shown or indicated in the Contract Documents.

c. Use necessary methods to successfully control erosion and sedimentation, including ecology-oriented construction practices, vegetative measures, and mechanical controls. Use best management practices (BMP) in accordance with Laws and Regulations, and regulatory requirements indicated in Article 1.2 of this Section, to control erosion and sedimentation during the Project.

d. Plan and execute construction, disturbances of soils and soil cover, and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation. Provide temporary measures for controlling erosion and sedimentation, as indicated in the Contract Documents and as required for the Project.

e. Where areas must be cleared for storage of materials or equipment, or for temporary facilities, provisions shall be made for regulating drainage and controlling erosion and sedimentation, subject to the ENGINEER’S approval.

f. Provide erosion and sediment controls, including stabilization of soils, at the end of each workday.

2. Coordination:
   a. Coordinate temporary erosion and sediment controls with construction of permanent drainage facilities and other Work to the extent necessary for economical, effective, and continuous erosion and sediment control.

3. Before commencing activities that will disturb soil or soil cover at the Site, provide all erosion and sediment control measures required by the Contract Documents for the areas where soil or soil cover will be disturbed.

4. In general, implement construction procedures associated with, or that may affect, erosion and sediment control to ensure minimum damage to the environment during construction. CONTRACTOR shall implement any and all additional measures required to comply with Laws and Regulations.

5. Vegetation Removal: Remove only those shrubs, grasses, and other vegetation that must be removed for construction. Protect remaining vegetation.

6. Access Roads and Parking Areas: When possible, access roads and temporary roads shall be located and constructed to avoid adverse effects on the environment. Provisions shall be made to regulate drainage, avoid erosion and sedimentation, and minimize damage to vegetation.

7. Earthwork and Temporary Controls:
   a. Perform excavation, fill, and related operations in accordance with Section 31 20 00, Earth Moving.

   b. Control erosion to minimize transport of silt from the Site into existing waterways and surface waters. Such measures shall include, but are not limited to, using berms, silt fencing, baled straw silt barriers, gravel or
crushed stone, mulching and soil stabilization, slope drains, and other methods. Apply such temporary measures to erodible materials exposed by activities associated with the construction of the Project.

c. Hold to a minimum the areas of bare soil exposed at one time.

d. Construct fills and waste areas by selectively placing fill and waste materials to eliminate surface silts and clays that will erode.

e. In performing earthwork, eliminate depressions that could serve as mosquito pools.

f. CONTRACTOR shall provide special care in areas with steep slopes, where disturbance of vegetation shall be minimized to maintain soil stability.

8. Inspection and Maintenance:
   a. Periodically inspect areas of earthwork and areas where soil or soil cover are disturbed to detect evidence of the start of erosion and sedimentation; apply corrective measures as required to control erosion and sedimentation. Continue inspections and corrective measures until soils are permanently stabilized and permanent vegetation has been established.

b. Repair or replace damaged erosion and sediment controls within 24 hours of CONTRACTOR becoming aware of such damage.

c. Periodically remove silt and sediment that has accumulated in or behind sediment and erosion controls. Properly dispose of silt and sediment.

9. Duration of Erosion and Sediment Controls:
   a. Maintain erosion and sediment controls in effective working condition until the associated drainage area has been permanently stabilized.

b. Maintain erosion and sediment controls until the Site is restored and site improvements including landscaping, if any, are complete with underlying soils permanently stabilized.

10. Work Stoppage: If the Work is temporarily stopped or suspended for any reason, CONTRACTOR shall provide additional temporary controls necessary to prevent environmental damage to the Site and adjacent areas while the Work is stopped or suspended.

11. Failure to Provide Adequate Controls: In the event CONTRACTOR repeatedly fails to satisfactorily control erosion and siltation, OWNER reserves the right to employ outside assistance or to use OWNER's own forces for erosion and sediment control. Cost of such work, plus engineering and inspection costs, will be deducted from monies due CONTRACTOR.

B. Silt Fencing:
   1. Install and maintain silt fencing in a vertical plane, at the location(s) shown or indicated on the Drawings.

   2. Locations of Silt Fencing:
      a. Where possible, install silt fencing along contour lines so that each given run fencing is at the same elevation.
b. On slopes install silt fencing at intervals that do not exceed the maximum intervals indicated in the following table:

<table>
<thead>
<tr>
<th>Slope (percent)</th>
<th>Maximum Length of Slope Above Each Silt Fence (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 and less</td>
<td>150</td>
</tr>
<tr>
<td>2.1 to 5</td>
<td>100</td>
</tr>
<tr>
<td>5.1 to 10</td>
<td>50</td>
</tr>
<tr>
<td>10.1 to 20</td>
<td>25</td>
</tr>
<tr>
<td>20.1 to 25</td>
<td>20</td>
</tr>
<tr>
<td>25.1 to 40</td>
<td>15</td>
</tr>
<tr>
<td>40.1 to 50</td>
<td>10</td>
</tr>
</tbody>
</table>

c. Provide silt fencing around perimeter of each stockpile of topsoil, general fill material, and excavated material. Install silt fencing before expected precipitation and maintain until stockpile is removed.

d. Do not install silt fencing at the following types of locations:
   1) Area of concentrated storm water flows such as ditches, swales, or channels.
   2) Where rock or rocky soils prevent full and uniform anchoring of silt fencing.
   3) Across upstream or discharge ends of storm water piping or culverts.

3. Installation:
   a. Securely fasten wire mesh to posts, and securely fasten filter cloth to wire mesh.
   b. When two sections of filter cloth abut each other, fold over edges and overlap by minimum of six inches and securely fasten to wire mesh.
   c. Embed posts in the ground to the depth necessary for proper controls; embed posts to at least 16 inches below ground.
   d. Filter cloth and wire mesh shall extend a minimum of eight inches below ground and a minimum of 16 inches above ground.
   e. Remove sediment accumulated at silt fencing as required. Repair and reinstall silt fencing as required.

4. Maintenance:
   a. Do not allow formation of concentrated storm water flows on slopes above silt fencing unless so shown or indicated in the Contract Documents. If unauthorized concentrated storm water flows occur, stabilize the slope via earthmoving and other stabilization measures as required to prevent flow of concentrated storm water flows toward silt fencing.

C. Straw Bale Dike.
   1. Install straw bale dikes where shown or indicated, including in swales, along contours, and along toe of slopes.
2. Install bales in shallow excavation as wide as the bale and approximately four to six inches below surrounding grade.
3. Ends of bale shall tightly abut ends of adjacent bales.
4. Securely install straw bales using two support posts per bale, driven into the ground a minimum of 1.5 to two feet below bottom of bale. Top of post shall be flush with top of bale. Angle first post for each bale toward the previously-installed bale.
5. Frequently inspect bales and repair or replace as required. Remove accumulated silt and debris from behind straw bales.

D. Mulching and Soil Stabilization:
1. Use mulching to temporarily stabilize exposed soil and fill material.
   a. Immediately following final grading, provide mulch and stabilize with mats or netting, or sprayed soil stabilization emulsion with fiber additive.
   b. Application of mulching for soil stabilization shall be as follows.
      1) Unrotted Straw or Salt Hay: 1.5 to two tons per acre.
      2) Soil stabilization emulsions, when used, shall be applied in accordance with manufacturer's instructions, and shall be applied with mulch or stabilization fibers.
      3) Wood-fiber or Paper-fiber Application: 1,500 lbs. per acre, installed by hydroseeding.
   c. Where mats or netting are used:
      1) Cover entire area to be stabilized with mats or netting.
      2) Provide anchoring trenches at the top and bottom of slopes to receive mats or netting. Bury at least the top and bottom ends of mat or netting, four inches or more wide, at top and bottom of slope. Tamp trench full of soil. Four inches from trench, secure mat or netting with appropriate staples spaced at intervals of 10 inches.
      3) Overlap adjacent strips of mat or netting by at least four inches.

E. Protection of Storm Water Drainage Inlets and Catch Basins:
1. Protect each drainage inlet and catch basin that has the potential to receive storm water runoff from exposed soils, and does not discharge into a storm water settlement basin.
2. Install either, inlet filter bags inside of drainage inlet or catch basin, or a silt fence barrier around drainage inlets and catch basins. Secure inlet filter bag with the structure's grate or by other acceptable means.
3. Inlet filter bags shall not pose any obstruction above the elevation of the drainage inlet or catch basin grate requiring barricades or flashers.
4. When removing silt and sediment from inlet filter bag, do not dump filter bag's contents into the drainage inlet or catch basin.
5. Remove silt and sediment from inlet filter bag, or replace inlet filter bag, when inlet filter bag is not more than half full.
F. Temporary Settlement Basin.
   1. For constructing embankments comply with requirements in Division 31
      Sections on earthwork, embankments, excavation, and fill.
   2. Overflow Weir and Discharge Pipe:
      a. Install piping in accordance with manufacturer's instructions.
      b. Install overflow weirs at elevations on shown or indicated on the
         Drawings or approved Shop Drawings, as applicable, to avoid
         overtopping and overfilling of settlement basin without short-circuiting
         the settlement basin's hydraulics.
      c. Wrap geotextile material specified for silt fencing around discharge
         structures of temporary settlement basins
   3. Crushed Stone and Riprap: Install in accordance with Division 31. Provide in
      areas of temporary settlement basin subject to erosion, and at upstream and
      downstream ends of discharge piping.
   4. Remove sediment when required based on accumulation of material.
   5. When temporary settlement basin is no longer required, remove the temporary
      settlement basin discharge weir, discharge pipe, and spillway, fill the temporary
      sediment basin to required grade in accordance with requirements of Division
      31 Section on excavation and fill.

G. Filter Bag on Dewatering Pump Discharge:
   1. Provide dewatering of excavations in compliance with Division 31 Sections on
      earthmoving, excavation, and fill.
   2. Locate filter bags and temporary pump discharge lines to avoid interfering with
      the public, use of private property, and OWNER's operations. Relocate filter
      bags and appurtenances when required.
   3. Filter bag discharge shall be directed to appropriate storm water drainage route.
      Do not discharge into roadways, driveways, or access roads. When temporary
      settlement basin is used, locate filter bags to discharge to temporary settlement
      basin when practicable.
   4. Provide filter bag on discharge of each dewatering pump drawing from an
      excavation.
   5. Securely attach filter bag to pump discharge pipe or hose.
   6. Maintain, clean out, and replace filter bags as required.

H. Temporary Stone Construction Entrance:
   1. Where shown on the Drawings, and where construction vehicles will regularly
      transit to paved surfaces from unstabilized surfaces, provide a temporary stone
      construction entrance. Contractor vehicles shall use temporary construction
      entrances.
   2. Provide temporary stone construction entrances of the width, length, and
      thickness shown or indicated on the Drawings. When not shown or indicated
      on the Drawings, temporary stone construction entrance shall be not less than
      50 feet long, by 20 feet wide, by eight inches deep.
3. Installation:
   a. Ensure that subgrade under temporary stone construction entrance is suitably dense for the intended purpose. Suitably prepare subgrade as required for temporary construction entrance.
   b. Provide on subgrade a layer of geotextile fabric, installed in accordance with geotextile manufacturer's recommendations for separation.
   c. Provide stone on installed geotextile. Grade stone for passage of vehicles.

4. Maintenance:
   a. Maintain temporary stone construction entrance at not less than the minimum required thickness. Add stone as required to maintain thickness.
   b. When upper layer of temporary stone construction entrance becomes contaminated with soil, remove the contaminated material and replace with clean stone.
   c. Using water to wash down temporary construction entrance or paved areas onto which soil material has been tracked is not allowed.

3.7 REMOVAL OF TEMPORARY CONTROLS

A. Removals – General:
   1. Upon completion of the Work, remove temporary controls and restore Site to pre-construction condition.
   2. After soils are permanently stabilized, remove from the Site temporary erosion and sediment controls.

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes the general requirements for preparing for shipping, delivering, and handling materials and equipment.
   2. CONTRACTOR shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.
   3. When required, move stored materials and equipment without additional compensation and without changes to the Contract Times.

1.2 SUBMITTALS

A. Refer to individual Specification Sections for submittal requirements relative to delivering and handling materials and equipment.

1.3 PREPARING FOR SHIPMENT

A. When practical, factory-assemble materials and equipment. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.

B. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate the associated purchase order number, bill of lading number, contents by name, OWNER’s contract name and number, CONTRACTOR name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

C. Protect materials and equipment from exposure to the elements and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer’s instructions.
D. Advance Notice of Shipments:
   1. Keep ENGINEER informed of delivery of all materials and equipment to be incorporated in the Work.
   2. Upon receipt of Supplier’s advance notice of shipment, at least seven days prior to delivery of materials and equipment, provide ENGINEER written notification of anticipated date and place of arrival of the following:
      a. Pre-Engineered Wood Building System.
      c. Engine Generator and ATS.
      d. Motor Control Centers.
      e. Packaged Potable Water Pump Station.
      f. Vertical Lineshaft Well Pumps.
      g. Hydropneumatic Tank.

E. Do not ship materials and equipment until:
   1. Related Shop Drawings and other submittals have been approved or accepted (as applicable) by ENGINEER, including, but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.
   2. Manufacturer’s instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by ENGINEER in accordance with the Specifications.
   3. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been reviewed and accepted by ENGINEER.
   4. Facilities required for handling materials and equipment in accordance with manufacturer’s instructions are in place and available.
   5. Required storage facilities have been provided.

1.4 DELIVERY

A. Scheduling and Timing of Deliveries:
   1. Arrange deliveries of materials and equipment in accordance with the accepted Progress Schedule and in ample time to facilitate inspection prior to installation.
   2. Schedule deliveries to minimize space required for and duration of storage of materials and equipment at the Site or delivery location, as applicable.
   3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:
      a. Work of other contractors and OWNER.
      b. Storage space limitations.
      c. Availability of equipment and personnel for handling materials and equipment.
      d. OWNER’s use of premises.
4. Deliver materials and equipment to the Site during regular working hours.
5. Deliver materials and equipment to avoid delaying the Work and the Project, including work of other contractors, as applicable. Deliver anchor system materials, including anchor bolts to be embedded in concrete or masonry, in ample time to avoid delaying the Work.

B. Deliveries:
1. Shipments shall be delivered with CONTRACTOR’s name, Subcontractor’s name (if applicable), Site name, Project name, and contract designation (example: “ABC Construction Co., City of Somewhere, Idaho, Wastewater Treatment Plant Primary Clarifier Improvements, Contract 25, General Construction”) clearly marked.
2. Site may be listed as the “ship to” or “delivery” address; but OWNER shall not be listed as recipient of shipment unless otherwise directed in writing by ENGINEER.
3. Provide CONTRACTOR’s telephone number to shipper; do not provide OWNER’s telephone number.
4. Arrange for deliveries while CONTRACTOR’s personnel are at the Site. CONTRACTOR shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when CONTRACTOR is not present will be refused by OWNER, and CONTRACTOR shall be responsible for the associated delays and additional costs, if incurred.

C. Containers and Marking:
1. Have materials and equipment delivered in manufacturer’s original, unopened, labeled containers.
2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Inspection of Deliveries:
1. Immediately upon delivery, inspect shipment to verify that:
   a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
   b. Quantities are correct.
   c. Materials and equipment are undamaged.
   d. Containers and packages are intact and labels are legible.
   e. Materials and equipment are properly protected.
2. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment to furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.
3. Advise ENGINEER in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise ENGINEER of the associated impact on the Progress Schedule.

1.5 HANDLING OF MATERIALS AND EQUIPMENT

A. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by OWNER, by methods that prevent soiling or damaging materials and equipment and packaging.

B. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.

C. Handle materials and equipment by methods that prevent bending and overstressing.

D. Lift heavy components only at designated lifting points.

E. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes general requirements for storing and protecting materials and equipment.

1.2 STORAGE

A. Store and protect materials and equipment in accordance with manufacturer’s recommendations and the Contract Documents.

B. CONTRACTOR shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment. Excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to OWNER, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to allow easy access for inspection.

C. Store materials and equipment to become OWNER’s property to facilitate their inspection and ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and high temperatures with ambient temperatures as high as 100 degrees F. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to OWNER. When placing orders to Suppliers for equipment and controls containing computer chips, electronics, and solid-state devices, CONTRACTOR shall obtain, coordinate, and comply with specific temperature and humidity limitations on materials and equipment, because temperature inside cabinets and components stored in warm temperatures can approach 200 degrees F.

D. CONTRACTOR shall be fully responsible for loss or damage (including theft) to stored materials and equipment.

E. Do not open manufacturer’s containers until time of installation, unless recommended by the manufacturer or otherwise specified in the Contract Documents.
F. Do not store materials or equipment in structures being constructed unless approved by ENGINEER in writing.

G. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.

1.3 PROTECTION

A. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01 65 00, Product Delivery Requirements.

B. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.

C. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of ENGINEER.

D. Protect electrical equipment, controls, and instrumentation against moisture, water damage, heat, cold, and dust. Space heaters provided in equipment shall be connected and operating at all times until equipment is placed in operation and permanently connected.

1.4 UNCOVERED STORAGE

A. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:
   1. Reinforcing steel.
   2. Precast concrete materials.
   4. Metal stairs.
   5. Handrails and railings.
   7. Checker plate.
   8. Metal access hatches.
  10. Rigid electrical conduit.
  11. Piping, except polyvinyl chloride (PVC) pipe.
1.5 COVERED STORAGE

A. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
   1. Grout and mortar materials.
   2. Masonry units.
   3. Rough lumber.
   4. Soil materials and granular materials such as aggregate.
   5. PVC pipe.

B. Tie down covers with rope, and slope covering to prevent accumulation of water.

C. Store loose granular materials, with covering impervious to water, in well-drained area or on solid surfaces to prevent mixing with foreign matter.

1.6 FULLY PROTECTED STORAGE

A. Store all material and equipment not named in Articles 1.4 and 1.5 of this Section on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully closed walls on all sides. Covering with visquine plastic sheeting or similar material in space without floor, roof, and walls is not acceptable. Comply with the following:
   1. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.
   2. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures.
   3. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
   4. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

1.7 HAZARDOUS PRODUCTS

A. Prevent contamination of personnel, storage area, and the Site. Comply with all applicable Laws and Regulations.

1.8 MAINTENANCE OF STORAGE

A. On scheduled basis, periodically inspect stored materials and equipment to ensure that:
   1. Condition and status of storage facilities is adequate to provide required storage conditions.
   2. Required environmental conditions are maintained on continuing basis.
   3. Materials and equipment exposed to elements are not adversely affected.
B. Mechanical and electrical equipment requiring long-term storage shall have complete manufacturer’s instructions for servicing each item, with notice of enclosed instructions shown on exterior of container or package.
1. Comply with manufacturer’s instructions on scheduled basis.
2. Space heaters that are part of electrical equipment shall be connected and operated continuously until equipment is placed in service and permanently connected.

1.9 MICROPROCESSORS, PANELS, AND INSTRUMENTATION STORAGE

A. Store panels, microprocessor-based equipment, electronics, and other devices subject to damage or decreased useful life because of temperatures below 40 degrees F or above 100 degrees F, relative humidity above 90 percent, or exposure to rain or exposure to blowing dust in climate-controlled storage space.

B. Requirements:
1. Storage shall be in third-party owned, bonded, insured, climate-controlled warehouse in Suwannee County.
2. OWNER and ENGINEER have the right to inspect materials and equipment during normal working hours.
3. Placed inside each panel or device a desiccant, volatile corrosion inhibitor blocks (VCI), moisture indicator, and maximum-minimum indicating thermometer.
4. Check panels and equipment at least once per month. Replace desiccant, VCI, and moisture indicator as often as required, or every six months, whichever occurs first.

C. Costs for storing climate-sensitive materials and equipment shall be paid by CONTRACTOR. Replace panels and devices damaged during storage, or for which storage temperatures or humidity range has been exceeded, at no additional cost to OWNER. Delays resulting from such replacement are causes within CONTRACTOR’s control.

D. Do not ship panels and equipment to the Site until conditions at the Site are suitable for installation, including slabs and floors, walls, roofs, and environmental controls. Failure to have the Site ready for installation shall not relieve CONTRACTOR from complying with the Contract Documents.

1.10 RECORDS

A. Keep up-to-date account of materials and equipment in storage to facilitate preparation of Applications for Payment, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.
PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +
SECTION 01 75 11
CHECKOUT AND STARTUP PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall initially start up and place equipment installed under the Contract into successful operation, in accordance with the equipment manufacturer’s written instructions and as instructed by Supplier at the Site.
   2. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up.
   3. Provide chemicals, lubricants, and other required operating fluids.
   4. Provide fuel, electricity, water, filters, and other expendables required for start-up of equipment, unless otherwise specified.
   5. General Activities Include:
      a. Cleaning, as required under other provisions of the Contract Documents.
      b. Removing temporary protective coatings.
      c. Flushing and replacing lubricants, where required by manufacturer.
      d. Lubrication.
      e. Checking shaft and coupling alignments and resetting where required.
      f. Checking and setting motor, pump, and other equipment rotation, safety interlocks, and belt tensions.
      g. Checking and correcting (if necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.
      h. All adjustments required.

B. Coordination:
   1. Coordinate checkout and start-up with other contractors, as necessary.
   2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
   3. OWNER will provide sufficient personnel to assist CONTRACTOR in starting up equipment, but responsibility for proper operation is CONTRACTOR’s.
   4. Supplier shall be present during checkout, start-up, and initial operation, unless otherwise acceptable to ENGINEER.
   5. Start-up of heating and air conditioning equipment and systems is dependent upon the time of year. Return to the Site at beginning of next heating or air
conditioning season (as applicable) to recheck and start the appropriate systems.

6. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals by CONTRACTOR, in accordance with Section 01 78 23, Operations and Maintenance Data.

C. OWNER’s Assumption of Responsibility for Equipment and Systems:
   1. OWNER will assume responsibility for the equipment upon Substantial Completion.
   2. Prior to turning over to OWNER responsibility for operating and maintaining system or equipment:
      a. Provide training of operations and maintenance personnel in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
      b. Complete system field quality control testing in accordance with the Contract Documents.
      c. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
      d. Obtain from ENGINEER final certificate of Substantial Completion for either entire Work or the portion being turned over to OWNER.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:
   1. Certifications:
      a. Supplier’s certification of installation in accordance with Paragraph 3.1.B of this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SERVICES OF SUPPLIER

A. When specified, furnish services of competent, qualified representatives of material and equipment manufacturers as specified, including supervising installation, adjusting, checkout, start-up, and testing of materials and equipment.

B. Certification:
   1. When services by Supplier are required at the Site, within 14 days after first test operation of equipment, submit to ENGINEER a letter from Supplier, on Supplier’s letterhead, stating that materials and equipment are installed in
accordance with Supplier’s requirements and installation instructions, and in accordance with the Contract Documents.

2. In lieu of Supplier letter, submit completed form attached to this Section.
3. Include in the final operations and maintenance manual for the associated equipment a copy of the letter or completed form, as applicable.

3.2 MINIMUM START-UP REQUIREMENTS

A. Bearings and Shafting:
1. Inspect for cleanliness, and clean and remove foreign matter.
2. Verify alignment.
3. Replace defective bearings and those that operate in a rough or noisy manner.
4. Grease as necessary, in accordance with manufacturer’s recommendations.

B. Drives:
1. Adjust tension in V-belt drives and adjust vari-pitch sheaves and drives for proper equipment speed.
2. Adjust drives for alignment of sheaves and V-belts.
3. Clean and remove foreign matter before starting operation.

C. Motors:
1. Check each motor for comparison to amperage nameplate value.
2. Correct conditions that produce excessive current flow and conditions that exist due to equipment malfunction.

D. Pumps:
1. Check glands and seals for cleanliness and adjustment before running pump.
2. Inspect shaft sleeves for scoring.
3. Inspect mechanical faces, chambers, and seal rings, and replace if defective.
4. Verify that piping system is free of dirt and scale before circulating liquid through pump.

E. Valves:
1. Inspect manual and automatic control valves, and clean bonnets and stems.
2. Tighten packing glands to ensure no leakage, but allow valve stems to operate without galling.
3. Replace packing in valves to retain maximum adjustment after system is determined to be complete.
4. Replace packing on valves that continue to leak.
5. Remove and repair bonnets that leak.
6. After cleaning, coat packing gland threads and valve stems with surface preparation of “Molycote” or “Fel-Pro”.

Suwannee County WTP
Checkout and Startup Procedures
40039002.0000  01 75 11-3
F. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.

G. Tighten flanges and other pipe joints after system has been placed in operation. Replace gaskets that show signs of leakage after tightening.

H. Inspect all joints for leakage:
   1. Promptly remake each joint that appears to be faulty; do not wait for rust other corrosion to form.
   2. Clean threads on both parts, and apply compound and remake joints.

I. After system has been placed in operation, clean strainers, drives, pockets, orifices, valve seats, and headers in fluid system to ensure freedom from foreign matter.

J. Open air vents, where used, and remove operating elements. Clean thoroughly, replace internal parts, and place back into operation.

K. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.

L. Set and calibrate equipment as required.

M. Inspect fan wheels for clearance and balance. Provide factory-authorized personnel for adjustment when needed.

N. Check each electrical control circuit to verify that operation complies with the Contract Documents.

O. Inspect each pressure gauge, thermometer, and other instruments for calibration. Replace items that are defaced, broken, or that read incorrectly.

P. Repair damaged insulation.

Q. Excess Gasses and Fluids:
   1. Vent gasses trapped in systems.
   2. Verify that liquids are drained from all parts of air systems.

3.3 ATTACHMENTS

A. The attachment listed below, following the “End of Section” designation, is a part of this Specification Section.
   1. Supplier’s Installation Certification Form (one page).

++ END OF SECTION ++
SUPPLIER’S INSTALLATION CERTIFICATION

Contract No. and Name: ______________________________

Equipment Specification Section: __________________

Equipment Name: _________________________________

Contractor: ______________________________________

Manufacturer of Equipment: _________________________

The undersigned Supplier of the equipment described above hereby certifies that Supplier has checked the equipment installation and that the equipment, as specified in the Contract Documents, has been provided in accordance with the manufacturer’s recommendations and the Contract Documents, and that the trial operation of the equipment has been satisfactory.

Comments: _______________________________________

__________________________
Date Supplier Name (print)

__________________________
Signature of Supplier

__________________________
Date Contractor Name (print)

__________________________
Signature of Contractor
SECTION 01 77 19

CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. Definitions: Closeout is defined to include the general requirements near the end of the Contract Time, in preparation for final acceptance, final payment, normal termination of the Contract, occupancy by the OWNER and similar actions evidencing completion of the WORK.

1.2 PREREQUISITES FOR FINAL ACCEPTANCE

A. General: Prior to requesting the OWNER’s final inspection for certifications of final acceptance and final payment, as required by the General Conditions, complete the following and list known exceptions (if any) in request:
   1. Submit final payment request with final releases and supports not previously submitted and accepted. Include certificates of insurance for products and completed operations.
   2. Submit updated final statement, accounting for additional changes to the Contract Sum.
   3. Submit certified copy of the OWNER's final punch-list of itemized WORK to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by the OWNER.

1.3 CLOSEOUT PROCEDURES

A. General Operating/Maintenance Instructions: Arrange for each installer of WORK requiring continuing maintenance (by the OWNER) or operation, to meet with the OWNER's personnel, at the project site, to provide basic instructions needed for proper operation and maintenance of the entire WORK. Include instructions by manufacturer's representatives where installers are not expert in the required procedures. Review maintenance manuals, record documentation, tools, spare parts and materials, identification system, hazards, cleaning and similar procedures and facilities. For operational equipment, demonstrates start-up, shut-down, emergency operations, noise and vibration adjustments, safety, economy/efficiency adjustments, and similar operations. Review maintenance and operations in relation with applicable guarantees, warranties, agreements to maintain, bonds and similar continuing commitments.
1.4 FINAL CLEANING

A. General: As specified herein, provide final cleaning of the WORK. The following are examples, but not by way of limitation, of the cleaning levels required.

1. Clean project site (yard and grounds), including landscaping, development areas, of litter and foreign substances. Sweep paved areas to a broom-clean condition; remove stains, petrochemical spills and other foreign deposits. Rake grounds, which are neither planted nor paved, to a smooth evenly textured surface.

2. Restore the grass and landscaping to original condition. Repair ruts caused by equipment.

3. Remove discharge piping and restore discharge pipeline trends to original condition. Sod where needed. Mow grass where needed.

4. Remove discharge piping and restore outfall area to original condition.

1.5 REMOVAL OF PROTECTION

A. Except as otherwise indicated or requested by the OWNER, remove temporary protection devices and facilities which were installed during the course of the WORK to protect previously completed WORK during the remainder of the construction period.

1.6 COMPLIANCE

A. Comply with safety standards and governing regulations for cleaning operations. Do not burn waste materials at the site, or bury debris or excess materials on the OWNER's property, or discharge volatile or other harmful or dangerous materials into drainage systems; remove waste materials from the site and dispose of in a lawful manner.

B. Where extra materials of value remaining after completion of the associated WORK have become the OWNER's property, dispose or store at the site as directed by the OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.
2. Required operation and maintenance data are presented in the individual Specification Sections. At minimum, submit operation and maintenance data for:
   a. All equipment and systems.
   b. Valves, gates, actuators, and related accessories.
   c. Instrumentation and control devices.
   d. Electrical gear.
3. For each operation and maintenance manual, submit the following:
   b. Final Submittal: Printed and bound copy of complete operations and maintenance manual, including test data and service reports by Supplier, with electronic copies.

B. Quantity Required and Timing of Submittals:
1. Preliminary Submittal:
   a. Electronic Copies: Two copies, exclusive of any printed copies required by CONTRACTOR.
   b. Submit to ENGINEER by the earlier of: ninety days following approval of Shop Drawings and product data submittals, or ten days prior to starting training of operations and maintenance personnel, or ten days prior to field quality control testing at the Site.
2. Final Submittal: Provide final submittal prior to Substantial Completion, unless submittal is specified as required prior to an interim Milestone.
   a. Printed Copies: Three copies.
   b. Electronic Copies: Three copies.
1.2 FORMAT OF PRINTED COPIES

A. Binding and Cover:
   1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.
   2. Binders shall be locking three-ring/"D"-ring type, or three-post type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front of each volume.
   3. Do not overfill binders.
   4. Covers shall be oil-, moisture-, and wear-resistant, including identifying information on cover and spine of each volume.
   5. Provide the following information on cover of each volume:
      a. Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”.
      b. Name or type of material or equipment covered in the manual.
      c. Volume number, if more than one volume is required, listed as “Volume ____ of ____”, with appropriate volume-designating numbers filled in.
      d. Name of Project and, if applicable, Contract name and number.
      e. Name of building or structure, as applicable.
   6. Provide the following information on spine of each volume:
      a. Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”.
      b. Name or type of material or equipment covered in the manual.
      c. Volume number, if more than one volume is required, listed as “Volume ____ of ____”, with appropriate volume-designating numbers filled in.
      d. Project name and building or structure name.

B. Pages:
   1. Print pages in manual on 30-pound (minimum) paper, 8.5 inches by 11 inches in size.
   2. Reinforce binding holes in each individual sheet with plastic, cloth, or metal. When published, separately-bound booklets or pamphlets are part of the manual, reinforcing of pages within booklet or pamphlet is not required.
   3. Provide each page with binding margin at least one inch wide. Punch each page with holes suitable for the associated binding.

C. Drawings:
   1. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing specified for pages.
   2. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.
D. Copy Quality and Document Clarity:
1. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color. Manuals that contain copies that are unclear, not completely legible, off-center, skewed, or where text or drawings are cut by binding holes, are unacceptable. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable. Faxed copies are unacceptable.
2. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content. Using highlighters to so indicate options furnished is unacceptable.

E. Organization:
1. Coordinate with ENGINEER and OWNER to develop comprehensive, practical, and consistent indexing system for operations and maintenance data. ENGINEER will review indexing system before operations and maintenance data is submitted.
2. Table of Contents:
   a. Provide table of contents in each volume of each operations and maintenance manual.
   b. In table of contents and at least once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identification is unacceptable.
3. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

1.3 FORMAT OF ELECTRONIC COPIES

A. Electronic Copies of Operation and Maintenance Manuals:
1. Each electronic copy shall include all information included in the corresponding printed copy.
2. Submit each electronic copy on a separate compact disc (CD), unless another electronic data transfer method or format is acceptable to ENGINEER.
3. File Format:
   a. Files shall be in “portable document format” (PDF). Files shall be electronically searchable.
   b. Submit separate file for each separate document in the printed copy.
c. Within each file, provide bookmarks for the following:
   1) Each chapter and subsection listed in the corresponding printed copy document’s table of contents.
   2) Each figure.
   3) Each table.
   4) Each appendix.

4. At the request of the OWNER, also submit drawings and figures in one of the following formats: “.bmp”, “.tif”, “.jpg”, or “.gif”. Submit files in a separate directory on the CD.

1.4 CONTENT

A. General:
   1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
   2. Completeness and Accuracy:
      a. Operation and maintenance manuals that include language stating or implying that the manual’s content may be insufficient or stating that the manual’s content is not guaranteed to be complete and accurate are unacceptable.
      b. Operations and maintenance manuals shall be complete and accurate.
      c. Operation and maintenance manuals shall indicate the specific alternatives and features furnished, and the specific operation and maintenance provisions for the material or equipment furnished.

3. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.

B. Submit written explanations of all safety considerations relating to operation and maintenance procedures.

C. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems
function economically throughout their expected service life. Instructions shall include:

1. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.
2. Recommended schedule for each preventive maintenance task.
3. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
4. Table of alternative lubricants.
5. Troubleshooting instructions.
6. List of required maintenance tools and equipment.

D. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
   1. Manufacturer’s name, address, telephone number, fax number, and Internet website address.
   2. Manufacturer’s local service representative’s or local parts supplier’s name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
   3. Manufacturer’s shop order and serial number(s) for materials, equipment or assembly furnished.
   4. For each part or piece include the following information:
      a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
      b. Part name or description.
      c. Manufacturer’s part number.
      d. Quantity of each part used in each assembly.
      e. Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.

E. Submit compete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.

F. Submit manufacturer’s recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.
G. Submit manufacturer’s installation and operation bulletins, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.

H. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.

I. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.

J. Submit copy of warranty bond and service contract as applicable.

K. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder’s written permission to use such material in the operation and maintenance manual.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall maintain and submit to ENGINEER with record documents as specified below, except where otherwise specified or modified in Divisions 2 through 46.

B. Maintenance of Record Documents:
   1. Maintain in CONTRACTOR’s field office, in clean, dry, legible condition, complete sets of the following record documents: Drawings, Specifications, and Addenda; Shop Drawings, and other CONTRACTOR submittals, including records of test results, approved or accepted as applicable, by ENGINEER; Change Orders, Work Change Directives, Field Orders, photographic documentation, survey data, and all other documents pertinent to the Work.
   2. Make record documents available for inspection upon request of ENGINEER or OWNER.
   3. Do not use record documents for purpose other than serving as Project record. Do not remove record documents from CONTRACTOR’s field office without ENGINEER’s approval.

C. Submittal of Record Documents:
   1. Submit to ENGINEER the following record documents:
      a. Drawings.
      b. Project Manual including Specifications and Addenda (bound).
   2. Prior to readiness for final payment, submit to ENGINEER one copy of final record documents. Submit complete record documents; do not make partial submittals.
   3. Submit record documents with transmittal letter on CONTRACTOR letterhead complying with letter of transmittal requirements in Section 01 33 00, Submittal Procedures.
   4. Record documents submittal shall include certification, with original signature of official authorized to execute legal agreements on behalf of CONTRACTOR, reading as follows:
      “[Insert Contractor’s corporate name] has maintained and submitted record documentation in accordance with the General Conditions and Supplementary Conditions, Section 01 78 39, Project Record Documents, and other elements of Contract Documents, for the Suwannee County Water Treatment Plant, Suwannee County, Florida. We certify that each record document submitted is
complete, accurate, and legible relative to the Work performed under our Contract, and that the record documents comply with the requirements of the Contract Documents.

[Provide signature, print name, print signing party’s corporate title, and date].

1.2 RECORDING CHANGES

A. General:

1. At the start of the Project, label each record document to be submitted as, “PROJECT RECORD” using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.
2. Keep record documents current. Make entries on record documents within two working days of receipt of information required to record the change.
3. Do not permanently conceal the Work until required information has been recorded.
4. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from ENGINEER-accepted record documents.
5. Marking of Entries:
   a. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.
   b. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of record documents into legible electronic files.
   c. Date all entries on record documents.
   d. Call attention to changes by drawing a “cloud” around the change(s) indicated.
   e. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

B. Drawings:

1. Record changes on copy of the Drawings. Submittal of CONTRACTOR-originated or -produced drawings as a substitute for recording changes on the Drawings is unacceptable.
2. Record changes on plans, sections, schematics, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.
3. Record actual construction including:
   a. Depths of various elements of foundation relative to Project datum.
   b. Horizontal and vertical location of Underground Facilities referenced to permanent surface improvements. For each Underground Facility,
including pipe fittings, provide dimensions to at least two permanent, visible surface improvements.

c. Location of exposed utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

d. Changes in structural and architectural elements of the Work, including changes in reinforcing.

e. Field changes of dimensions, arrangements, and details.

f. Changes made in accordance with Change Orders, Work Change Directives, and Field Orders.

g. Changes in details on the Drawings. Submit additional details prepared by CONTRACTOR when required to document changes.

4. Recording Changes for Schematic Layouts:

a. In some cases on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by CONTRACTOR subject to acceptance by ENGINEER.

b. Record on record documents all revisions to schematics on Drawings, including: piping schematics, ducting schematics, process and instrumentation diagrams, control and circuitry diagrams, electrical one-line diagrams, motor control center layouts, and other schematics when included in the Contract. Record actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.

c. When dimensioned plans and dimensioned sections on the Drawings show the Work schematically, indicate on the record documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items

1) Clearly identify the Work item by accurate notations such as “cast iron drain”, “rigid electrical conduit”, “copper waterline”, and similar descriptions.

2) Show by symbol or note the vertical location of Work item; for example, “embedded in slab”, “under slab”, “in ceiling plenum”, “exposed”, and similar designations. For piping not embedded, also provide elevation dimension relative to Project datum.

3) Descriptions shall be sufficiently detailed to be related to Specifications.

d. ENGINEER may furnish written waiver of requirements relative to schematic layouts shown on plans and sections when, in ENGINEER’s judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on waiver(s) being issued.

5. Supplemental Drawings:

a. In some cases, drawings produced during construction by ENGINEER or CONTRACTOR supplement the Drawings and shall be included with record documents submitted by CONTRACTOR. Supplemental record
drawings shall include drawings provided with Change Orders, Work Change Directives, and Field Orders and that cannot be incorporated into the Drawings due to space limitations.

b. Supplemental drawings provided with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.

c. When supplemental drawings developed by CONTRACTOR using computer-aided drafting/design (CADD) software are to be included in record drawings, submit electronic files for such drawings in AutoCAD as part of record drawing submittal. Submit electronic files on compact disc labeled, “Supplemental Record Drawings”, together with CONTRACTOR name, Project name, and Contract name and number.

C. Specifications and Addenda:

1. Mark each Section to record:
   a. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually provided.
   b. Changes made by Addendum, Change Orders, Work Change Directives, and Field Orders.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall furnish spare parts data and extra materials for materials and equipment in accordance with the Contract Documents.

B. List of Spare Parts and Extra Materials: With the Shop Drawings and product data for each Specification Section, submit a complete list of spare parts, extra stock materials, maintenance supplies, and special tools required for maintenance (“spare parts and extra materials”) for two years of operation, with unit prices in current United States funds, and source(s) of supply for each.

C. Packaging and Labeling: Furnish spare parts and extra materials in manufacturer’s unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion and deterioration for maximum length of storage normally anticipated by manufacturer. Packaging of spare parts and extra materials shall be clearly marked and identified with name of manufacturer, applicable equipment, part number, part description, and part location in the equipment. Protect and package spare parts and extra materials for maximum shelf life normally anticipated by manufacturer.

D. Storage Prior to Delivery to Owner: Prior to furnishing spare parts and extra materials to OWNER, store spare parts and extra materials in accordance with the Contract Documents and manufacturers’ recommendations.

E. Delivery Time and Eligibility for Payment:
   1. Deliver to OWNER spare parts and extra materials upon Substantial Completion for equipment or system associated with the spare parts and extra materials. Do not deliver spare parts and extra materials before commencing start-up for associated equipment or system.
   2. Spare parts and extra materials are not eligible for payment until delivered to OWNER and CONTRACTOR’s receipt of OWNER’s countersignature on letter of transmittal.

F. Procedure for Delivery to Owner: Deliver spare parts and extra materials to OWNER’s storage room at the Site at a Site designated by OWNER. When spare parts and extra materials are delivered, CONTRACTOR and ENGINEER will mutually inventory the spare parts and extra materials delivered to verify compliance
with the Contract Documents regarding quantity and part numbers. Additional procedures for delivering spare parts and extra materials to OWNER, if required, will be developed by ENGINEER and complied with by CONTRACTOR.

G. Transfer Documentation:
   1. Furnish on CONTRACTOR letterhead a letter of transmittal for spare parts and extra materials furnished under each Specification Section. Letter of transmittal shall accompany spare parts and extra materials. Do not furnish letter of transmittal separate from associated spare parts and extra materials.
   2. Furnish an original signed letter of transmittal for each Specification Section. Upon delivery of specified quantities and types of spare parts and extra materials to OWNER, designated person from OWNER will countersign each original letter of transmittal indicating OWNER’s receipt of spare parts and extra materials.
   3. Letter of transmittal shall include the following:
      a. Information required for letters of transmittal in Section 01 33 00, Submittal Procedures.
      b. Transmittal shall list spare parts and extra materials furnished under each Specification Section. List each individual part or product and quantity furnished.
      c. Provide space for countersignature by OWNER as follows: space for signature, space for printed name, and date.

H. CONTRACTOR shall be fully responsible for loss or damage to spare parts and extra materials until spare parts and extra materials are received by OWNER.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 01 79 23

INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall furnish services of Supplier’s operation and maintenance training specialists to instruct OWNER’s personnel in recommended operation and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
   2. Supplier shall provide field training at the Site, unless otherwise required elsewhere in the Contract Documents.
   3. OWNER reserves the right to record training sessions on video for OWNER’s later use in instructing OWNER’s personnel.

B. Scheduling of Training Sessions:
   1. General:
      a. CONTRACTOR shall coordinate training services with start-up and initial operation of materials and equipment on days and times, and in manner, acceptable to OWNER, in accordance with the Contract Documents.
      b. Training may be required outside of normal business hours to accommodate schedules of operations and maintenance personnel. Furnish training services at the required days and times at no additional cost to OWNER.
   2. Prerequisites to Training:
      a. Training of OWNER’S personnel shall commence after acceptable preliminary operation and maintenance data has been submitted and work required in Section 01 75 11, Checkout and Startup Procedures, and Section 01 79 13, Equipment and System Startup and Performance Testing Procedures is complete.
      b. At option of OWNER or ENGINEER, training may be allowed to take place before, during, or after equipment start-up.
   3. Training Schedule Submittal:
      a. Training Schedule Required: CONTRACTOR shall prepare and submit proposed training schedule for review and acceptance by ENGINEER and OWNER. Proposed training schedule shall show all training required in the Contract Documents, and shall demonstrate compliance with
specified training requirements relative to number of hours of training, number of training sessions, and scheduling.

b. Timing of Training Schedule Submittal: Submit initial training schedule at least thirty days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with ENGINEER’s comments, no later than fourteen days prior to starting the first training session.

c. OWNER reserves the right to modify personnel availability for training in accordance with process or emergency needs at the Site.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer’s instructors shall be factory-trained by manufacturer of material or equipment.
   2. Manufacturer’s instructors shall be proficient and experienced in conducting training of type required.
   3. Qualifications of instructors are subject to acceptance by ENGINEER. If ENGINEER does not accept qualifications of proposed instructor, furnish services of replacement instructor with acceptable qualifications.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule submittals in accordance with time frames specified in this Section.

B. Informational Submittals: Submit the following:
   1. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with the Contract Documents. Lesson plan shall comply with requirements of this Section. Include with lesson plan copy of handouts that will be used during training sessions. Provide lesson plan submittals in accordance with time frames specified in this Section.
   2. Qualifications: Credentials of manufacturer’s proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Section and shall include brief resume’ and specific details of instructor’s operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.

C. Closeout Submittals: Submit the following:
   1. Trainee sign-in sheet for each training session. Submit to OWNER.
1.4 LESSON PLAN

A. Supplier’s lesson plan shall describe specific instruction topics, system components for which training will be furnished, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan “hands-on” demonstrations planned for training sessions.

B. Submit acceptable lesson plan seven days prior to starting associated training.

C. Lesson plan shall include estimated duration of each training segment.

D. Lesson plan shall include the following:
   1. Equipment Overview (required for all types of operations and maintenance training):
      a. Describe equipment’s operating (process) function and performance objectives.
      b. Describe equipment’s fundamental operating principles and dynamics.
      c. Identify equipment’s mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem’s interaction with other subsystems.
      d. Identify all support equipment associated with operation of subject equipment, such as air intake filters, valve actuators, motors, and other appurtenant items and equipment.
      e. Identify and describe safety precautions and potential hazards related to operation.
      f. Identify and describe in detail safety and control interlocks.
   2. Operations Personnel Training:
      a. Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
      b. Operation:
         1) Describe operating principles and practices.
         2) Describe routine operating, start-up, and shutdown procedures.
         3) Describe abnormal or emergency start-up, operating, and shutdown procedures that may apply.
         4) Describe alarm conditions and responses to alarms.
         5) Describe routine monitoring and recordkeeping procedures.
         6) Describe recommended housekeeping procedures.
      c. Troubleshooting:
         1) Describe how to determine if corrective maintenance or an operating parameter adjustment is required.
   3. Mechanical Maintenance Training:
      a. Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.
      b. Equipment Preventive Maintenance:
1) Describe preventative maintenance inspection procedures required to:
   a) Inspect equipment in operation.
   b) Identify potential trouble symptoms and anticipate breakdowns.
   c) Forecast maintenance requirements (predictive maintenance).
2) Define recommended preventative maintenance intervals for each component.
3) Describe lubricant and replacement part recommendations and limitations.
4) Describe appropriate cleaning practices and recommend intervals.
5) Identify and describe use of special tools required for maintenance of equipment.
6) Describe component removal, installation, and disassembly and assembly procedures.
7) Perform “hands-on” demonstrations of preventive maintenance procedures.
8) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
9) Define recommended torquing, mounting, calibrating, and aligning procedures and settings, as appropriate.
10) Describe recommended procedures to check and test equipment following corrective maintenance.

c. Equipment Troubleshooting:
   1) Define recommended systematic troubleshooting procedures.
   2) Provide component-specific troubleshooting checklists.
   3) Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
   4) Describe common corrective maintenance procedures with “hands on” demonstrations.

4. Instrumentation/Controls Maintenance Training:
   a. Equipment Overview: As described in Paragraph 1.4.D.1 of this Section.

1.5 TRAINING AIDS

A. Manufacturer’s instructor shall incorporate training aids as appropriate to assist in the instruction. Provide handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:
   1. Audio-visual aids, such as videos, Microsoft Powerpoint presentations, overhead transparencies, posters, drawings, diagrams, catalog sheets, or other items.
   2. Equipment cutaways and samples, such as spare parts and damaged equipment.
3. Tools, such as repair tools, customized tools, and measuring and calibrating instruments.

B. Handouts:
   1. Manufacturer’s instructor shall distribute and use descriptive handouts during training. Customized handouts developed especially for training for the Project are encouraged.
   2. Photocopied handouts shall be good quality and completely legible.
   3. Handouts should be coordinated with the instruction, with frequent references made to the handouts.
   4. Provide at least five copies of handouts for each training session.

C. Audio-visual Equipment: Training provider shall provide audio-visual equipment required for training sessions. OWNER is not responsible for providing audio-visual equipment. Audio-visual equipment that training provider shall provide, as required, includes:
   1. Laptop computer, presentation software, and suitable projector.
   2. As required, extension cords and spare bulb for projector.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++
SECTION 03 00 05

CONCRETE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, reinforcing, and related materials.
2. The Work includes:
   a. Providing concrete consisting of portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
   b. Fabricating and placing reinforcing, including ties and supports.
   d. Building into the concrete all sleeves, frames, anchorage devices, inserts, and other items required to be embedded in concrete.
   e. Providing openings in concrete as required to accommodate Work under this and other Sections.

B. Coordination:
1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:
1. Class “A” concrete shall be steel-reinforced and includes all concrete in contact with earth unless otherwise shown or indicated and provided for chemical resistance concrete, due to aggressive soil conditions.

D. Related Sections:
1. Section 05 05 33, Anchor Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:
1. ACI 224R, Control of Cracking in Concrete Structures.
2. ACI 301, Specifications for Structural Concrete for Buildings.
5. ACI 306R, Cold Weather Concreting.
7. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
8. ACI 347, Guide to Formwork for Concrete.
10. ASTM A82/A82M, Specification for Steel Wire, Plain, for Concrete Reinforcement.
11. ASTM A185/A185M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
12. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
13. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
14. ASTM C33/C33M, Specification for Concrete Aggregates.
16. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
18. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
21. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
22. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
30. ASTM E1745, Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
32. CRSI 1MSP, Manual of Standard Practice.
33. NSF/ANSI 61, Drinking Water System Components - Health Effects.
1.3 QUALITY ASSURANCE

A. Laboratory Trial Batch:
   1. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
   2. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
   3. Perform the following testing on each trial batch:
      a. Aggregate gradation for fine and coarse aggregates.
      b. Slump.
      c. Air content.
      d. Compressive strength based on three cylinders each tested at seven days and at 28 days.
   4. Submit for each trial batch the following information:
      a. Project identification name and number (if applicable).
      b. Date of test report.
      c. Complete identification of aggregate source of supply.
      d. Tests of aggregates for compliance with the Contract Documents.
      e. Scale weight of each aggregate.
      f. Absorbed water in each aggregate.
      g. Brand, type, and composition of cementitious materials.
      h. Brand, type, and amount of each admixture.
      i. Amounts of water used in trial mixes.
      j. Proportions of each material per cubic yard.
      k. Gross weight and yield per cubic yard of trial mixtures.
      l. Measured slump.
      m. Measured air content.
      n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28-day test, and for each design mix.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. List of concrete materials and concrete mix designs proposed for use. Include results of tests performed to qualify the materials and to establish the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.
      b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.
      c. Concrete placement drawings showing the location and type of all joints.
      d. Drawings for fabricating, bending, and placing concrete reinforcing.
Comply with ACI SP-66. For walls and masonry construction, provide elevations to a minimum scale of 1/4-inch to one foot. Show bar schedules, stirrup spacing, adhesive dowels, splice lengths, diagrams of bent bars, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing.

2. Product Data:
   a. Manufacturer’s specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.

3. Samples:
   a. Samples: Submit samples of materials as specified and as otherwise requested by ENGINEER, including names, sources, and descriptions.

B. Informational Submittals: Submit the following:
   1. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site. Each delivery tickets shall contain the information in accordance with ASTM C94/C94M along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water introduced.
   2. Site Quality Control Submittals:
      a. Report of testing results for testing of field concrete cylinders for each required time period. Submit within 24 hours after completion of associated test. Test report shall include results of all testing required at time of sampling.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transportation, Delivery, and Handling:
   1. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
   2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
   3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
   4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.
   5. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage:
   1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof
covering. Provide for adequate air circulation or ventilation under cover.

2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.

3. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight.

4. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.

5. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. All cementitious materials, admixtures, curing compounds, and other industrial-produced materials used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

2.2 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type II.

B. Fly Ash Mineral Admixture:
   1. Mineral admixtures, when used, shall conform to the requirements of ASTM C618 Class F, except as follows:
      a. The loss on ignition shall be a maximum of four percent.
      b. The maximum percent of sulfur trioxide (SO3) shall be 4.0.
   2. Fly ash shall be considered to be a cementitious material.
   3. Laboratory trial batches shall be tested to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.

C. For concrete, when Type II Cement is used, fly ash shall be used within the following percentages by weight.
   1. Fly ash shall have minimum of 20 percent and maximum of 25 percent of total weight of cementitious material.

D. Aggregates: ASTM C33/C33M.
   1. Fine Aggregate: Clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are unacceptable.
2. Coarse Aggregate:
   a. Clean, uncoated, processed aggregate containing no clay, mud, loam, or
      foreign matter.
   b. Coarse aggregate shall comply with the following:
      1) Crushed stone, processed from natural rock or stone.
      2) Washed gravel, either natural or crushed. Slag, pit gravel, and bank-
         run gravel are not allowed.
   c. Coarse Aggregate Size: ASTM C33/C33M, Nos. 57 or 67, unless
      otherwise approved by ENGINEER.

E. Water: Clean, potable.

F. Admixtures:
   2. Water-Reducing Admixture: ASTM C494/C494M, Type A.
      D and E.
   4. High Range Water-Reducing Admixture: ASTM C494/C494M, Type F/G.
   5. Use only admixtures that have been tested and approved in the mix designs.
   6. Do not use calcium chloride or admixtures containing chloride ions.

G. Crystalline Admixture:
   1. Product and Manufacturer: Provide one of the following:
      a. Xypex Admix C-500, as manufactured by Xypex Chemical Corporation.
      b. Or equal.

2.3 CONCRETE MIX

A. General:
   1. Normal weight: 145 pounds per cubic foot.
   2. Use air-entraining admixture in all concrete. Provide from three to five percent
      entrained air for other concrete.

B. Proportioning and Design of Class “A” Concrete Mix:
   1. Minimum compressive strength at 28 days: 4,500 psi.
   2. Maximum water-cement ratio by weight: 0.40.
   3. Minimum cement content: 564 pounds per cubic yard.
   4. Crystalline admixture shall be used, at a dosage rate of 3% by weight of
      cementitious content.
   5. Use amounts of admixtures recommended by admixture manufacturer for
      climatic conditions prevailing at the Site at time of placing. Adjust quantities
      and types of admixtures as required to maintain quality. Site soil conditions
      contain acidic soils.
C. Slump Limits:
   1. Proportion and design mixes to result in concrete slump at point of placement of not less than one inch and not more than four inches.
   2. When using high-range water reducers, slump prior to addition of admixture shall not exceed three inches. Slump after adding admixture shall not exceed eight inches at point of placement.

D. Adjustment of Concrete Mixes:
   1. Concrete mix design adjustments may be requested by CONTRACTOR when warranted by characteristics of materials, Site conditions, weather, test results, or other, similar circumstances.
   2. Submit for ENGINEER’s approval laboratory test data for adjusted concrete mix designs, including compressive strength test results.
   3. Implement adjusted mix designs only after ENGINEER’s approval.
   4. Adjustments to concrete mix designs shall not result in additional costs to OWNER.

2.4 FORM MATERIALS

A. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection. CONTRACTOR shall be responsible for designing the formwork system to resist all applied loads including pressures from fluid concrete and construction loads.

B. Smooth Form Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces in accordance with ACI 301.

C. Unexposed Concrete Surfaces: Material to suit project conditions.

D. Provide 3/4-inch chamfer at all external corners. Chamfer is not required at re-entrant corners unless otherwise shown or indicated.

E. Form Ties:
   1. Provide factory-fabricated, removable, or snap-off metal form ties, that prevent form deflection and prevent spalling of concrete surfaces upon removal. Materials used for tying forms are subject to approval of ENGINEER.
   2. Unless otherwise shown or indicated, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1.5 inches from outer surface of concrete. Unless otherwise shown or indicated, provide form ties that, upon removal, will leave a uniform, circular hole not larger than one-inch diameter in the concrete surface.
   3. Ties for exterior walls, below-grade walls, and walls subject to hydrostatic pressure shall be provided with waterstops.
   4. Wire ties are unacceptable.
2.5 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.

B. Welded Wire Fabric: ASTM A185/A185M.

C. Steel Wire: ASTM A82/A82M.

D. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
   1. Use wire bar-type supports complying with CRSI MSP1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
   2. For slabs on grade, use precast concrete blocks, four inches square minimum with compressive strength equal to or greater than the surrounding concrete, or supports with sand plates or horizontal runners where base materials will not support chair legs.
   3. For all concrete surfaces where legs of supports are in contact with forms, provide supports having either hot-dip galvanized, plastic-protected, or stainless steel legs in accordance with CRSI MSP1.
   4. Provide precast concrete supports over waterproof membranes.

E. Adhesive Dowels:
   1. Dowels:
      a. Dowel reinforcing bars shall comply with ASTM A615, Grade 60.
   2. Adhesive:
      a. For requirements for adhesive, refer to Section 05 05 33, Anchor Systems.

2.6 RELATED MATERIALS

A. Membrane-Forming Curing Compound: ASTM C309, Type I.

B. Epoxy Bonding Agent:
   1. Two-component epoxy resin bonding agent.
   2. Products and Manufacturers: Provide one of the following:
      a. Sikadur 32, Hi-Mod LPL, by Sika Corporation.
      b. Eucopoxy LPL, by the Euclid Chemical Company.
      c. Or equal.

C. Epoxy-Cement Bonding Agent:
   1. Three-component blended epoxy resin-cement bonding agent.
   2. Products and Manufacturers: Provide one of the following:
b. Duralprep A.C., by Euclid Chemical Company.
c. Or equal.

D. Preformed Expansion Joint Filler:
   1. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).

E. Exterior and Interior Vertical Joint Sealant; Non-submerged:
   1. Two-component Polyurethane Sealant:
      a. Products and Manufacturers: Provide one of the following:
         1) Sikaflex- 2c NS by Sika Corporation.
         2) Dymeric 240 FC by Tremco Sealant/Waterproofing Division of RPM International, Inc.
         3) Or equal.
      b. Polyurethane based, two-component elastomeric sealant complying with:
         1) FS TT-S-00227E: Type II (non-sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
         2) Adhesion-in-Peel, FS TT-S-00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 10 pounds.
         3) Hardness (Standard Conditions), ASTM C661: 25 to 35 (Shore A).
         4) Stain and color change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
         5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
         6) Rheological Vertical Displacement at 120 degrees F, FS TT-S-00227E: No sag.
         7) VOC Content: 100 g/L, maximum.

F. Exterior and Interior Horizontal Joint Sealant; Non-submerged:
   1. Two-component Polyurethane Sealant:
      a. Products and Manufacturers: Provide one of the following:
         1) Sikaflex- 2c SL by Sika Corporation.
         2) THC/900 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
         3) Or equal.
      b. Polyurethane based, two-component elastomeric, self-leveling sealant complying with:
         1) FS TT-S-00227E, Type I (self-leveling) Class A and ASTM C920, Type M, Grade P, Class 25.
         2) Water Immersion Bond, FS TT-S-00227E: Elongation of 50 percent with no adhesive failure.
         3) Hardness (Standard Conditions), ASTM C661: 35 to 45.
         4) Stain and Color Change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
6) VOC Content: 165 g/L, maximum.

G. Miscellaneous Joint Sealant Materials:
   1. Joint Cleaner: As recommended by calking and sealant manufacturer.
   2. Joint Primer and Sealer: As recommended for compatibility with calking and sealant by calking and sealant manufacturer.
   3. Bond Breaker Type: Polyethylene tape or other plastic tape as recommended for compatibility with calking and sealant by calking and sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of calking and sealant. Provide self-adhesive tape where applicable.
   4. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable nonabsorptive material as recommended for compatibility with calking and sealant by calking and sealant manufacturer. Provide size and shape of rod that will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide highly-compressible backer to minimize possibility of sealant extrusion when joint is compressed.

2.7 GROUT

A. Non-shrink Grout:
   1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site.
   2. Minimum 28-day Compressive Strength: 7,000 psi.
   3. Products and Manufacturers: Provide one of the following:
      a. NS Grout by Euclid Chemical Company.
      b. Set Grout by Master Builders, Inc.
      c. NBEC Grout by Five Star Products, Inc.
      d. Or equal.

B. Epoxy Grout:
   1. Pre-packaged, non-shrink, non-metallic, 100 percent solids, solvent-free, moisture-insensitive, three-component epoxy grouting system.
   2. Minimum Seven-day Compressive Strength: 14,000 psi, when tested in accordance with ASTM C579.
   3. Products and Manufacturers: Provide one of the following:
      a. Euco High Strength Grout, by Euclid Chemical Company.
      b. Sikadur 42, Grout Pak, by Sika Corporation.
      c. Five Star Epoxy Grout, by Five Star Products, Inc.
      d. Or equal.
C. Grout Fill:
   1. Grout mix shall consist of cement, fine and coarse aggregates, water, and admixtures complying with requirements specified in this Section for similar materials in concrete.
   2. Proportion and mix grout fill as follows:
      a. Minimum Cement Content: 564 pounds per cubic yard.
      b. Maximum Water-Cement Ratio: 0.45.
      c. Maximum Coarse Aggregate size: 1/2-inch, unless otherwise indicated.
      d. Minimum 28-day Compressive Strength: 4,000 psi.

PART 3 – EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the substrate and the conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 FORMWORK

A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Provide openings in formwork to accommodate the Work of other trades. Accurately place and securely support items required to be built into formwork.

C. Clean and adjust forms prior to placing concrete. Apply form release agents or wet forms as required. Re-tighten forms during and after concrete placing, when required, to eliminate cement paste leaks.

D. Removing Formwork:
   1. Comply with ACI 301 and ACI 347, except as otherwise indicated in the Contract Documents.
   2. Do not remove formwork and shoring until supported concrete members have acquired minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field-cured specimens may be submitted to ENGINEER for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated in the Contract Documents.
   3. Removal time for formwork is subject to ENGINEER’s acceptance.
   4. Repair form tie-holes following in accordance with ACI 301.
3.3 REINFORCING, JOINTS, AND EMBEDDED ITEMS

A. Comply with the applicable recommendations of Laws and Regulations and standards referenced in this Section, including CRSI MSP1, for details and methods of placing and supporting reinforcing.

B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials which act to reduce or destroy bond between reinforcing material and concrete.

C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers, and hangers, as required.
   1. Place reinforcing to obtain minimum concrete coverages as shown on the Drawings and as required in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
   2. Do not secure reinforcing to formwork using wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.

D. Provide sufficient quantity of supports of strength required to carry reinforcing. Do not place reinforcing more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

E. Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown or indicated for minimum lap of spliced bars, as shown on the Drawings.

F. Install welded wire fabric in lengths as long as practical, lapping adjoining sections a minimum of one full mesh.

G. Do not place concrete until reinforcing is inspected and ENGINEER indicates that conditions are acceptable for placing concrete. Concrete placed in violation of this paragraph will be rejected. Notify ENGINEER in writing at least two working days prior to proposed concrete placement.

H. Joints:
   1. Provide construction, isolation, expansion, and control joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs-on-grade to stabilize differential settlement and random cracking.
2. In walls, locate joints at a maximum spacing of 40 feet and approximately 12 feet from corners.
3. In foundation slabs and slabs-on-grade, locate joints at intervals of approximately 40 feet.
4. In mats and structural slabs and beams, locate joints in compliance with ACI 224R.
5. Locations of joints shall be in accordance with the Contract Documents and as approved by ENGINEER in the Shop Drawings.
6. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously-placed concrete to amplitude of 1/4-inch.

I. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by, cast-in-place concrete. Use setting diagrams, templates, and instructions provided under other Sections and, when applicable, other contracts for locating and setting. Refer to Paragraph 1.1.B of this Section. Do not embed in concrete uncoated aluminum items. Where aluminum items are in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete.

J. Adhesive Dowels:
   1. Adhesive dowels shall be reinforcing bar dowels set in an adhesive in hole drilled into hardened concrete. Comply with adhesive system manufacturer’s installation instructions regarding hole diameter, drilling method, embedment depth required to fully develop required tensile strength, and hole cleaning and preparation instructions. Unless more-stringent standards are required by adhesive system manufacturer, comply with the following.
   2. Drill holes to adhesive system manufacturer’s recommended diameter and depth to develop required tensile strength. Holes shall not be more than 1/4-inch greater than nominal bar diameter, and hole depth shall not be less than twelve times nominal bar diameter. Hammer-drill holes. Cored holes are not allowed.
   3. Embedment depths shall be based on concrete compressive strength of 2,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
   4. Determine location of existing reinforcing steel in vicinity of proposed holes prior to drilling. Adjust location of holes to be drilled to avoid drilling through or damaging existing reinforcing bars only when approved by ENGINEER.
   5. Before setting adhesive dowel, hole shall be free of dust and debris using method recommended by adhesive system manufacturer. Hole shall be brushed, with manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
   6. Inject adhesive into hole through injection system mixing nozzle and necessary extension tubes, placed to bottom of hole. Withdraw discharge end as adhesive
is placed, but keep end of tube immersed to prevent forming air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placement.

7. Twist dowels during insertion into partially-filled hole to guarantee full wetting of bar surface with adhesive. Insert bar slowly to avoid developing air pockets.

3.4 CONCRETE PLACING

A. Site Mixing: Use drum-type batch machine mixer, mixing not less than 1.5 minutes for one cubic yard or smaller capacity. Increase required mixing time by minimum of 15 seconds for each additional cubic yard or fraction thereof.

B. Ready-Mixed Concrete: Comply with ASTM C94/C94M.

C. Concrete Placing:
   1. Place concrete in a continuous operation within planned joints or sections in accordance with ACI 304R.
   2. Do not begin placing concrete until work of other trades affecting concrete is completed.
   3. Wet concrete and subgrade surfaces to saturated surface dry condition immediately prior to placing concrete.
   4. Deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
   5. Avoid separation of the concrete mixture during transportation and placing. Concrete shall not free-fall for distance greater than four feet during placing.
   6. Complete concrete placing within 90 minutes of addition of water to the dry ingredients.

D. Consolidate placed concrete in accordance with ACI 309R using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around placing and other embedded items and into all parts of formwork. Insert and withdraw vibrators vertically at uniformly-spaced locations. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or placing is not allowed.

E. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
   1. In hot weather comply with ACI 305R.
   2. In cold weather comply with ACI 306R.

3.5 QUALITY OF CONCRETE WORK

A. Make concrete solid, compact, smooth, and free of laitance, cracks, and cold joints.
B. Concrete for liquid-retaining structures and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.

C. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces that contain cracks or voids, are unduly rough, or are in defective in any way. Patches or plastering are unacceptable.

D. Repair, removal and replacement of defective concrete directed by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by using moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until formwork is removed. Provide protection, as required, to prevent damage to exposed concrete surfaces. Total curing period shall not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHING

A. Slab Finish:
   1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Use a wood float only. Check and level surface plane to a tolerance not exceeding 1/4-inch in ten feet when tested with a ten foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture. Slab surfaces shall receive a float finish. Provide additional trowel finishing as required in this Section.
   2. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
   3. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten-foot straightedge. Grind smooth surface defects that would telegraph through applied floor covering system.
   4. Use trowel finish for the following:
      a. Interior exposed slabs, unless otherwise shown or indicated.
      b. Apply non-slip broom finish, after troweling, to exterior concrete slab and elsewhere as shown.
B. Formed Finish:
1. Provide smooth form concrete finish at exposed surfaces. Use largest practical form panel sizes to minimize form joints. Exposed surfaces include interior water-contacting surfaces of tanks, whether or not directly visible. All surfaces shall be considered as exposed, unless buried or covered with permanent structural or architectural material. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/8-inch in height. Where surface will be coated or will receive further treatment, remove all fins flush with concrete surface.
2. Provide rough form finish at all unexposed surfaces. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/2-inch in height.

C. Non-Slip Broom Finish:
1. Immediately after float finishing, slightly roughen concrete surface by brooming in direction perpendicular to main traffic route. Use fine fiber-bristle broom, unless otherwise directed by ENGINEER. Coordinate required final finish with ENGINEER before applying finish.
2. Use non-slip broom finish for the following:
   a. Exterior exposed horizontal surfaces subject to lightweight foot traffic.
   b. Interior and exterior concrete steps and ramps.
   c. Horizontal surfaces which will receive a grout topping or a concrete equipment base slab.

3.8 GROUT PLACING

A. Place grout as shown and indicated, and in accordance with grout manufacturer’s instructions and recommendations. If grout manufacturer’s instructions conflict with the Contract Documents, notify ENGINEER and not proceed until obtaining ENGINEER’s clarification.

B. Dry-packing is not allowed, unless otherwise indicated.

C. Manufacturers of proprietary grout materials shall make available upon 72 hours notice the services of qualified, full-time, factory-trained employee to aid in ensuring proper use of grout materials at the Site.

D. Placing grout shall comply with temperature and weather limitations described in Article 3.4 of this Section.

3.9 FIELD QUALITY CONTROL

A. Site Testing Services:
1. CONTRACTOR shall employ independent testing laboratory to perform field quality control testing for concrete. ENGINEER will direct where samples are obtained.

2. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.

3. CONTRACTOR shall provide a large, tightly-constructed, firmly-braced, insulated, storage boxes of wood or steel, each with capacity of not less than 15 concrete cylinders under conditions described in ASTM C31/C31M. Quantity, size, and location shall be coordinated with ENGINEER and shall be as required to provide storage for specimens for each concrete placement.

B. Quality Control Testing During Construction:

1. Perform sampling and testing for field quality control during concrete placing, as follows:
   
a. Sampling Fresh Concrete: ASTM C172.
   
b. Slump: ASTM C143/C143M; one test for each concrete load at point of discharge.
   
c. Concrete Temperature: ASTM C1064/C1064M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
   
d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
   
e. Unit Weight: ASTM C138/C138M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
   
f. Compression Test Specimens:
      1) In accordance with ASTM C31/C31M, make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
      2) Cast, store, and cure specimens in accordance with ASTM C31/C31M.
   
g. Compressive Strength Tests:
      1) In accordance with ASTM C39/C39M; one specimen tested at seven days, and three specimens tested at 28 days.
      2) Concrete that does not comply with strength requirements will be considered as defective Work.
   
h. Submit test results from certified by testing laboratory to ENGINEER within 24 hours of completion of test.
   
i. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, CONTRACTOR shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42/C42M and the following:
1) Testing of Adhesive Dowels: CONTRACTOR will employ testing agency to perform field quality control testing of drilled dowel installations. After adhesive system manufacturer’s recommended curing period and prior to placing connecting reinforcing, proof-test for pullout ten percent of adhesive dowels installed. Adhesive dowels shall be tensioned to 60 percent of specified yield strength. Where dowels are located less than six bar diameters from edge of concrete, ENGINEER will determine tensile load required for test. If one or more dowels fail, retest all dowels installed for the Work. Dowels that fail shall be reinstalled and retested at CONTRACTOR’s expense.

++ END OF SECTION ++
1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide labor, materials, equipment, and incidentals as shown, specified and required for masonry Work, including:
   a. Providing openings in unit masonry construction to accommodate the Work under this and other Specification Sections, and building into unit masonry construction all items such as sleeves, anchorage devices, inserts and other items to be embedded in unit masonry construction for which placement is not specifically provided under other Specification Sections.
2. Extent of each type of unit masonry is shown.
3. Types of products and features required include:
   a. Concrete unit masonry.
   b. Masonry mortar and grout.
   c. Masonry accessories.

B. Coordination:
1. Review installation procedures under other Specification Sections and coordinate the items that must be installed with unit masonry construction Work.
2. Unit masonry construction done without built-in flashings and other built-in Work shall be removed and rebuilt at no additional cost to OWNER, even if discovered after apparent completion of unit masonry construction.
3. Coordinate Work under other Specification Sections to avoid delay of masonry construction.

C. Related Sections:
1. Section 09900, Painting.

1.2 REFERENCES

A. Referenced Standards: Standards referenced in this Section are:
1. ACI 530, Building Code Requirements for Masonry Structures.
2. ACI 530.1, Specification for Masonry Structures.
4. ASTM A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
11. ASTM C90, Standard Specification for Hollow Load-Bearing Concrete Masonry Units.
13. ASTM C62, Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)
15. ASTM C140, Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
22. ASTM C426, Standard Test Method for Linear Drying Shrinkage of Concrete Block.
25. ASTM C1093, Practice for Accreditation of Testing Agencies for Unit Masonry.
1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Installer: Hire a single installer regularly engaged in preformed unit masonry installation and with successful and documented experience in erecting unit masonry of scope and type of Work required; and employs only tradesmen with specific skill and successful experience in this type of Work.
   2. Laboratory Qualifications:
      a. Testing Laboratory: In accordance with ASTM C1093.

B. Component Supply and Compatibility:
   1. Obtain each type of concrete masonry unit from one Supplier, cured by one process and of uniform texture and color, or in an established uniform blend thereof.
   2. Do not change source or brands of mortar products during the Project.
   3. Where question of compliance to requirements of this Section arise, mortar properties Specification will take precedence over mortar proportion Specification.
   4. Do not change proportions established for mortar accepted under property Specifications, and do not use products with different physical characteristics in mortar used in the Work, unless compliance with requirements of property Specifications is re-established by submitting acceptable data to ENGINEER.
   5. Do not combine two air-entraining materials in mortar.

1.4 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings: Submit the following:
      a. Complete layout of all masonry walls showing modular planning and all special shapes to be used in the Work.

B. Informational Submittals:
   1. Source Quality Control Submittals: Submit the following:
      a. Pre-construction laboratory test results, in accordance with ASTM C140.
   2. Test and Evaluation Reports
      a. Preconstruction testing results as specified in Paragraph 3.1.B of this Section.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling of Products:
   1. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage of Materials:
1. Comply with 01 66 00, Product Storage and Handling Requirements.
2. Maintain temperatures under cover so that masonry products are above 20 degrees F during installation.

1.6 JOB CONDITIONS

A. Temporary Facilities: Provide supplemental heat sources and equipment as required should CONTRACTOR desire to continue unit masonry Work in cold weather. Pay for fuel for supplemental heat.

B. Environmental Requirements:
1. Do not perform unit masonry Work when air temperature is below 28 degrees F on a rising temperature, or below 36 degrees F on falling temperatures without providing temporary, heated enclosures, or without providing temporary heating or other precautions to prevent freezing.
2. Do not use frozen products, and do not build upon frozen unit masonry Work.
3. Remove and replace all unit masonry Work damaged by cold.

C. Protection:
1. Protect unit masonry Work against freezing for at least 48 hours after being placed.
   a. For Mean Daily Air Temperatures of 40 degrees F to 32 degrees F: Protect unit masonry construction from precipitation for 48 hours after installation.
   b. For Mean Daily Air Temperatures of 32 degrees F to 25 degrees F: Completely cover unit masonry construction for 48 hours after installation.
   c. For Mean Daily Temperatures of 25 degrees F to 20 degrees F: Completely cover unit masonry construction with insulating blankets for 48 hours after installation of the masonry.
   d. For Mean Daily Air Temperatures of 20 degrees F and Below: Maintain unit masonry construction above 32 degrees F for 48 hours by enclosure and supplementary heating.
2. When Work is not in progress, protect partially completed unit masonry construction against rapid heat loss and from water entering the masonry by covering the top of walls with a strong, waterproof, non-staining membrane. Extend the membrane at least two feet down both sides of wall and secure in place using wall cover clamps spaced at intervals of four feet and at each end, and at joints in membrane.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS
A. Portland Cement: Provide the following for Portland cement-lime mortars:
   1. ASTM C150, Type I.
   2. Use ASTM C150, Type III high-early strength, for laying masonry when air temperature is less than 50 degrees F.

B. Masonry Cement: Provide the following for masonry cement mortars:
   1. ASTM C91 Type S, proportioned to comply with ASTM C270.
   2. Maximum Air Content, ASTM C91: 19 percent.
   3. Non-staining.

C. Hydrated Lime: ASTM C207 Type S, or lime putty ASTM C5.

D. Sand Aggregates:
   1. ASTM C144, except for joints less than ¼-inch, use aggregate graded with 100 percent passing the No. 16 sieve.
   2. White Mortar Aggregates: Provide natural white sand or ground white stone for Portland cement-lime mortars.
   3. Colored Mortar Aggregates: Provide ground marble, granite, or other sound stone as required to match the sample approved by ENGINEER for Portland cement-lime mortars.
   5. Course Aggregate for Grout: ASTM C404, Size No. 8 or Size No. 89.
   6. ENGINEER will select color of mortar.

E. Ready-mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified for mortar materials, combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C270 and C387.

F. Water: Free from injurious amounts of oils, acids, alkalis, or organic matter, and clean, fresh, and potable.

2.2 MORTAR MIXES

A. General:
   1. Anti-freeze Admixture or Agents: Not allowed.
   2. Calcium Chloride: Not allowed.

B. Mortar for Unit Masonry: Comply with ASTM C270, Table 2, except limit materials to those specified in this Section, do not substitute ASTM C91 masonry cement for ASTM C150 Portland cement without an submittal approval by ENGINEER, and limit cement to lime ratio by volume as follows:
   1. Type N:
a. Provide the following proportions by volume:
   1) Portland Cement: One part.
   2) Hydrated Lime or Lime Putty: Over 1/2 to 1-1/4, maximum.
   3) Aggregate Ratio (measured in damp loose condition): Not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.

b. Properties:
   1) Average Compressive Strength, ASTM C270: 750 psi.
   3) Maximum Air Content, ASTM C270: 12 percent.

C. Grout:
   1. Fine Grout:
      a. Provide the following proportions by volume:
         1) Portland Cement: One part.
         2) Hydrated Lime or Lime Putty: Zero to 1/10 part.
         3) Aggregate Ratio (Measured in a Damp Loose Condition): Sand shall be not less than 2.25 times and not more than three times sum of volumes of cement and lime.
      b. Mix grout to have a slump of ten inches plus or minus one-inch at placement.

   2. Coarse Grout:
      a. Provide the following proportions by volume:
         1) Portland Cement: One part.
         2) Hydrated Lime or Lime Putty: Zero to 1/10 part.
         3) Fine Aggregate Ratio (Measured in a Damp Loose Condition): Sand shall be not less than 2.25 times and not more than three times sum of volumes of cement and lime.
         4) Coarse Aggregate Ratio: Not less than one and not more than two times sum of volumes of cement and lime.
      b. Mix grout to have slump of ten inches plus or minus one-inch, at placement.

2.3 CONCRETE MASONRY UNITS

A. General: Concrete masonry units shall comply with requirements below.

B. Hollow and Solid Load-bearing Concrete Masonry Units: ASTM C90, with minimum of 15 percent coal fly ash and 50 percent recycle aggregate as part of concrete mix.

C. Hollow Non-load-bearing Concrete Masonry Units: ASTM C129 with minimum of 15 percent coal fly ash and 50 percent recycle aggregate as part of the concrete mix.
D. Weight:
1. Provide normal weight Masonry units using concrete aggregates complying with ASTM C33 producing dry net weight of not less than 125 pounds per cubic foot.

E. Size: Manufacturer’s standard units with nominal face dimensions of 16 inches long by eight inches high by nominal width dimension shown on Drawings (15-5/8-inches by 7-5/8-inches actual).

F. Special Shapes: Provide the following:
1. Bond beams, reinforcing units, and flush-end reinforcing units, interior and exterior corner shapes, solid jambs, sash block, coves, pre-molded control joint blocks, headers, and other special conditions.

G. Exposed Faces: Provide manufacturer’s standard and custom colors and textures as specified for type of concrete masonry unit.

H. Provide two-core concrete masonry units.

2.4 MASONRY ACCESSORIES

A. Continuous Horizontal Wire Reinforcing and Ties for Masonry: Provide the following unless otherwise shown:
1. General: Welded wire units prefabricated in straight lengths of not less than ten feet, with matching corner “L” and intersection “T” units. Fabricate from cold-drawn steel wire complying with ASTM A82, with deformed continuous 3/16-inch gage side rods and plain 9 gage cross rods, crimped for cavity wall construction, with unit width of 1.5 to two inches less than thickness of wall or partition. All reinforcing and ties shall be hot dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153, Class B-2, unless otherwise specified.

2. For single-wythe masonry, use units fabricated as follows:
   a. Truss-type fabricated with one horizontal rod beneath each unit masonry shell wall and continuous diagonal cross-rod spaced not more than 16 inches on centers.
   b. Products and Manufacturers: Provide one of the following:
      1) #120 Truss-Mesh by Hohmann and Barnard, Inc.
      2) Series 300 Single Wythe System by Wire-Bond.
      3) DA 3100 Truss by Dur-O-Wall, a Dayton Superior Company.
      4) Or equal.

B. Miscellaneous Masonry Accessories: Provide the following, where shown:
1. Reinforcing Bars:
a. Deformed carbon steel, ASTM A615, Grade 60 for bars No. 3 to No. 18 except as otherwise shown.

2. Rebar Positioners: Provide the following:
   a. Nine-gage reinforcing bar positioners that accommodate both horizontal and vertical reinforcing steel.
   b. Fabricate units as required for the Work.
   c. Products and Manufacturers: Provide products of one of the following:
      1) #RB Series and #RB-Twin Series Rebar Positioners by Hohmann & Barnard, Inc
      2) Rebar Positioners by Heckmann Building Products.
      3) Or equal.

3. Masonry Control Joint Components: Provide the following:
   a. Pre-molded Control Joint Strips: Provide complete selection of solid extruded rubber and PVC strips with a Shore A durometer hardness of 80 to 90 complying with ASTM D2240 and D2287, designed to fit standard sash block and maintain lateral stability in masonry wall. Size and configuration shall be as shown.
      1) Products and Manufacturers: Provide products of one of the following:
         a) Control Joints by Hohmann & Barnard, Inc.
         b) Control Joints by Heckmann Building Products.
         c) Or equal.

4. Compressible Filler: Provide watertight joint filler where unit masonry construction abuts structural framework members, or as shown. Provide the following:
   a. Polyurethane foam strip saturated with polybutylene waterproofing material which, when installed at a compression ratio of two-to-one, is impermeable to water.
   b. Resilient to -40 degrees F with 100 percent movement recovery.
   c. Elongation of 140 percent with a tensile strength of not less than 53 pounds per square inch.
   d. Products and Manufacturers: Provide products of one of the following:
      1) Polytite Standard by Polytite Manufacturing Corporation.
      2) Polyseal by Sandell Manufacturing Company, Inc.
      3) Or equal.

2.5 SOURCE QUALITY CONTROL

A. Allowable Tolerances: For concrete masonry units provide the following:
   1. Face Dimension: Total variation in finished and installed face dimensions of units shall not exceed 1/16-inch between largest and smallest units in each lot of units of each size.
2. Distortion: Distortion of plane and edges of face of individual units, as installed, from corresponding plane surface and edges of prefaced concrete masonry unit, shall not exceed 1/16-inch.

3. Top and Bottom Surfaces: Ground to provide finish height of 7-5/8 inches plus or minus 1/16-inch.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and installer shall examine areas and conditions under which unit masonry construction Work will be installed, and notify ENGINEER of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. Preconstruction Testing: Testing agency shall perform tests prior to installation of unit masonry. Special inspections testing procedures are specified in the referenced standards and the Contract Documents.
   1. Mortar Test: For each mix required, per ASTM C780.
   2. Grout Test: For each mix required, per ASTM C1019 and ACI 530.1.
   3. Prism Test: For each type of construction required, per ASTM C 1314 and ACI 530.1.
   4. Compressive strength of completed concrete unit masonry walls shall not be less than 1,500 psi as determined by methods specified in ACI 530.1.

3.2 PREPARATION

A. Measurement of Mortar Materials:
   1. Cement and Hydrated Lime: Batched by the bag.
   2. Sand: Batched by volume in suitably calibrated containers, provided proper allowance is made for bulking and consolidation and for weight per cubic foot, of contained moisture.
   3. Proportion of Volumetric Mixtures: One 94-pound sack of Portland cement and one 50-pound sack of hydrated lime constitute nominal one cubic foot.
   4. Shovel measurement: Not allowed.

B. Mortar Mixing:
   1. Type of Mixer: Machine mix in approved mixer in which quantity of water is accurately and uniformly controlled.
   2. While mixer is in operation add approximately three-quarters of required water, half the sand, all the cement, then add remainder of sand.
   3. Allow batch to mix briefly then add water in small quantities until satisfactory workability is obtained.
4. Mix for at least five minutes after all materials have been added.
5. Hydrated Lime for Mortar Requiring Lime Content: Use dry-mix method. Turn over materials for each batch together until even color of mixed, dry materials indicates that cementitious material has been thoroughly distributed throughout mass, then add water to obtain required plasticity.
6. Lime putty, if approved for use, shall be prepared in accordance with ASTM C5.
7. Mixer drum shall be completely emptied before recharging next batch.
8. Re-tempering of mortar is not allowed.

C. Wetting of Masonry Units:
1. Concrete Masonry Units: Except for absorbent units specified to be wetted, lay masonry units dry. Do not wet concrete masonry units.

D. Cleaning Reinforcement: Before being placed, remove loose rust, mill scale, earth, ice, and other coatings except galvanizing from reinforcement. Do not use reinforcing bars with kinks or bends not shown on Drawings or approved Shop Drawings, or bars with reduced cross-section.

3.3 INSTALLATION, GENERAL

A. Thickness: Build walls, floors and other unit masonry construction work to thickness shown. Build single-wythe walls to actual thickness of masonry units using units of nominal thickness shown or specified.

B. Leave openings for equipment, piping, ducts, and other items to be installed subsequent to start of masonry Work. After installing said items, complete unit masonry Work to match Work immediately adjacent to openings.

C. Cut masonry units using wet cutting, motor driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining Work neatly. Use full size units without cutting wherever possible.

3.4 LAYING MASONRY WALLS

A. General:
1. Mortar Types: Unless otherwise indicated, use mortar as specified and as follows:
   a. For all Work, use Type S mortar.
   b. Use coarse grout fill for structural requirements and for grouting reinforcing steel in unit masonry construction Work.
   c. Do not use mortar that has begun to set or if more than 30 minutes have elapsed since initial mixing. Re-temper mortar during the 30-minute period only as required to restore workability.
2. Lay out walls in advance for accurate spacing of surface pattern bond with uniform joint widths and to properly locate openings, masonry control joints, returns, and offsets. Avoid using less than half-size units at corners, jambs, and where possible at other locations.

3. Lay up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced, and coordinated with other Work.

4. Pattern Bond Unit Masonry:
   a. Lay all unit masonry Work visible in the finished Work in running bond with vertical joints in each course centered on units in courses above and below. Avoid using less than full-size units.
   b. Bond and interlock each course of each wythe at corners.
   c. Do not use units with less than eight-inch horizontal face dimensions at corners or jambs.
   d. Interlock alternate courses at corners.

5. Color of Concrete Unit Masonry:
   a. Lay all concrete unit masonry of natural color.

B. Construction Tolerances:
   1. Variation from Plumb: For lines and surfaces of columns, walls and arises, do not exceed 1/4-inch in 10 feet, or 3/8-inch in a story height (20 feet maximum), nor two-inch in 40 feet or more. Except for external corners, expansion joints and other conspicuous lines, do not exceed 1/4-inch in any story or 20 feet maximum, nor two-inch in 40 feet or more.
   2. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4-inch in any bay or 20 feet maximum, nor 3/4-inch in 40 feet or more.
   3. Variation of Linear Building Line: For position shown and related portion of columns, walls and partitions, do not exceed two-inch in any bay or 20 feet maximum, nor 3/4-inch in 40 feet or more.
   4. Variation in Cross-sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4-inch nor plus two-inch.

C. Mortar Bedding and Jointing:
   1. Lay solid masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
   2. Lay hollow masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.
   3. Cut joints flush for masonry walls that are to be concealed or to be covered by other materials, except paint, unless otherwise shown.
4. Tool exposed joints, when mortar is "thumbprint" hard, slightly concave. Rake out mortar in preparation for application of calking or sealants where required.
5. Concave-tool exterior joints below grade.
6. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

D. Stopping and Resuming Work: Rake back half-unit masonry length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly, if required, and remove loose masonry units and mortar prior to laying new masonry.

E. Built-in Work:
1. As the Work progresses, build in items shown, specified or required by others. Fill cores in one block width solidly with masonry around built-in items.
2. Where built-in items are to be embedded in cores of hollow masonry units, place layer of cavity fill mesh in joint below and rod mortar or grout into core.

F. Horizontal Joint Reinforcing:
1. Provide continuous horizontal joint reinforcing as specified. Fully embed longitudinal side rods in mortar for their entire length with minimum cover of 5/8-inch on exterior side of walls and 1/2-inch at other locations. Lap reinforcement minimum of six inches at ends of units. Do not bridge masonry control joints with reinforcing.
2. Reinforce all masonry walls with continuous horizontal joint reinforcing unless specifically noted or specified to be omitted.
3. Provide continuity at corners and wall intersections by use of prefabricated “L” and “T” sections. Cut and bend units in accordance with manufacturer’s written instructions.
4. Space continuous horizontal reinforcing as follows:
   a. Space reinforcing at 16 inches on centers vertically, unless otherwise shown.
5. Reinforce masonry openings greater than 12 inches wide, with horizontal joint reinforcing placed in two horizontal joints approximately eight inches apart, immediately above lintel and immediately below sill. Extend reinforcing minimum of 2.0 feet beyond jambs of opening.
6. In addition to wall reinforcing, provide additional reinforcing at openings as required to comply with the Contract Documents.

G. Non Load Bearing Interior Partitions and Non Load Bearing Interior Cavity Wall Wythe:
1. Build full height of story to underside of structure above, unless otherwise shown.
2. Tie non load bearing partitions and non load bearing interior wythe of cavity walls at top and sides with masonry anchors at terminations. Build in end blocks as shown and specified to facilitate placing compressible filler. Insert compressible filler in all horizontal and vertical joints where non load bearing masonry and non load bearing interior wythe of cavity walls terminate. Insert filler 3/4 inches from both faces of masonry. Use filler four times as thick as the widest part of joint. Thickness of filler shall be minimum of 1.5 times the compressed thickness. Compress filler to less than thickness of joint and insert. At splices, overlap strips by three inches and compress ends to form tight joint. Finish with backer rod and sealant.

H. Structural Reinforced Unit Masonry Construction:
   1. Comply with the requirements of ACI 530.1 and applicable codes.

I. Grouting Structural Reinforced Unit Masonry Construction:
   1. Comply with requirements of ACI 530.1 and applicable codes.

J. Anchoring Masonry Work:
   1. Provide anchoring devices of type specified. If not shown or specified, provide standard type for facing and back up involved in compliance with requirements of Laws and Regulations.
   2. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:
      a. Provide an open space not less than 1/2-inch or more than one-inch in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar and other rigid materials.
      b. Space anchors as shown, but not more than 2.0 feet on center vertically and 3.0 feet on center horizontally.
      c. Provide end blocks where masonry abuts structural support to facilitate installation of compressible filler, firesafing insulation, backer rod, and sealant.

K. Masonry Control and Expansion Joints:
   1. Provide vertical control and expansion joints in masonry where shown. Build in related items as unit masonry Work progresses. Rake out mortar in preparation for application of compressible filler, calking and sealants.
   2. Masonry Control and Expansion Joints Items: Build in sash block and premolded control joint strips as the Work progresses.

L. Bond Beams:
   1. Provide masonry lintels and bond beams where openings of 16 inches or more are shown. Provide formed in place masonry lintels and bond beams. Temporarily support formed-in-place lintels and bond beams.
a. Unless otherwise shown, provide one horizontal number six deformed reinforcing bar for each 4 inches of wall thickness.
b. For hollow masonry unit walls, use specially formed “U”-shaped lintel and bond beam units with reinforcing bars placed as shown, filled with coarse grout as specified.

2. Provide minimum bearing at each jamb of eight inches for all openings.
3. On concrete unit masonry walls where pattern bond remains visually exposed, increase minimum bearing of masonry lintels to maintain joint pattern of wall and install to be indistinguishable from surrounding masonry.

3.5 REPAIR, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes, except weep holes, and completely fill with mortar. Point up all joints at corners, openings and adjacent Work to provide neat, uniform appearance, properly prepared for application of sealant compounds.

C. Cleaning Exposed, Unglazed Masonry Surfaces:
   1. Final Cleaning: After mortar is thoroughly set and cured, clean sample wall area of approximately 20 square feet as described below. Obtain ENGINEER’s acceptance of sample cleaning before proceeding to clean remainder of masonry Work.
      a. Dry-clean to remove large particles of mortar using wood paddles and scrapers. Use chisel or wire brush if required.
      b. Presoak wall by saturating with water and flush off loose mortar and dirt.
      c. Comply with requirements and recommendations for “Cleaning Clay Products Masonry” of Technical Notes on Brick and Tile Construction by Brick Industry Association for type of masonry and conditions involved in the Work.
      d. Apply cleaners per manufacturer’s instructions.
      e. Protect other Work from cleaning solutions and cleaning operations.
   2. Do not use acid cleaning agent, abrasive tools or powders, or metal cleaning tools or wire brushes, unless specifically recommended in writing by manufacturer.

D. Protection:
   1. Protect unit masonry construction Work from deterioration, discoloration or damage during subsequent construction operations.
3.6  FIELD QUALITY CONTROL

A. CONTRACTOR shall hire independent testing laboratory acceptable to ENGINEER to take samples and conduct tests to evaluate air entrainment, water retention, and compliance of products with Contract Documents, and to determine compressive strength of mortar and grout. Conduct tests in accordance with ASTM C91. Provide tests results to ENGINEER prior to commencement of Work.

B. After initial test, ENGINEER will require maximum of five additional tests to be conducted at his discretion.

C. Test and inspect all non-load-bearing concrete unit masonry during construction, meeting requirements of Level 2 Quality Assurance as defined by ACI 530.1.

++ END OF SECTION ++
SECTION 05 05 33
ANCHOR SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.
2. This Section includes all anchor systems required for the Work, but not specified under other Sections.

B. Coordination:
1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.

1.2 REFERENCES

A. Standards referenced in this Section are:
1. ACI 318, Building Code Requirements for Structural Concrete.
2. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
3. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
4. ANSI B212.15, Cutting Tools - Carbide-tipped Masonry Drills And Blanks For Carbide-tipped Masonry Drills.
6. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

1.3 QUALITY ASSURANCE

A. Qualifications:
1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.
2. Post-installed Anchor Installer: Shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer’s products. Product installation training by distributors or manufacturer’s representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.
1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.
   2. Product Data:
      a. Manufacturer’s specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.
      b. When required by ENGINEER, copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents.
      b. Post-installed anchor system manufacturer’s certification that installer received training in the proper installation of manufacturer’s products required for the Work.
   2. Manufacturer’s Instructions:
      a. Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time tables, and temperature ranges (storage, installation and in-service).
   3. Field Quality Control Submittals:
      a. Submit results of field quality control testing and inspections performed by testing laboratory.

1.5 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:
   1. Keep materials dry during delivery and storage.
   2. Store adhesive materials within manufacturer’s recommended storage temperature range.
   3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.
PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. General:

1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems of stainless steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless steel materials where stainless steel materials are required in the Contract Documents.

2. Stainless Steel Nuts:

a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.

b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.

3. Materials that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

B. Design Criteria

1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:

a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.

b. Adhesive Anchors, Expansion Anchors, or Concrete Inserts: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor
capacities shall be based on design procedure required in the applicable ICC Evaluation Service Report.

1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength of base fastening materials, spacing, and edge distance, as indicated in the manufacturer’s design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition, unless calculations demonstrate that the anchor system will be installed in an area that is not expected to crack under any and all conditions of design loading.

2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of the greater of the following: required to develop tensile strength of anchor, or a minimum embedment of 10 anchor diameters; and minimum anchor spacing and edge distance of 12 anchor diameters.

3) Concrete Masonry Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer’s instructions.

4) Concrete Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of six anchor diameters, and minimum anchor spacing and edge distance of seven anchor diameters.

5) Concrete Masonry Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as indicated in anchor manufacturer’s instructions.

6) Concrete Undercut Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum anchor spacing and edge distance as tabulated in anchor manufacturer’s instructions.

2. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:
   a. Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.
   b. Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.
   c. Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and
the next hanger or support. When piping or equipment is to be filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.

d. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to a design professional retained by CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents.

C. Application:

1. Anchor Bolts:
   a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.
   b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.

2. Concrete Adhesive Anchors:
   a. Use where adhesive anchors are shown or indicated for installation in concrete.
   b. Suitable for use where subject to vibration.
   c. Suitable for use in exterior locations or locations subject to freezing.
   d. Suitable for use in submerged, intermittently submerged, or buried locations.
   e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.
   f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.

3. Grout-filled Concrete Masonry Adhesive Anchors:
   a. Use where adhesive anchors are shown or indicated for installation in grout-filled concrete masonry units.
   b. Suitable for use where subject to vibration.
   c. Suitable for use in exterior locations or locations subject to freezing.
   d. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.

4. Hollow Concrete Masonry Adhesive Anchors:
   a. Use where adhesive anchors are shown or indicated for installation in hollow concrete unit masonry.
   b. Suitable for use where subject to vibration.
   c. Suitable for use in exterior locations or locations subject to freezing.
   d. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.

5. Concrete Wedge Expansion Anchors:
   a. Use where expansion anchors are shown or indicated for installation in concrete.
   b. Do not use where subject to vibration.
c. Do not use in exterior locations or locations subject to freezing.
d. Do not use in submerged, intermittently submerged, or buried locations.
e. Suitable for use in overhead applications.

6. Grout-filled Concrete Masonry Wedge Expansion Anchors:
a. Use where expansion anchors are shown or indicated for installation on the interior face of grout-filled unit masonry.
b. Do not use where subject to vibration.
c. Do not use in exterior locations or locations subject to freezing.

7. Hollow Concrete Masonry Sleeve Expansion Anchors:
a. Use where expansion anchors are shown or indicated for installation in hollow concrete unit masonry or solid brick.
b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
c. Do not use where subject to vibration.
d. Do not use in exterior locations or locations subject to freezing.

8. Drop-in Expansion Anchors:
a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.
b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
c. Do not use where subject to vibration.
d. Do not use at submerged, intermittently submerged, or buried locations.
e. Do not use in exterior locations or locations subject to freezing.
f. Suitable for use in overhead applications.

9. Concrete Inserts:
a. Use only where shown or indicated in the Contract Documents.
b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.

10. Drive-In Expansion Anchors:
a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.
b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
c. Do not use in overhead applications.

2.2 MATERIALS

A. Anchor Bolts:
1. Interior Dry Non-corrosive Locations: Provide straight threaded carbon steel rods complying with ASTM F1554, Grade 36, with heavy hex nuts complying with ASTM A563 Grade A, unless otherwise shown or indicated on the Drawings. Hooked anchor bolts are unacceptable.

2. Exterior, Buried, Submerged Locations, or When Exposed to Wastewater: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by ENGINEER. Hooked bolts are unacceptable.

3. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer’s requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.

4. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.

B. Concrete Adhesive Anchors:
   1. General:
      a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.

   2. Products and Manufacturers: Provide one of the following:
      a. HIT-RE 500-SD Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.
      c. Or equal.

   3. Adhesive:
      a. Adhesive system shall use two-component adhesive mix.
      b. Epoxy adhesives shall comply with physical requirements of ASTM C881/C881M, Type IV, Grade 2 and 3, Class A, B, and C, except gel times.
      c. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308.
      d. Adhesives shall have minimum bond strength and minimum design bond strength (bond strength multiplied by strength reduction factor) in accordance with Table 05 05 33-A:
TABLE 05 05 33-A:  
ADHESIVE BOND STRENGTH \(^{1,2}\)

<table>
<thead>
<tr>
<th>Anchor</th>
<th>Uncracked Concrete</th>
<th>Cracked Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rod Diameter / Dowel Size</td>
<td>Bond Strength (psi)</td>
<td>Design Bond Strength (psi)</td>
</tr>
<tr>
<td>3/8-inch / #3</td>
<td>2040</td>
<td>1300</td>
</tr>
<tr>
<td>1/2-inch / #4</td>
<td>1920</td>
<td>1200</td>
</tr>
<tr>
<td>5/8-inch / #5</td>
<td>1830</td>
<td>1150</td>
</tr>
<tr>
<td>3/4-inch / #6</td>
<td>1760</td>
<td>1050</td>
</tr>
<tr>
<td>7/8-inch / #7</td>
<td>1670</td>
<td>900</td>
</tr>
<tr>
<td>1-inch / #8</td>
<td>1650</td>
<td>1050</td>
</tr>
<tr>
<td>- / #9</td>
<td>1900</td>
<td>1000</td>
</tr>
<tr>
<td>1.25-inch/ #10</td>
<td>1580</td>
<td>1000</td>
</tr>
</tbody>
</table>

Table Notes:
1. Bond strengths listed for hammer-drilled, dry hole.
2. Bond strengths listed for maximum short term concrete temperature of 110 degrees F and maximum long term concrete temperature of 75 degrees F.

4. Anchor:
   a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer’s specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

C. Grout-filled Concrete Masonry Adhesive Anchors:
   1. General:
      a. Adhesive anchors shall consist of threaded rods anchored into grout-filled concrete block masonry using an adhesive system.
   2. Products and Manufacturers: Provide one of the following:
      a. HIT-HY 150 Max Adhesive Anchoring System, by Hilti Fastening Systems, Inc.
      c. Or equal.
   3. Adhesive:
      a. Adhesive system shall use two-component adhesive mix.
      b. Acrylate hybrid adhesives shall comply with the following:
         1) ASTM C579 compressive strength greater than 7,252 psi, or ASTM D695 compressive yield strength greater than or equal to 10,210 psi.
2) ASTM C307 modulus of elasticity greater than 507,000 psi or
ASTM D695 compressive modulus of elasticity greater than
660,800 psi.

c. Adhesives shall have current ICC Evaluation Service Report for use in
grout-filled concrete masonry, tested and assessed in accordance with
ICC-ES AC 58.

4. Anchor:
a. Provide stainless steel adhesive anchor rod complying with ASTM
F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type
316 stainless steel nuts. Provide ASTM A194/A194M, Grade 8S
(Nitronic 60) stainless steel nuts where required.

D. Hollow Concrete Masonry Adhesive Anchors:
1. General:
a. Adhesive anchors shall consist of threaded rods with a cylindrical
mesh steel or plastic screen tube anchored into hollow concrete block
masonry using an adhesive system.

2. Products and Manufacturers: Provide one of the following:
a. HIT-HY 20 for Masonry Anchoring System, by Hilti Fastening
Systems, Inc.
b. Acrylic-Tie Anchoring Adhesive, by Simpson Strong-Tie Company,
Inc.
c. Or equal.

3. Adhesive:
a. Adhesive system shall use two-component adhesive mix.
b. Hybrid adhesives shall comply with the following:
   1) ASTM D695 compressive strength, greater than 7,410 psi.
   2) ASTM D790 modulus of elasticity: 0.33 $x 10^6$ psi or ASTM D695
      compressive modulus of elasticity greater than 0.668 $x10^6$ psi.
c. Adhesives shall have a current ICC Evaluation Service Report for use
in hollow concrete masonry as tested and assessed in accordance with
ICC-ES AC58.

4. Anchor:
a. Provide stainless steel adhesive anchor rod complying with ASTM
F593, AISI Type 316, Condition CW, with ASTM F594, AISI Type
316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S
(Nitronic 60) stainless steel nuts where required.

5. Mesh Screen Tube:
a. Provide with mesh size, length, and diameter as specified by adhesive
anchor manufacturer.
b. Mesh shall be AISI 304 stainless steel.

E. Concrete Wedge Expansion Anchors:
1. General:
a. Concrete wedge expansion anchors shall consist of stud, wedge, nut,
and washer.
2. Products and Manufacturers: Provide one of the following:
   a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.
   b. Or equal.
4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
5. Other Locations: Provide AISI Type 304 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.
6. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

F. Grout-filled Masonry Wedge Expansion Anchors:
1. General:
   a. Grout-filled masonry wedge expansion anchors shall each consist of stud, wedge, nut, and washer.
2. Product and Manufacturers: Provide one of the following:
   b. Wedge-All Wedge Anchors, by Simpson Strong-Tie Company, Inc.
   c. Or equal.
3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Anchors shall be non-bottom bearing type with single-piece steel expansion clip providing 360-degree contact with base material and shall not require oversized holes for installation.
4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
5. Other Locations: Provide AISI Type 316 stainless steel anchor, complete with nut and washer, in accordance with ASTM A276 or ASTM A493.
6. Grout-filled masonry wedge expansion anchors shall have a current ICC Evaluation Service report for use in fully-grouted concrete masonry construction when tested and assessed in accordance with ICC-ES AC01.

G. Hollow Concrete Masonry Sleeve Expansion Anchors:
1. General:
   a. Sleeve expansion anchors shall each consist of an externally threaded stud with full length expanding sleeve.
2. Products and Manufacturers: Provide one of the following:
   a. HLC Sleeve Anchors, by Hilti Fastening Systems, Inc.
b. Dynabolt Sleeve Anchors, by ITW Red Head.
c. Or equal.

3. Anchors shall comply with physical requirements of FS A-A-1922A. Anchors shall be non-bottom bearing type with single-piece steel expansion sleeve providing 360-degree contact with base material, and shall not require oversized holes for installation.

4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.

5. Other Locations: Provide expansion anchors complete with nuts and washers, Type 304 stainless steel, in accordance with ASTM A276 or ASTM A493.

H. Drop-in Expansion Anchors:
   1. General:
   a. Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled expander plug.
   
   2. Products and Manufacturers: Provide one of the following:
      a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.
      b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.
      c. Or equal.
   
   3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633, complying with physical requirements of FS A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.

I. Concrete Inserts:
   1. Manufacturers: Provide products of one of the following:
      a. Unistrut Corporation.
      b. Cooper B-Line, Inc.
      c. Anvil International, Inc.
      d. Or equal.
   
   2. Spot Concrete Inserts:
      a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.

   3. Continuous Concrete Inserts:
      a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 12-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with styrofoam inserts, end caps, and means for attaching to forms. Provide
channel nuts compatible with insert suitable for threaded hanger rod sizes.

4. Provide inserts with plain finish.

J. Drive-In Expansion Anchors:
1. General:
   a. Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.
2. Products and Manufacturers: Provide one of the following:
   a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.
   c. Or equal.

K. Unless approved by ENGINEER, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.

L. Anti-Seizing Compound:
1. Products and Manufacturers: Provide one of the following:
   c. Or equal.
2. Provide pure nickel anti-seizing compound.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Anchor Bolts:
1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.
2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.
3. Protect threads and shank from damage during installation and subsequent construction operations.
4. Unless otherwise shown or approved by ENGINEER anchor bolts shall comply with Table 05 05 33-B:

### TABLE 05 05 33-B:
SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS

<table>
<thead>
<tr>
<th>Bolt Diameter (inch)</th>
<th>Minimum Embedment (inch)</th>
<th>Minimum Distance and Spacing (inch)</th>
<th>Shear (^1) (lb)</th>
<th>Tension (^1) (lb)</th>
<th>Minimum Embedment (inch)</th>
<th>Minimum Distance and Spacing (inch)</th>
<th>Shear (^2) (lb)</th>
<th>Tension (^2) (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>6</td>
<td>9</td>
<td>1,262</td>
<td>2,420</td>
<td>8.5</td>
<td>12.75</td>
<td>1,660</td>
<td>3,190</td>
</tr>
<tr>
<td>5/8</td>
<td>7.5</td>
<td>11.25</td>
<td>2,010</td>
<td>3,860</td>
<td>10.5</td>
<td>15.75</td>
<td>2,640</td>
<td>5,080</td>
</tr>
<tr>
<td>3/4</td>
<td>9</td>
<td>13.5</td>
<td>2,974</td>
<td>5,720</td>
<td>13</td>
<td>19.5</td>
<td>3,910</td>
<td>7,520</td>
</tr>
<tr>
<td>7/8</td>
<td>10.5</td>
<td>15.75</td>
<td>4,106</td>
<td>7,890</td>
<td>15</td>
<td>22.5</td>
<td>5,400</td>
<td>10,390</td>
</tr>
<tr>
<td>1</td>
<td>12</td>
<td>18</td>
<td>5,386</td>
<td>10,360</td>
<td>17</td>
<td>25.5</td>
<td>7,090</td>
<td>13,450</td>
</tr>
<tr>
<td>1 1/8</td>
<td>13.5</td>
<td>20.25</td>
<td>6,787</td>
<td>13,052</td>
<td>19</td>
<td>28.5</td>
<td>8,930</td>
<td>16,580</td>
</tr>
<tr>
<td>1 1/4</td>
<td>15</td>
<td>22.5</td>
<td>8,617</td>
<td>16,572</td>
<td>21</td>
<td>31.5</td>
<td>11,340</td>
<td>20,040</td>
</tr>
</tbody>
</table>

Table Notes:
1. Table is based on ACI 318 and ACI 350, Appendix D, \(f'c = 4000\) psi. Table 05 05 33-B is not applicable to anchor bolts embedded in grouted masonry.
2. Critical edge distance and spacing are indicated in the table. Capacity of anchor bolts for other combination of edge distances and spacing shall be evaluated in accordance with ACI 318 and ACI 350, Appendix D.
3. Values for shear and tension listed are not considered to act concurrently. Interaction of tension and shear will be evaluated by ENGINEER in accordance with ACI 318 and ACI 350, Appendix D.

B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors – General:
1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER’s approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.

C. Adhesive Anchors:
1. Comply with manufacturer’s written installation instructions and the following.
2. Drill holes to adhesive system manufacturer’s recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.
3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system.
4. Before injecting adhesive, obtain ENGINEER’s concurrence that hole is dry and free of oil and other contaminants.

5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.

6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.

7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.

8. Provide adequate curing in accordance to adhesive system manufacturer’s requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.

9. Limitations:
   a. Installation Temperature: Comply with manufacturer’s instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor systems manufacturer’s requirements during installation and curing of adhesive anchor system.
   b. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.
   c. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 2,500 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.

D. Expansion Anchors:
   1. Comply with expansion anchor manufacturer’s written installation instructions and the following:
      2. Drill holes using anchor system manufacturer’s recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI B212.15. Core drilled holes are unacceptable.
      3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
4. Before installing anchor, obtain ENGINEER’s concurrence that hole is dry and free of oil and other contaminants.

5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer’s recommended torque using a torque wrench.

E. Concrete Inserts:
1. Comply with concrete insert manufacturer’s installation instructions.
2. Inserts shall be flush with slab bottom surface.
3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.
4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.

F. Anti-Seizing Compound:
1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer’s installation instructions, at locations indicated in Paragraph 2.1.B of this Section.
2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.3 CLEANING
A. After embedding concrete is placed, remove protection and clean bolts and inserts.

3.4 FIELD QUALITY CONTROL
A. Site Tests:
1. Furnish services of independent testing laboratory to perform field quality tensile testing of production adhesive anchors at the Site, unless otherwise specified.
   a. Testing shall comply with ASTM E488.
   b. Test at least ten percent of all types of adhesive anchors. If one or more adhesive anchors fail the test, CONTRACTOR shall pay cost of testing, or at ENGINEER’s option CONTRACTOR may arrange for testing paid by CONTRACTOR, for all adhesive anchors of same diameter and type installed on the same day as the failed anchor. If anchors installed on the same day as the failed anchor also fail the test, ENGINEER may require retesting of all anchors of the same diameter and type installed in the Work. CONTRACTOR shall be responsible for retesting costs.
c. ENGINEER will direct which adhesive anchors are to be tested and indicate test load to be used.
d. Apply test loads with hydraulic ram.
e. Displacement of post-installed anchors shall not exceed D/10, where D is nominal diameter of anchor being tested.

2. Correct defective Work by removing and replacing or correcting, as directed by ENGINEER.

3. CONTRACTOR shall pay for all corrections and subsequent testing required to confirm competence in the installation of post-installed mechanical anchors.

4. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.

B. Manufacturer’s Services:
1. Provide at the Site services of qualified adhesive manufacturer’s representative during initial installation of adhesive anchor systems to train CONTRACTOR’s personnel in proper installation procedures. Manufacturer’s representative shall observe to confirm that installer demonstrates proper installation procedures for adhesive anchors and adhesive material.

++ END OF SECTION ++
SECTION 09 91 00
PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and apply paint systems.
   a. CONTRACTOR is responsible for surface preparation and painting of all new interior and exterior items and surfaces throughout the Project areas included under this and other Sections.
2. Extent of painting includes the Work specified below. Refer to Article 2.2 of this Section where all surfaces of generic types specified are specified for preparation and painting according to their status, intended function, and location, using the painting system for that surface, function, and location as specified, unless specifically identified on the Drawings as a surface not to receive specified painting system.
   a. All new surfaces and items except where natural finish of material is specified as a corrosion-resistant material not requiring paint; or is specifically shown as indicated by written note, or specified as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint them the same as adjacent similar materials or areas.
   b. Surface preparation and painting of all new items, both interior and exterior, and other surfaces, are included in the Work, except as otherwise shown or specified.
3. This Section includes non-potable, multi-functional, painting systems for use on concrete, masonry, metals, wood, and plastics.
4. Painting systems in contact with potable water are covered in other respective Sections.

B. Coordination:
1. Review installation, removal, and demolition procedures under other Sections and coordinate them with the Work specified in this Section.
2. Coordinate painting of areas that will become inaccessible once equipment and similar fixed items have been installed.
3. Furnish information to ENGINEER on characteristics of finish materials proposed for use and ensure compatibility with prime coats used. Provide barrier coats over incompatible primers or remove and repaint as required. Notify ENGINEER in writing of anticipated problems using specified
painting systems with surfaces primed by others. Reprime equipment primed in factory and other factory-primed items that are damaged or scratched.

C. Related Sections:
1. Section 13 34 23, Pre-Engineered Wood Building System.
2. Section 33 16 13, Pre-Stressed Concrete Tanks.
3. Section 40 05 05, Exposed Piping Installation.
4. Section 43 42 21, Hydropneumatic Tanks.

D. Work Not Included: The following Work is not included as painting Work, or are included under other Sections or in other contracts:
1. Shop Priming: Shop priming of structural metal, miscellaneous metal fabrications, other metal items and fabricated components such as shop-fabricated or factory-painted process equipment, plumbing equipment, heating and ventilating equipment, electrical equipment, and accessories shall conform to applicable requirements of this Section but are included under other Sections or in other contracts.
2. Pre-finished Items:
   a. Items furnished with such finishes as baked-on enamel, porcelain, and polyvinylidene fluoride shall only be touched up at Site by CONTRACTOR using manufacturer's recommended compatible field-applied touchup paint.
   b. Items furnished with finishes such as chrome plating or anodizing.
3. Concealed Surfaces: Non-metallic wall or ceiling surfaces in areas not exposed to view, and generally inaccessible areas, such as furred spaces, pipe chases, duct shafts, and elevator shafts.
4. Concrete surfaces below grade, unless otherwise shown or specified.
5. Concrete floors, unless specifically shown as a surface to be painted.
7. Corrosion-Resistant Metal Surfaces: Where the natural oxide of item forms a barrier to corrosion, whether factory- or Site-formed, including such materials as copper, bronze, muntz metal, terne metal, and stainless steel.
8. Operating Parts and Labels:
   a. Do not paint moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sensing devices, interior of motors, and fan shafts.
   b. Do not paint over labels required by governing authorities having jurisdiction at Site, or equipment identification, performance rating, nameplates, and nomenclature plates.
   c. Cover moving parts and labels during the painting with protective masking. Remove all protective masking upon completion of Work. Remove all paint, coatings, and splatter that comes in contact with such labels.
9. Structural and miscellaneous metals covered with concrete need not receive primers, intermediate, or finish coats of paint.

E. Description of Colors and Finishes:
   1. Color Selection:
      a. ENGINEER reserves the right to select non-standard colors for paint systems specified within ability of paint manufacturer to produce such non-standard colors. Provide such colors at no additional expense to OWNER.
   2. Color Coding of Pipelines, Valves, Equipment, and Ducts:
      a. Color-coding of pipelines, valves, equipment and ducts shall comply with applicable standards of ANSI A13.1, ANSI Z535.1, CFR 1910.144, and Recommended Standards for Water Works. For piping and equipment not covered by the above standards, color will be selected by ENGINEER.
      b. For equipment located on roofs and equipment that is exposed-to-view, color will be selected by ENGINEER.

1.2 REFERENCES

A. Referenced Standards: Standards referenced in this Section are:
   1. ANSI A13.1, Scheme for Identification of Piping Systems.
   3. ASTM D16, Terminology for Paint, Related Coatings, Materials and Applications.
   4. ASTM D2200, Pictoral Surface Preparation Standards for Painting Steel Surfaces.
   5. ASTM D4262, Testing Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
   6. ASTM D4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
  11. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
  12. SSPC VIS 1, Visual Standard for Abrasive Blast Cleaned Steel.
  13. SSPC VIS 2, Method of Evaluating Degree of Rusting/Painted Steel Surfaces.

1.3 DEFINITIONS

A. Coating terms defined in ASTM D16 apply to this Section.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Engage a single applicator regularly performing installation of painting systems, with documented skill and successful experience in installing types of products required and agrees to employ only tradesmen trained, skilled, and with successful experience in installing types of products specified.

B. Testing Agency Qualifications: Provide independent testing agency with experience and capability to satisfactorily conduct testing specified in accordance with ASTM E329. Testing agency shall be selected by ENGINEER and paid for by CONTRACTOR.

C. Source Quality Control:
   1. Obtain products from manufacturers that will provide services of a qualified manufacturer’s representative at Site at commencement of painting Work to advise on products, mock-ups, installation, and finishing techniques, at completion of the Work to advise ENGINEER on acceptability of completed Work, and during course of Work as requested by ENGINEER.
   2. Submit “or equal” products, when proposed, with direct comparison to products specified, including information on durability, adhesion, color and gloss retention, percent solids, VOC’s grams per liter, and recoatability after curing.
   3. “Or equal” manufacturers shall furnish same color selection as manufacturers specified, including intense chroma and custom pigmented colors in painting systems.
   4. Color Pigments: Provide pure, non-fading, applicable types to suit surfaces and services indicated. Comply with the following:
      a. Lead and Chromate: Lead and chromate content shall not exceed amount allowed by authorities having jurisdiction.
      b. Through CONTRACTOR, paint manufacturer shall notify ENGINEER of colors that are not suitable for long-term color retention in areas subject to hydrogen sulfide fume exposure.
      c. Manufacturer shall identify colors that meet requirements of authorities having jurisdiction at Site for use in locations subject to contact with potable water or water that will be treated to become potable.
d. Comply with paint manufacturers’ recommendations on preventing coating contact with levels of carbon dioxide and carbon monoxide that may cause yellowing during application and initial stages of curing of paint coatings.

D. Regulatory Requirements:

E. Pre-Painting Conference:
   1. Conduct a pre-painting conference at the Site to review specified requirements. Meeting attendees shall include painting applicator and its foreman, paint manufacturer’s technical representative, installers of other work in and around painting that must follow painting Work, ENGINEER, and other representatives directly concerned with performance of painting Work.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Copies of manufacturer’s technical data sheets, including surface preparation, number of coats, dry film thickness, test performance data including paint analysis, VOC and chemical component content in comparison to maximum allowed by the Contact Documents, and application instructions for each product proposed for use.
      b. Submit proof of acceptability of proposed application techniques by paint manufacturer selected.
      c. Copies of CONTRACTOR’s proposed protection procedures in each area of the Work explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption, and for maintaining acceptable application, curing, and environmental conditions during and after painting systems application.
      d. List each material and cross-reference to the specific painting system and application, including a list of site-specific surfaces to which painting system will be applied. Identify by manufacturer’s catalog number and general classification. State number of gallons of each product being purchased for delivery to Site and square foot area calculated to be covered by each painting system specified based on theoretical loss of 20 percent. Where actual area to be covered by paint system exceeds area submitted to ENGINEER for that system, proof of additional material purchase shall be provided to ENGINEER.
Calculated coverage shall be as specified for each component of each painting system specified. This requirement does not take precedence over CONTRACTOR’s responsibility to provide dry film thickness required for each component of each painting system.

e. Identify maximum exposure times allowable for each paint system component before next coat of paint can be applied. Submit proposed methods for preparing surfaces for subsequent coats if maximum exposure times are exceeded.

f. Information on curing times and environmental conditions that affect curing time of each paint system component and proposed methods for accommodating variations in curing time. Identify this information for each painting system in the Work.

g. Specification for spray equipment with cross-reference to paint manufacturer’s recommended equipment requirements.

2. Samples:

a. Copies of manufacturer's complete color charts for each coating system.

B. Informational Submittals: Submit the following:

1. Certificates:

a. Certificate from paint manufacturer stating that materials meet or exceed Contract Documents requirements.

b. CONTRACTOR shall provide statement verifying that all painting systems are compatible with surfaces specified. All painting systems components shall be reviewed by an authorized technical representative of paint manufacturer for use as a compatible system. Verify that all painting systems are acceptable for exposures specified and that paint manufacturer is in agreement that selected systems are proper, compatible, and are not in conflict with paint manufacturer’s recommended specifications. Show by copy of transmittal form that a copy of letter has been transmitted to paint applicator.

2. Test Reports:

a. Certified laboratory test reports for required performance and analysis testing in compliance with ASTM E329.

b. Adhesion testing plan and procedures.

c. Locations of and test methods for soil sampling before beginning Work and after Substantial Completion.

d. Proposed methods for testing, handling, and disposal of waste generated during Work.

e. Results of alkalinity and moisture content tests performed per ASTM D4262 and ASTM D4263.

f. Results of film thickness, holidays, and imperfections tests.

3. Manufacturer’s Instructions: Provide paint manufacturer’s storage, handling, and application instructions prior to commencing painting Work at Site.
4. Special Procedure Submittals:
   a. Proposed protection procedures for each area of Work, explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption.
   b. Site-specific health and safety plan.
   c. Procedures for maintaining acceptable application, curing and environmental conditions during and after painting systems application.
   d. Procedures for providing adequate lighting, ventilation, and personal protection equipment relative to painting Work.

5. Qualifications:
   a. Applicator.
   b. Testing laboratory

C. Closeout Submittals: Submit the following:
   1. Maintenance Manual: Upon completion of the painting Work, furnish ENGINEER three copies of detailed maintenance manual including the following information:
      a. Complete and updated product catalog of paint manufacturer’s currently available products including complete technical information on each product. Identify product names and numbers of each product used in the painting Work.
      b. Name, address, e-mail address and telephone number of manufacturer, local distributor, applicator and technical representative.
      c. Detailed procedures for routine maintenance and cleaning.
      d. Detailed procedures for light repairs such as dents, scratches and staining.
   2. Statement of Application: Upon completion of the painting Work, submit a notarized statement to ENGINEER signed by CONTRACTOR and painting applicator stating that Work complies with requirements of the Contract Documents and that application methods, equipment, and environmental conditions were proper and adequate for conditions of installation and use.

1.6 DELIVERY, STORAGE AND HANDLING

A. Product Delivery Requirements: Deliver products to Site in original, new, and unopened packages and containers, accurately and legibly and accurately labeled with the following:
   1. Container contents, including name and generic description of product.
   2. Manufacturer’s stock number and date of manufacture.
   3. Manufacturer’s name.
   4. Contents by volume, for major pigment and vehicle constituents.
5. Grams per liter of volatile organic compounds.
6. Thinning instructions, where recommended.
7. Application instructions.
8. Color name and number.

B. Product Storage Requirements:
1. Store acceptable materials at Site.
2. Store in an environmentally controlled location as recommended in paint manufacturer’s written product information. Keep area clean and accessible. Prevent freezing of products.
3. Store products that are not in actual use in tightly covered containers.
4. Comply with health and fire regulations of authorities having jurisdiction at Site.

C. Product Handling Requirements:
1. Handle products in a manner that minimizes the potential for contamination, or incorrect product catalyzation.
2. Do not open containers or mix components until necessary preparatory work has been completed and approved by ENGINEER and painting Work will start immediately.
3. Maintain containers used in storing, mixing, and applying paint in a clean condition, free of foreign materials and residue.

1.7 SITE CONDITIONS

A. Site Facilities:
1. Supplemental heat sources, as required to maintain both ambient and surface temperatures within range recommended by paint manufacturer for paint system applications, are not available at the Site.
2. Provision of supplemental heat energy sources, power, equipment, and operating, maintenance, and temperature-monitoring personnel is CONTRACTOR’s responsibility.
3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being painted. Properly locate and vent heat sources to exterior so that paint systems and personnel are unaffected by exhaust products.

B. Environmental Requirements:
1. Comply with manufacturer’s published requirements.

C. Protection:
1. Cover or otherwise protect finished Work of other trades and those surfaces not being painted concurrently and not to be painted.
2. Coordinate and schedule surface preparation and painting to avoid exposing personnel to hazards associated with painting Work. Provide required
personnel safety equipment per requirements of authorities having jurisdiction at Site.

3. Submit protection procedures to be employed. Do not begin surface preparation and painting Work until ENGINEER accepts protection techniques proposed by CONTRACTOR.

4. When working with flammable materials, provide fire extinguishers and post temporary signs warning against smoking and open flame.

PART 2 - PRODUCTS

2.1 PAINTING SYSTEM MANUFACTURERS

A. Products and Manufacturers: Where referenced under painting systems, provide painting systems manufactured by the following:
   1. Tnemec Company, Incorporated (TCI).
   2. The Carboline Company, part of StonCor Group, an RMP Company (TCC).
   4. Or approved equal.

2.2 PAINTING SYSTEMS

A. New Surfaces; Non-Submerged, Interior; Buried, Submerged and Intermittently Submerged, OTC Compliant; Interior and Exterior:
   1. Surface Preparation: Comply with manufacturer’s published recommendations for material and surface condition.
   2. Filler, Surfacer and Patching Compound:
      a. Products: Provide one of the following:
         1) Epoxy-based products, number of coats, and dry film thickness recommended in manufacturer’s published data sheets for finish coats and surfaces specified.
   3. Primer/Intermediate:
      a. Products: Provide one of the following:
         1) Epoxy-based products, number of coats, and dry film thickness recommended in manufacturer’s published data sheets for finish coats and surfaces specified.
   4. Finish for All Surfaces Except Wood; Semi-gloss:
      a. Generic Components:
         1) Minimum 62-percent volume solids, high-build, two-component, polyamide-catalyzed epoxy or polyamido-amine epoxy; 250 grams per gallon VOC, maximum.
b. Products and Manufacturers: Provide products of one of the following:
   1) Series V69 Hi-Build Epoxoline (TCI); Carboguard 890 Series (TCC); Macropoxy HS (SWC)- two coats, 3.0 to 6.0 dry mils per coat, 107 to 201 square feet per gallon.

5. Wood Finish; Semi-gloss:
   a. Generic Components:
      1) Minimum 36-percent solids, acrylic polymer, 215 grams per liter VOC, maximum.
   b. Product and Manufacturer: Provide products of one of the following:
      1) Series 28/29 Tufcryl (TCI); Carbocrylic 3359 (TCC); Sher-Cryl HPA (SWC): Two coats, 2.0 to 3.0 dry mils per coat.

2.3 INSTRUMENTS

A. Instruments:
   1. CONTRACTOR to utilize a dry-film thickness gauge for checking film thickness, a holiday detector to detect holidays or holes in the coating, and a set of visual standards to check surface preparation. Calibrate dry film thickness gauge at Site using Bureau of Standards standard shim blocks.
   2. Products and Manufacturers: Provide the following:
      a. Film Thickness Testers: Model FM-III manufactured by Mikrotest, or equal.
      b. Holiday detector shall be Model M-1 as manufactured by Tinker & Rasor, or equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which painting Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

B. Do not paint over existing paint where there is no assurance that existing paint will provide an acceptable surface for long-term adherence and durability of painting systems specified, or where paint manufacturer requires removal of all existing paint to recommend use of specified painting system.
3.2 **SURFACE PREPARATION**

A. General:
   1. Comply with paint manufacturer’s published recommendations for products, surface condition, and surface preparation.

3.3 **PROTECTION OF PROPERTY AND STRUCTURES**

A. Protect property and structures adjacent to the Work from waste residues resulting from cleaning, surface preparation, and painting Work.

B. Use shrouding, vacuum blasting, or other acceptable methods for cleaning and surface preparation of exterior surfaces.

C. During blast cleaning and surface preparation of interior and exterior surfaces, control exhausting of dust and grit using shrouding, negative-pressure containment/dust collection systems, or other means to protect adjacent property and structures and prevent dust and grit from escaping. Similarly, control removal and temporarily store residues to protect adjacent property and structures.

D. For painting of exterior surfaces, use rollers, shrouding, or other acceptable methods as required to protect adjacent property and structures from wind-blown paint residues.

E. Submit proposed procedures for cleaning, surface preparation, and paint application that describe in detail methods to be used to protect adjacent property and structures from residues. Do not proceed with cleaning, surface preparation, or painting until proposed procedures are accepted by ENGINEER.

3.4 **MATERIALS PREPARATION**

A. General: Mix and prepare painting products in strict accordance with paint manufacturer's product data sheets.

3.5 **APPLICATION**

A. General:
   1. Apply paint systems by brush, roller, or airless spray per paint manufacturer's recommendations and in compliance with Paint Application Specifications No. 1 in SSPC Volume 2, where applicable, and in strict accordance with paint manufacturer's product data sheets.
2. Except for color-coded process piping systems, surfaces of items not normally exposed-to-view do not require same color as other components of system of which they are a part, but require same painting system specified for exposed surfaces of system.
3. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint before final installation of registers or grilles.
4. Paint backs of access panels and removable or hinged covers to match exposed surfaces.
5. Omit field-applied primer on metal surfaces that have been primed in the shop. Touch-up paint to shop-primed coats and pre-finished items only when approved by ENGINEER using compatible primers and paint manufacturer's recommended compatible field-applied finishes.
6. Welds shall be stripe-coated with intermediate or finish coat of paint after application of prime coat.

B. Minimum/Maximum Paint Film Thickness: Comply with manufacturer’s published recommendations for coating type and surface.

C. Scheduling Surface Preparation and Painting: Comply with manufacturer’s published recommendations for coating type and surface.

D. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to result in a finish coat with no burn-through or other defects caused by insufficient sealing.

E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.

F. Brush Application:
   1. Brush-out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections are unacceptable. Neatly draw all glass and color break lines.
   2. Brush-apply all primer or first coats, unless otherwise allowed to use mechanical applicators.

G. Mechanical Applicators:
   1. Use mechanical methods for applying paint when allowed by applicable ordinances, paint manufacturer, and approved by ENGINEER.
   2. Limit roller applications, if approved by ENGINEER, to interior wall finishes for second and third coats. Apply each roller coat to provide equivalent hiding as brush-applied coats.
3. Where spray application is used, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment for purpose of building up film thickness of two coats in one pass.

H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements as required by ENGINEER.

3.6 FIELD QUALITY CONTROL

A. Notify ENGINEER after completing each coat of paint. After inspection and checking of film thickness, holidays, and imperfections, and after acceptance by ENGINEER, proceed with succeeding coat. Perform testing using testing instruments specified in Article 2.3 of this Section.
1. ENGINEER will witness all testing and shall be notified of scheduled testing at least twenty-four hours in advance.
2. Apply additional coats, if required, to produce specified film thickness and to correct holidays and to completely fill all surface air holes.

B. For magnetic substrates, measure thickness of dry film nonmagnetic coatings following recommendations of SSPC PA-2. These procedures supplement manufacturers’ approved instructions for manual operation of measurement gauges and do not replace such instructions.

C. Record time, location, number of coats, dry film thickness, holidays, and other imperfections and submit testing results to ENGINEER.

3.7 PROTECTION

A. Provide “Wet Paint” signs as required to protect newly painted finishes. After completing painting Work, remove temporary protective wrappings provided for protection of the Work.

3.8 ADJUSTMENT AND CLEAN-UP

A. Correct damage to work of other trades by cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.

B. During progress of the Work, remove from Site all discarded paint products, rubbish, cans, and rags at end of each workday.

C. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
D. At completion of Work of other trades, touch-up and restore all damaged or defaced painted surfaces as determined by ENGINEER.

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and
      incidentals as shown, specified, and required to furnish and install all fire
      protection specialties Work.
   2. Extent of fire protection specialties Work is shown and specified.
   3. Types of fire protection specialties Work required includes:
      a. Dry chemical extinguishers.
      b. Mounting accessories and miscellaneous fasteners.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate
      installation of items that must be installed with or before fire protection
      specialties.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. UL Fire Classification Rating.

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:
   1. Provide fire protection specialties products from one manufacturer.

B. Regulatory Requirements: Provide fire protection specialties approved and
   labeled by UL.

1.4 SUBMITTALS

A. Action Submittals:
   1. Product Data: Submit the following:
      a. Manufacturer’s technical data, certification of UL rating, and
         installation instructions for fire protection specialties.
PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. General: Provide manufacturer’s standard mounting brackets for portable fire extinguishers size as specified.

B. Multi-Purpose Dry Chemical Fire Extinguishers:
   1. Ten-pound capacity, enameled steel container with pressure-indicating gauge, for Class A, Class B, Class C fires, UL rating 4A-60 BC.
   2. Products and Manufacturers: Provide one of the following:
      a. Cosmic Model 10E by J.L. Industries.
      b. Or equal.

C. Quantity and Location: Provide Fire Extinguishers in the following locations, as shown:
   1. Potable Water Pump Station Room (two).
   2. Chemical Feed System Room (one).

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine substrates and conditions under which fire protection specialties will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to ENGINEER.

3.2 INSTALLATION OF FIRE EXTINGUISHERS

A. When exact locations of fire protection specialties are not shown on Drawings, locate as directed by ENGINEER.

B. Securely fasten products to structure, square and plumb, per Supplier’s instructions. Mounting heights shall be:
   1. Install fire extinguishers with gross weight less than 40 pounds with top of fire extinguisher no more than 4.0 feet above finished floor.
   2. Clearance between bottom of fire extinguisher and finished floor shall be at least four inches.

C. Identification Devices: Provide signs level and plumb directly above surface mounted portable fire extinguishers, securely mounted, attached to substrate per sign manufacturer’s instructions.
D. Recharge fire extinguishers provided under this Contract so that most recent inspection date coincides as nearly as possible with date of Substantial Completion. Inform COUNTY in writing of next required inspection and recharging date.

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install metal storage shelving system complete and operational.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the metal storage shelving system Work.
   2. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.
   3. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
      a. ASTM A 1011/A 1011M.
      b. ASTM A 1008/A 1008M.
      c. ASTM A 653/A 653M.
      d. ASTM A 513.
      e. ASTM A 554.
      f. ASTM A 899.
      g. ASTM A 580/A 580M.
      h. ASTM A 780.
      i. ASTM A 276.
      j. ASTM A 666.
      a. ANSI A135.4.
      a. SSPC-SP 5.
      b. SSPC-SP 8.
1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section, regardless of the component manufacturer, from a single metal storage shelving system manufacturer.
   2. The metal storage shelving system manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the metal storage shelving system manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data: Manufacturers' catalog literature, specifications, and illustrations with the following information:
      a. Construction details.
      b. Material and finishes description and properties.
      c. Rated load capacities.
      d. Dimensions of individual components and profiles
      e. Installation instructions.
      f. Maintenance data.

B. Shop Drawings: For customized metal storage shelving, include plans, elevations, sections, details, and attachments to other work. Include installation details of connectors, lateral bracing, and special bracing.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store all materials in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
3. Store material in clean, dry area, out of the weather.
4. Material shall be tightly covered to protect against dirt, water, mechanical injury or chemical damage.
5. Material shall remain in original cartons until time of installation.

C. Acceptance at Site:
1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Metal storage shelving systems shall be constructed of the following materials:
   1. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
   2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
   5. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating.
   7. Stainless-Steel Tubing: ASTM A 554, Grade MT-304.
   11. Floor Anchors: Galvanized-steel, post-installed expansion anchors. Provide number per unit recommended by manufacturer.
   12. Wall Anchors: Manufacturer's standard, galvanized-steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall.

2.2 FOUR-POST METAL STORAGE SHELVING

A. Open, Four-Post Metal Storage Shelving: Factory-formed, field-assembled, freestanding system, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units
similarly, so each unit is independent. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

1. Manufacturers: Provide products by one of the following:
   a. Adjustable Shelving Products; a division of Karp Associates, Inc.
   b. Borroughs Corporation.
   c. Edsal.
   d. Equipto.
   e. Or equal.

2. Load-Carrying Capacity per Shelf: 200 lb.

3. Posts: Fabricated from hot-rolled steel, with perforations to receive shelf-to-post connectors.
   a. Steel Thickness, Nominal: As required for load-carrying capacity per shelf and number of shelves.
   b. Add-On Shelf Posts: Fabricated from hot-rolled steel, perforated to match main posts and of same thickness.

4. Bracing: Manufacturer's standard, as required for stability, load-carrying capacity and number of shelves.

5. End Panels: Fabricated from cold-rolled steel sheet with thickness as required for load-carrying capacity of each shelf.

6. Solid-Type Shelves: Fabricated from steel sheet as follows:
   a. Steel-Sheet Thickness: As required for load-carrying capacity per shelf.
   b. Fabricate fronts and backs of shelves with box-formed edges, with corners lapped and welded.
   c. Fabricate fronts and backs of shelves with vertical edges that are flanged and returned, with reinforced steel edges.

7. Shelf Quantity: 3 shelves per shelving unit in addition to top and bottom shelf.

8. Shelf-to-Post Connectors: Manufacturer's standard connectors.

9. Quantity and Location: Provide 4 shelving units in Potable Pump Skid Room as shown on drawings.

10. Overall Unit Width: 48 inches.

11. Overall Unit Depth: 16 inches.

12. Overall Unit Height: 72 inches.

13. Accessories:
   a. Shelf-Label Holders: Clear plastic, designed to clip onto front edge of shelf.


2.3 FABRICATION

A. Shop Fabrication: Prefabricate shelving components in shop to greatest extent possible to minimize field fabrication; temporarily preassemble shelving components where necessary to ensure that field-assembled components fit together properly. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
B. Fabricate metal storage shelving square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.
   1. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
   2. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
   3. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
   4. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.

C. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work. Form backs of shelving units up to 48 inches wide from one piece.

D. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a 1/2-inch- wide hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch. Shear and punch metals cleanly and accurately. Remove burrs.

E. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 METALLIC-COATED STEEL-SHEET FINISHES

A. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A 780.
B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry thickness.

2.6 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling."

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry thickness.

PART 3 – EXECUTION

3.1 INSPECTION

A. Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Inspect areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

C. Examine floors for suitable conditions where metal storage shelving will be installed.

D. Examine walls to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FIELD QUALITY CONTROL

A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.

1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.

3. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.

4. Install shelves in each shelving unit at equal spacing.
   a. Four-Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.

B. Accessories:
   1. Shelf-Label Holders: Install one on each shelf, centered within each shelving unit.

C. Adjust metal storage shelving so that connectors and other components engage accurately and securely.

D. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.

E. Replace metal storage shelving that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

++ END OF SECTION ++
SECTION 13 34 23

PRE-ENGINEERED WOOD BUILDING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all design, labor, materials, components, and accessories as specified and necessary to provide a complete wood building system. System includes but is not limited to primary and secondary structural framing systems, connections, roofing, wall liner panels, roof and wall insulation, personnel doors, sectional door and accessories.
   2. The wood building shall be a clear span building with a roof slope of 4:12.
   3. The wood building clear height shall not be less than 10'-0".

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the Work that must be installed with or attached to the wood building Work.

C. Related Sections:
   1. Section 05 05 33, Anchor Systems.

1.2 REFERENCES

A. Preservative Treated Lumber
   1. American Wood Protection Association (AWPA)
      a. Commodity Specification C2 (2001), Preservative Treatment By Pressure Processes
      b. Use Category System U1, User Specification for Treated Wood
      c. UC4A (Important Structural – Ground Contact)
      d. UC4B (Structural Support – Ground Contact)
      e. Items treated under AWPA standards shall bear the quality mark of an independent testing agency or service
      a. Items treated under ICC-ES reports shall meet or exceed the applicable standard and shall bear the quality mark of an independent testing agency or service.

B. Framing Lumber
   1. Lumber Grading Rules and Wood Species
C. Wood Trusses
   1. All lumber used in the design of wood trusses shall be kiln dried to maximum 19% moisture content and graded in accordance with the current grading rules. Design stresses allowed are those listed in the current editions of the respective Lumber Association’s grading rules.
   2. The design of wood members shall be in accordance with the formulas published in the 2001 edition of the National Design Specification for Wood Construction.
      a. Connector plates shall be fabricated in accordance with applicable ICC-ES standards.
   4. Truss members and joints shall be designed in accordance with TPI-2002. All truss designs shall be accompanied by complete and accurate shop drawings and contain the following information:
      a. Slope or depth, span and spacing of the truss
      b. Heel bearing height
      c. Design loading to include:
         1) Top chord live load
         2) Top chord dead load
         3) Bottom chord dead load
         4) Concentrated loads and their points
      d. Adjustments to lumber and plate design values for conditions of use
      e. Plate type, thickness of gauge and size
      f. Lumber size, species and grade for each member

1.3 SYSTEM DESCRIPTION

A. Clear span

B. Bay spacing of 10’-0” O.C.

C. Primary framing
   1. Columns
   2. Trusses
   3. Wind bracing
D. Secondary framing
   1. Perimeter baseboards and preservative treatment
   2. Wall girts
   3. Purlins
   4. Overhang rafters and fascia
   5. Ancillary blocking or furring as required

E. Roof Covering
   1. Prefinished ribbed metal panels
   2. Other roof coverings as required

F. Wall Covering
   1. Prefinished ribbed metal panels
   2. Other wall coverings as required

G. Insulation and Liner package
   1. Wall insulation
   2. Ceiling insulation
   3. Air deflectors
   4. Vapor retarder
   5. Wall stripping
   6. Prefinished ribbed metal panels

1.4 SUBMITTALS

A. Wood Building Shop Drawings: Submit for approval the following:
   1. Dimensioned Shop Drawings and Design Drawings showing plans, elevations
      and cross sections of the buildings. Locate center lines of the bottom of all
      columns.
   2. Manufacturers product information, specifications and installation instructions
      for building components and accessories.
   3. Complete erection Shop Drawings showing anchor bolts settings, sidewall,
      endwall, and roof framing, transverse cross sections, covering and trim details,
      and accessory installation details to clearly indicate the proper assembly of
      building components.
   4. Foundations Loads: Shop drawing showing all vertical and horizontal reactions
      on foundation. Include direction and location of application.
   5. Design calculations, signed and stamped with the seal of a Registered Engineer
      licensed to practice in the State of Florida.
   6. Certification: Submit for approval written certification prepared, signed and
      stamped with the seal of a Registered Engineer, licensed to practice in the State
      of Florida, verifying that the building design meets indicated loading
      requirements and codes of authorities having jurisdiction.
   7. Samples: Submit for approval the following:
a. 12-inch long by actual width of roofing material, siding panels, and liner panels with required finishes, where appropriate.
b. Fasteners for application of roofing, siding panels and liner.
c. Sealants and closures.
d. ENGINEER review will be for color and texture only. Compliance with all other requirements is the responsibility of CONTRACTOR.

8. Maintenance Stock: Provide a minimum of 5 percent excess over the required amount of metal wall panels, roofing material, roof and wall insulation, nuts, bolts, screws, washers, and other required fasteners for building. Pack in cartons and store on the site where directed.

9. Quality Assurance/Control Submittals:
   a. Certificates:
      1) Manufacturer qualification.
      2) Dealer qualification.
      3) Installer qualification.

10. Manufacturer’s standard color chart.

1.5 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: All Work of this Section shall comply with the requirements of all State and Local Codes.

B. Qualifications:
   1. Manufacturer Qualifications: Minimum five years experience in producing pre-engineered wood buildings of the type specified.
   2. Dealer Qualifications: Must be manufacturer authorized dealer; state date authorization granted and expiration if any.
   3. Installer Qualifications: Minimum one year experience in erection of pre-engineered wood buildings of the type specified, and having installed at least two structures fabricated by manufacturer.

C. Fabrication Criteria: Comply with the following:
   1. Provide prefabricated wood buildings as produced by a manufacturer who is regularly engaged in the fabrication and erection of pre-engineered wood structures of the type and quality indicated.
   2. Design sizes of prefabricated components and necessary field connections required for erection to permit easy assembly. Fabricate components in such manner that once assembled they may be disassembled, repackaged and reassembled with a minimum amount of labor and maximum salvageability.
   3. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.

D. Structural Engineer Certification: Letter signed by an Engineer/Structural Engineer, registered to practice in the State of Florida verifying compliance with specified
design requirements. Letter must reference specific dead loads, live loads, wind loads, tributary area load reductions (if applicable) collateral loads, seismic loads, end use categories, and governing building code including edition and load applications. Design calculations, design drawings, and shop drawings shall be prepared under the direction of this Engineer. All calculations and drawings shall bear the Engineer’s seal.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver and store prefabricated components, sheets, panels, and other manufactured items so that they will not be damaged or deformed. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal sheets or panels so that water accumulations will drain freely. Do not store sheets or panels in contact with other materials, which might cause staining.

B. Follow manufacturer’s instructions.

1.7 CERTIFICATIONS

A. In order for the bidder’s proposal to be considered, the following certifications shall be tendered with the bid forms:
   1. Certification of the sheet steel supplier stating:
      a. Minimum thickness of metallic coating steel in decimal inch
      b. Identification of all metallic coatings
      c. Coating weight range
      d. Verification that material supplied is in conformance with applicable ASTM standard as stated in the technical specification.
   2. Certification of paint supplier stating:
      a. Generic chemistry of exterior side topcoat
      b. Percentage of polyvinylidene difluoride (PVDF) in resin.
   3. Certification of sheet steel coater stating:
      a. Nominal paint film thickness in mils (one mil equals one thousandth of an inch).
   4. Certification of treated lumber stating:
      a. Preservative type
      b. Preservative retention in the wood (pounds per cubic foot of wood)
      c. Depth of assay zone
      d. Compliance of preservative and its retention in wood with AWPA or ICC-ES standards.
   5. Warranty
      a. Sample copy of warranty to be issued at completion of project.
      b. Verification that warranty meets or exceeds the requirements stated in the technical specification.
B. Failure to supply the required submittals will result in the bidder’s proposal being rejected as non-responsive.

1.8 WARRANTY

A. CONTRACTOR shall furnish written guarantees from the manufacturer stating that the manufacturer will:
1. For a period of fifty (50) years:
   a. Absorb repair or replacement costs, including materials and labor, if any preservative treated lumber fails due to decay or insect attack
2. For a period of thirty-five (35) years:
   a. Repaint any roofing or siding panel on which, under conditions of normal weather, the paint has separated from the panels due to flaking or peeling.
   b. Repaint any roofing or siding panels on which, under conditions of normal weathering, chalking greater than a rating of 8 (ASTM D4212 Method ‘A’) or color change greater than five (5) units (ASTM D2244) has occurred.
3. For a period of ten (10) years:
   a. Repaint any roofing or siding panel on which, under conditions of normal weather, exhibit corrosion resulting in red rust greater than 1/2 inch from any sheared edge which is clearly visible in casual observation.
4. For a period of five (5) years:
   a. Repair, or at its discretion, replace free of charge the building framework, including roofing and/or siding panels, if directly damaged by wind loads, unless damage is caused by flying or falling objects.
   b. Repair any roof leaks due to defects in materials or workmanship.
5. For a period of one (1) year:
   a. Repair other building parts that prove to be defective in materials or workmanship.
6. The manufacturer shall not be liable for damage due to deterioration caused by interior chemical vapors and/or dust, deterioration from proximity to salt water body or aggressive exterior atmosphere, damage by flying or falling objects, or collateral damage to interior walls, ceiling, partitions, equipment and/or contents, or cost of preparation of the site.

1.9 DESIGN CRITERIA

A. The wood building manufacturer is responsible for the structural design of all components of the building as generally shown on the conceptual layout drawings and as specified.
B. The design shall comply with the applicable provisions and recommendations of the following codes and design requirements except as otherwise shown or specified. Where conflict occurs between codes, the more stringent provision shall govern. Latest editions of codes shall apply.

1. Since the manufacturer reserves the right to constantly change and improve his products without notice CONTRACTOR shall provide the latest and recommended details and components and shall comply with the most up to date criteria published by the manufacturer at no additional expense to the OWNER.

2. Perform calculations using diaphragm design analysis. Incorporate bracing as required if building exceeds diaphragm requirements.


5. Design loads:
   a. Refer to drawings for design load criteria.

6. Structural Design:
   a. Perform calculations using diaphragm and/or frame analysis. Incorporate bracing as required.
   b. Comply with American Forest and Paper Association (AF&PA) "National Design Specification for Wood Construction (NDS)."
   c. Trusses:
      1) Limit deflection for live to L/360 for trusses supporting ceilings and to L/240 for overhangs and trusses not supporting ceilings.
      2) Comply with appropriate NDS and Truss Plate Institute (TPI) standards.
   d. Metal Wall and Roof Panels:
      1) Design in accordance with AISI Specifications for the Design of Light-Gauge, Cold-Formed Steel Structural Members and in accordance with sound engineering methods and practices.
      3) Expansion/Contraction Provisions: Where required, design roof system to allow for expansion and contraction of roofing, due to seasonal temperature variations, without detrimental effect to the roof panels.

C. The design shall be based on, as a minimum, the design criteria as noted on the conceptual layout drawings and as outlined below:

1. Dead Loads:
   a. Use actual weights of materials used in construction.

2. Live Loads:
   a. Use minimum roof live load of 20 psf.
3. Equipment Loads and Pipe Support Loads:
   a. Use actual equipment weights and pipe support loads. Consider dead loads, live loads, impact loads, and overturning moments where applicable on all equipment and piping.

4. Colateral Load: (applied to the bottom chord)
   a. Use minimum colateral load of 10 psf.

5. Windload:
   a. Use either an ultimate design wind speed of 130 miles per hour or one due to special requirements associated with the building location, whichever is greater. Refer to the applicable code for appropriate coefficients.

6. Stability Factors:
   a. Comply with the requirements of the applicable code for minimum factors of safety for stability of structures.

D. All structures shall be designed and constructed to support safely all loads, including dead loads, without exceeding the allowable stresses or specified strengths when appropriate load factors are applied. Consider the most critical combination of loads utilizing the applicable code as the basis for the load combination. Refer to the conceptual layout drawings for the design loads and minimum load combinations.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. MORTON BUILDINGS, INC., Morton, Illinois

B. Other manufacturers offering similar systems
   1. As approved by project architect
   2. See certification procedure 1.16.

2.2 STRUCTURAL FRAMING

A. Columns (Columns on Concrete Foundation)
   1. Lower portion (Three feet above finish floor)
      a. Factory fabricated from minimum 3-ply No. 1 SYP
      b. The area in contact with the ground shall be pressure treated with a wood preservative to a net retention of 0.8 pounds per cubic foot of wood and kiln dried after treating to 19% maximum moisture content.
      c. The wood preservative shall be Chromated Copper Arsenate Type “C” (Oxide type) as listed in Federal specification TT-W-571J and compliant with USEPA Guidelines.
      d. The preservative shall penetrate 100% of the sapwood.

Suwannee County WTP
Pre-Engineered Wood Building System
40039002.0000 13 34 23-8
e. The treated portion of the column shall be laminated with stainless steel nails.

2. Upper portion
   a. Factory fabricated from minimum 3-ply No. 1 SYP
   b. Attach upper column to lower column with appropriate number and size of pneumatically driven fasteners.
   c. Provide factory or field installed blocking on outside face of column between nailers.

B. Wood Trusses
   1. Lumber
      a. Top Chord: Southern Yellow Pine of size and grade to meet design requirements.
      b. Bottom Chord: Southern Yellow Pine of size and grade to meet design requirements.
      c. Webs: Southern Yellow Pine of size and grade to meet design requirements.
   2. Trusses shall be constructed of surfaced lumber (S4S) and compliant with SPIB visual and structural grade requirements
   3. Plates: Connector plates shall meet design requirements and shall be compliant with applicable ICC-ES standards and specifications
   4. Design and fabricate trusses and connections to withstand live, wind and all dead loads.
   5. Fabricate trusses in plant, using mechanical or hydraulic fixtures as required to bring members into contact. Install plates in accordance with manufacturer’s instructions.

C. Baseboards
   1. 2” x 8” No. 1 Southern Yellow Pine with 1/2” x 7/16” notch
   2. Pressure treated with wood preservative to a retention in compliance with applicable AWPA or ICC-ES standards and specifications and kiln dried after treatment to 19% maximum moisture content
   3. Preservative shall penetrate 100% of sapwood.

D. Wall Girts
   1. First nailer (girt) above baseboard: 2” x 6” No. 2 or better Spruce-Pine-Fir (SPF) with 1/2” x 3/4” notch in bottom.
   2. Balance of nailers: 2” x 4” 2100 MSR (minimum) SPF.
   3. Overhang top nailer: 2” x 6” No. 2 or better SPF.

E. Base Reinforcement
   1. 7/16” x 32” plywood panels installed between the baseboard and first nailer and located in notches.
F. Purlins and Truss Ties
   1. 2” x 4” No. 2 or better SPF

G. Overhang Framing
   1. Provide factory fabricated rafter frames.
   2. Provide 2” x 6” No. 2 or better SPF factory beveled fascia boards.

H. Bracing, Wall and Lateral Truss Type (where required by "Structural Design"):
   1. 2” x 6” No. 2 or better SPF from endwall column to first truss back.

I. Framing Around Openings
   1. 2” x 4” No. 2 or better SPF around personnel doors.
   2. 2” x 6” No. 2 or better SPF around overhead door openings

J. Headers
   1. Provide built-up headers as required for proper installation.

K. Incidental Framing
   1. 2” x 4” and/or 2” x 6” No. 2 or better SPF

L. Interior Framing
   1. 2” x 4” No. 2 or better SPF

2.3 MATERIALS – PREFINISHED METALS

A. Roofing Panels
   1. Panel substrate shall be 0.019” minimum thickness commercial steel sheet with an AZ55 Aluminum/Zinc (Galvalume) coating (ASTM A792).
   2. The weather side of the panel shall receive a thick polyurethane primer and a nominal one mil topcoat of 70% polyvinylidene difluoride (PVDF) resin.
   3. Color selection of roofing panels by OWNER shall be from the manufacturer’s standard color chart.
   4. The non-weather side paint system shall consist of a two coat finish with a total nominal thickness of one-half mil.

B. Siding Panels
   1. Panel substrate shall be 0.019” minimum thickness commercial steel sheet with G90 (zinc) coating per ASTM A653 or AZ55 (aluminum/zinc) coating per ASTM A792.
   2. The weather side of the panel shall receive a nominal two tenths mil polyurethane primer and a nominal eight tenths mil topcoat of 70% polyvinylidene difluoride (PVDF) resin to achieve a total nominal paint film thickness of one mil.
3. Color selection of siding panels by OWNER shall be from the manufacturer’s standard color chart.
4. The non-weather side paint system shall consist of a two coat finish with a total nominal thickness of one-half mil.

C. Metal Trim Items
   1. Die-formed steel from the same quality material as the siding panels

D. Interior Panels
   1. Panel substrate shall be .019 minimum thick commercial steel sheet with a AZ50 (Galvalume) coating ASTM A792.
   2. The interior-facing side of the panel shall receive a nominal two tenths mil acrylic primer and a nominal eight tenths mil top coat of white polyester paint to achieve a total nominal paint film thickness of one mil.
   3. The hidden (backer) side paint system shall consist of a two coat finish with a total nominal thickness of one half mil.

2.4 MATERIALS - OTHERS

A. Corner bracing
   1. Provide 1-1/4” wide high tensile steel strapping in all unobstructed corners in an “X” configuration.

B. Roofing and siding fasteners
   1. EPDM washered, painted, center drive stainless steel screws for ribbed steel panels, or
   2. EPDM washered, galvanized ring-shank nails for ribbed steel panels

C. Closure strips
   1. Closed cell foam.

D. Sealant
   1. ASTM C 920, Type S, Class 25, Grade NS.

E. Insulation
   1. Minimum 6” thick, R19 fiberglass blankets in wall.

F. Post Bracket
   1. Fabricate socket from minimum 4 gauge hot rolled steel
   2. Factory paint socket to inhibit corrosion

G. Post Bracket Anchors
   1. Anchors shall be stainless steel.
2. Anchors shall conform to Section 05 05 33.

2.5 ACCESSORIES

A. Personnel Doors: Provide the following:
   2. Comply with the following for door construction:
      a. Sound Transmission Coefficient, ASTM E 90 and ASTM E 413: 34 minimum.
      b. Air Infiltration, ASTM E 283: No uncontrolled air infiltration when subjected to test pressure specified.
      c. Water Infiltration, ASTM E 331: No entry.
      d. Door Thickness: 1-3/4-inch for all doors.
      e. Exterior Doors: Steel insulated with polystyrene foam insulation.
      f. Gage: 20 gage hot dipped galvanized steel for all doors, except as locally required for hardware reinforcement.
      g. All doors shall be finished with a coat of prime paint applied to a phosphatized surface. Coordinate primer for compatibility with finish coats specified in Section 09 91 00, Painting.
   3. Comply with the following for frame construction:
      a. Frames assemblies shall consist of door posts, door jambs, door header, header reinforcement, sill plate, clips and extensions as required.
      b. Provide knock-down type with upper ends of members butted to provide square and solid joints for threaded fastener attachment.
      c. Size: 5-3/4-inch by 2-inch with double return.
      d. Gage: 16 gage for all doors; swaged for mortise hinge installation.
      e. Provide sill plate clips welded to bottom of jambs.
      f. Provide brackets welded to frame coordinated with door post sand header reinforcement.
      g. All frames shall be finished with a coat of finish paint in applied to a phosphatized surface. Colors shall be selected by the OWNER. Door posts and extensions shall be prime painted. Coordinate primer for compatibility with finish coats specified in Section 09 91 00, Painting.
   4. Comply with the following for hardware:
      a. Provide all doors with 1-1/2-inch full mortise hinges; 0.134 gage; ball bearing action with one nonremovable button-tip pin. Provide all hinges with dull chrome finish.
      b. Provide mortise lock sets for all locations.
      c. Provide mortise locks with ANSI F13 function with latch bolt retractable by either knob; or inside turn lever capable of operating deadbolt to lock outside knob; deadbolt shall be capable of operation
from outside by key and inside by knob which shall retract deadbolt and latch bolt, unlocking outside knob. Finish of mortise locks and trim shall be dull chrome. All sets shall be supplied with flat ANSI strikes. Provide manufacturer's ADA approved lever as required by governing authorities.

d. Panic Exit Devices:
1) Exit Doors: Where required by governing authorities having jurisdiction at the Site, provide panic exit devices, of the type required, including UL labels.
2) Strikes: Provide manufacturer's standard wrought stainless steel jamb-mounted top latch bolt and bottom latch bolt for each location and use shown to allow independent opening and closing of each leaf of double doors with panic exit devices; complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
3) Lock Throws: Provide minimum of 3/4-inch latch bolt throw complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
4) Provide the following features and materials:
   a) Latch Bolt: Two-piece; mechanical; anti-friction, stainless steel.
   b) Dead Bolt: One-piece, stainless steel with two enclosed hardened-steel roller armor pins.
   c) Case: Wrought steel, zinc dichromatized.
   d) Cylinders: High-security; brass; pick- and drill-resistant; ANSI/BHMA A156.5 - E09211A.
   e) Armor Front: 8-inches by 1-1/4-inches wide, minimum; steel.
   f) Hubs: Sintered steel, copper infiltrated.
   g) Crossbar: Oval, seamless with interlocking expansion collets and roll pins; knurled, satin stainless steel, 0.062-inches minimum thickness, with steel reinforcing tube.
   h) Concealed bolts: Minimum 1/2-inch diameter, stainless steel.
5) Backset: Provide minimum backset of 2-3/4-inches.
7) ANSI/BHMA: A156.3, Type 3 and Type 8, Grade 1; F08, entrance by lever, key locks or unlocks lever for entrances shown as accessible to people with disabilities as required by ADAAG; and F05, entrance by thumb piece, key locks or unlocks thumb piece.

e. All hardware shall be master keyed as directed by OWNER.
f. Provide all doors with closers. Closers shall be mounted so as not to appear on exterior of building. Hold-open arms shall be provided except where not approved by governing authorities. Select closer arms to avoid interference with weather stripping on exterior doors.

5. Comply with the following for weather stripping:
   a. Provide EPDM bottom sweep for all exterior doors.
   b. All exterior doors shall be provided with an adhesive-backed press-on flexible black TPE material factory installed on the frame.

6. Comply with the following for thresholds:
   a. Provide extended aluminum mill-finished thresholds for all exterior doors and where scheduled.
   b. Provide complete selection of threshold mounting details.
   c. Cope threshold tightly around frame profile.
   d. Provide predrilled countersunk fastener holes for attachment of threshold to floor.

7. Comply with the following for door and frame trim:
   a. Door trim shall consist of drip gutter, fabricated from pre-painted 22 gage galvanized steel and side trim applied to wall panels as required by wall panel system specified.

B. Sectional Door: Provide the following:
1. Structural Design Criteria: Sectional door components shall be capable of resistance to the following loads:
   a. Design door to withstand wind loads in accordance with ASCE 7 without permanent deformation or damage and movement caused by an ambient temperature range of 120 degrees and a surface temperature of 160 degrees F.
      1) Dead Loading: Provide resistance to deformation of door components caused by the effects of gravity loads.
      2) Applied loadings shall not cause either short-term or permanent deformation of any system component. Doors shall remain operable and in undamaged condition during, and after, application of specified wind pressure loading.

2. Helically-wound Torsion Springs: Provide Very-High-Cycle design capable of performing for 100,000 operational cycles. Provide non-resetable electric counters for all overhead coiling doors.

3. Manual Push-Up Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 pounds.


5. Tracks and Supports.
   a. Tracks: Provide manufacturer's standard galvanized steel track system, sized for door size and weight, and designed for clearances shown. Provide complete track assembly including brackets, bracing
and reinforcing for rigid support of ball-bearing roller guides, for the required door type and size. Slot vertical sections of track at 2-inches on centers for door drop safety device. Slope tracks at proper angle from vertical or otherwise design to ensure tight closure at jambs when door unit is closed. Weld or bolt track to specified supports.

   a. Extension Spring: Hang door assembly for operation by extension spring counterbalance mechanism with aircraft-type stainless steel cable over ball-bearing sheaves. Provide oil-tempered, wired springs with internal safety rods. Combine operation with a spring bumper in each horizontal track to cushion door at end of opening operation.

7. Hardware: Provide heavy-duty, rust-resistant hardware, with stainless steel fasteners, as required for type of door.

C. Custom Frame Openings: Provide openings, framing, flashing and trim as required for piping, vents, louvers, and equipment as required to make a watertight seal.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR and his installer shall examine the areas and conditions under which the wood building system Work is to be constructed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 ERECTION GENERAL

A. Erect in accordance with manufacturer’s instructions and approved Shop Drawings.

B. Provide temporary erection and wind load bracing to maintain structure plumb and in alignment until installation of permanent bracing and/or roofing and wall coverings are completed.

C. Do not field cut or alter structural members without approval of ENGINEER and manufacturer.

3.3 ERECTION FRAMING

A. Column
   1. Attach steel column socket to the concrete foundation with anchors conforming to Section 05 05 33.
2. Attach the column to the socket with (4) 1/2” stainless steel machine bolts and (8) 20d stainless steel R.S. nails.

B. Upper Column
1. Set upper column to positive interlock with lower column.
2. Install manufacturer’s recommend quantity and size pneumatically driven fasteners.

C. Baseboards
1. Install 2’’ x 8’’ treated plank, at grade, using builder’s recommended fasteners.

D. Wall Girts
1. Install 2’’ x 6’’ notched nailer to receive plywood panel.
2. Install 2’’ x 4’’ nailers with on-center spacing as shown on building plans.
3. Install 2’’ x 6’’ overhang nailer at the top.

E. Trusses
1. Set trusses in plane with the center member of the upper column using lifting methods as approved by the manufacturer.
2. When properly positioned, install machine bolts and manufacturer-recommended 20d ring shank nails through two of the upper column laminates and the truss heel, as required to resist design uplift and lateral loads.
3. Brace trusses as recommended by the manufacturer.

F. Purlins
1. Install 2’’ x 4’’ purlins at 24” on-center (maximum) and attached to trusses with 60d ring shank nails.

G. Wind bracing
1. Install 2’’ x 6’’ angled bracing at locations recommended by the manufacturer.

H. Incidental framing
1. Install 2’’ x 4’’ or 2’’ x 6’’ blocking as required according to building manufacturer’s recommendations.

I. Interior framing
1. Install 2’’ x 4’’ baseboard at 4” above grade and case in metal trims.
2. Install 2’’ x 4’’ horizontal stripping at 36” o.c. (max) in areas receiving ribbed steel panels.
3. Install 2’’ x 4’’ horizontal stripping at 16” o.c. in areas receiving gypsum board if applicable.
3.4 **ERECTION – PREFINISHED METALS**

A. **Roofing Panels**
   1. Install panels perpendicular to supports, aligned straight with end fascia.
   2. Fasten panels to purlins with screw fasteners.

B. **Siding**
   1. Install panels perpendicular to supports, aligned level and plumb to industry standards.
   2. Fasten panels to wall girts with screw fasteners.

C. **Trim items**
   1. Install trim items at the base, wainscot transition, corners, top of steel siding, fascia, gables and ridge using appropriate fasteners.

D. **Vent-A-Ridge**
   1. Install over ridge trim using screw fasteners.
   2. Insure that a minimum of 2” clear throat opening is maintained.

E. **Soffits**
   1. Install soffits to interlock with trim items at top of steel siding and at fascia.
   2. Use solid soffit at end overhang.
   3. Use a combination of solid and perforated soffits to provide balanced ventilation at side overhangs.

F. **Gutter and downspouts**
   1. Install gutters with spikes and ferrules (with washers) spaced 24” on-center.
   2. Silicone sealant and silicone rubber gaskets shall be used at laps to maintain leak prevention and to relieve stress due to thermal movement.

G. **Filler strips**
   1. Provide closed cell foam filler strips at the top and bottom of the roofing panels.

H. **Interior Panels**
   1. Install panels perpendicular to supports, aligned level and plumb.
   2. Fasten panels to wall girts with 1” painted screws.
   3. Fasten panels to lower truss chords with 1” painted screws.
3.5 TOLERANCES

A. Framing Members
   1. 1/4” from level.
   2. 1/8” from plumb.

B. Siding and roofing
   1. 1/8” from true position.

3.6 CLEANING

A. Clean surfaces soiled by work as recommended by manufacturer.

B. Touch up abrasions and other defects on pre-painted metal panel surfaces with same type of primer and paint as original finish.

C. Remove surplus material and debris from site.

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install an NFPA-rated, prefabricated, prewired, and pretested diesel engine packaged fire pump system and enclosure, complete and operational with accessories. Fire pump system includes the following:
      a. Diesel-driven fire pump.
      b. Diesel fire engine controller.
      c. Electric jockey pump.
      d. Jockey pump controller.
      e. Diesel fuel tank.
      f. Sprinklered enclosure.
      g. Piping.
      h. Wiring.
      i. Controls.
      j. Valves.
      k. Flow meter.
      l. And all ancillary appurtenances.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the fire pump Work.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 05 05 33, Anchor Systems.
   3. Section 09 91 00, Painting.
   4. Section 26 00 05, Electrical Work.
   5. Section 40 05 05, Exposed Piping Installation.
   6. Section 40 05 53, Process Valves Four-inch Diameter and Larger.
   7. Section 40 60 05, Instrumentation and Control for Process Systems.
   8. Section 40 61 96, Process Control Descriptions.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
1. American Iron and Steel Institute, (AISI).
   b. NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances.
   d. NFPA 70, National Electrical Code.
   a. UL 508, Industrial Control Equipment.
   b. UL 1008, Transfer Switch Equipment.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:
   1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. To ensure that the equipment is properly coordinated and will function in accordance with the requirements of the Contract Documents, the equipment specified herein shall be provided by a single supplier, whom shall have complete responsibility for the proper function of the fire pump system. However, the CONTRACTOR shall retain ultimate responsibility under this Contract for equipment coordination, installation, operation and guarantee, and the CONTRACTOR shall furnish and install all labor, equipment, materials, appurtenances, specialty items and services not provided by the supplier but required for a complete and operable system.
   2. The fire pump system manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the fire pump system manufacturer.

C. Regulatory Requirements: Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.
   1. American National Standards Institute, (ANSI).
   2. Institute of Electrical and Electronic Engineers, (IEEE).
7. Factory Mutual Insurance Company, (FM)
8. Local and State Building Codes and Ordinances.
9. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.

D. Source Quality Control: Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
1. Tested and inspected for approval as a unit by Underwriter’s Laboratories, UL Label.

E. Factory Testing:
1. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that all the controls function as specified herein and that the package meets the specified performance requirements, including manufacturer’s data report.

F. Manufacturer’s Responsibilities:
1. CONTRACTOR shall ensure that the complete equipment systems shall be the direct product of one manufacturer and supplier who shall assume all responsibility for:
a. Manufacturing.
b. Servicing.
c. Start-up.
d. Warranty.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Drawings showing fabrication methods, assembly, accessories, installation details and wiring diagrams.
b. Complete equipment list.
c. Detailed drawings of each individual component’s wiring diagrams.
d. Detailed installation drawing of each individual component showing:
   1) Mounting requirements.
   2) Location (panel, field, etc).
   3) Piping and wiring connections labeled and coded.
   4) Instructions.
   5) Materials of construction.
   6) Data sheets.
2. Product Data:
a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction and performance data for all equipment.
b. Provide pump curves showing overall pump efficiencies, required net positive suction head, flow rate, head, brake horsepower, motor horsepower, speed, and shut-off head.
c. Catalog cut sheets and detailed descriptions of each component.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit independent certification reports.
   2. Supplier Instructions:
      a. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
   3. Source Quality Control Submittals:
      a. Submit Factory Test reports.
   4. Site Quality Control Submittals:
      a. Submit Field Acceptance tests reports.
   5. Warranty:
      a. Submit a copy of the Warranty.

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data:
      a. Submit complete installation, operation and maintenance manuals, including test reports, maintenance data and schedules, description of operation and spare parts information.
      b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Submit the following:
   1. Spare Parts:
      a. Spare parts list and recommended quantities.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
   2. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
   1. Unload, store, and handle equipment in accordance with manufacturer's recommendations and the requirements of the Contract Documents.
   2. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports.
Protect steel members and packaged materials from corrosion and deterioration.

3. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer’s recommendations for long-term storage.

4. Conform to Section 01 66 00, Product Storage and Handling Requirements.

C. Acceptance at Site:
   1. All boxes, crates, equipment, and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 WARRANTY AND GUARANTEE

A. The Manufacturer shall provide a warranty that the packaged fire pump system shall be free of defects in workmanship for a period of one year from date of authorized start-up. Packaged fire pump system manufacturer shall provide replacement parts or components during the warranty life, provided all installation and operation responsibilities have been properly performed. Any repairs to be accomplished at manufacturer's expense must be pre-authorized.

B. In addition to the manufacturer's standard guarantee, CONTRACTOR shall include the services of a factory-trained serviceman to provide repair service for the equipment for the period of one year commencing with the time the equipment is placed in continuous permanent operation. This service shall include the cost of all replacement parts required during the interval.

C. Copies of all warranties and guarantees shall be placed in the Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 GENERAL

A. The NFPA-rated and Factory Mutual-approved fire pump system shall consist of a diesel-driven fire pump, a diesel fire engine controller, a jockey pump, a jockey pump controller, a diesel fuel tank, a sprinklered enclosure, and all piping, wiring, controls, valves, flow meters, and appurtenances.

2.2 FIRE PUMP, DRIVE, AND CONTROLLER

A. General: Provide a UL-listed and Factory Mutual-approved automatic diesel-driven fire pump system complete with required engine, controls, interconnecting
pipe and fittings and accessories required for a complete installation in accordance with the Building Code and NFPA 20.

1. Provide fire pump system to automatically maintain required pressure in fire protection system.

B. Design Conditions: Provide diesel-driven fire pump and controller for the fire pump service meeting the following operating conditions:

1. Type: Horizontal split case.
2. Rated Capacity: 2,250 gpm.
3. Total Head at Rated Capacity: 118 psi.
4. Maximum Shut-off Head: 150 psi.
7. Provide fire pump capable of supplying at least 150 percent of the rated pump capacity at 65 percent of the total head at rated capacity.
8. Pump Manufacturer: Provide one of the following:
   a. SPP Pumps, Inc.
   b. Aurora Pump.
   c. Or approved equal.
9. Diesel Engine Manufacturer: Provide one of the following:
   a. Clarke.
   b. Or approved equal.

C. Pump and Drive: Provide bronze-fitted cast-iron horizontal split case fire pump furnished complete with drive, motor, mounting base, controls, and other appurtenances required for complete and functioning installation. Provide pump installation to meet the applicable provisions of the Uniform Building Code and NFPA 20.

1. Provide low point of pump casing with manual drain and high point with automatic air release valve. The pump shall have ANSI 125 pound suction and 250 pound discharge flanges.
2. Provide enclosed impeller of cast bronze securely keyed to pump shaft, with bronze wear rings and shaft sleeves. Provide heavy-duty, anti-friction, grease-lubricated, ball type bearings with accessible lubrication fittings.
3. Provide diesel engine that is listed by Underwriters Laboratories and approved by Factory Mutual for fire pump service. Engine horsepower shall be de-rated for elevation and temperature as required by NFPA 20. The engine shall have sufficient horsepower to operate the fire pump under any condition of pump load. The engine shall be provided with 120 volt, 1 phase power for water jacket and battery charger. The engine shall be tested prior to shipment from the manufacturer's factory. The diesel engine shall meet local emission regulations and shall be Tier 3 certified.
4. Provide additional support for pump and motor assembly from the bottom of the pump in accordance with the manufacturer's instructions.
5. Include all appurtenances required by the Uniform Building Code and NFPA 20, in the pump installation; including suction and discharge pressure gages,
discharge check valve, isolating OS&Y gate valves, air release valve, bypass venturi with two butterfly valves for measuring waterflow, test manifold with hose valves, and casing relief valve. Provide UL listed and FM approved accessory components rated for a minimum of 175 psi working water pressure. Provide flow metering device with flanged connections meeting local fire department requirements. Pipe discharge from relief valves to suction piping.

6. Provide fire pump shop and field acceptance tests in accordance with the Uniform Building Code and NFPA testing standards and Division 01, General Requirements. Furnish certified test curves for approval in conformance with the requirements of Division 01, General Requirements. Provide acceptable field performance tests verifying substantially matching approved certified shop tests.

D. Fire Pump Control Panel (FPCP): Provide a control panel for control and monitoring of the diesel engine driven fire pump, as required and shown.

1. FPCP shall include combined manual and automatic diesel engine fire pump controller intended for starting and monitoring fire pump diesel engines. FPCP shall be of NEMA 12 construction. Enclosure shall contain appurtenant control and alarm circuitry.

2. Provide monitoring and alarm functions for indicating diesel engine driven pump operation. The enclosure shall be provided with the following features:
   a. Pump “RUN” (green) and failure (amber) indicating lights.
   b. Auxiliary alarm contacts for remote indication of pump run and general (any alarm) failure.
   c. Provisions shall be made for ease of field terminations for remote alarm monitoring. Provide factory pre-wired NEMA 4X terminal junction box, with identified terminal strips on exterior wall of system enclosure for remote alarm monitoring to an autodialer. Coordinate with the CONTRACTOR.

3. The FPCP shall be a factory assembled, wired and tested unit and shall conform to all the requirements of the latest edition of NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection and NFPA 70, National Electrical Code.

4. The controller shall be listed by Underwriters Laboratories, Inc., in accordance with UL218, Standard for Fire Pump Controllers, and approved by Factory Mutual.

5. The controller shall be 12VDC, and shall be compatible with either mechanical or electronic type engines.

6. Operator Interface:
   a. The FPCP shall feature an operator interface with user keypad.
   b. The interface shall monitor and display motor operating conditions, including all alarms, events, and pressure conditions. All alarms, events, and pressure conditions shall be displayed with a time and date stamp.
   c. The display shall be capable of customized graphics and character display. The display and interface shall be NEMA 12 rated for
protection and shall be fully accessible without opening the enclosure door.

d. The display and user interface shall utilize multiple levels of password protection for system security. A minimum of 3 password levels shall be provided.

7. Battery Chargers
   a. The FPCP shall include two fully automatic, 200 amp hour, 4 step battery chargers. The chargers shall feature a qualification stage, in which the batteries are examined by the charger to insure that they are not defective and are capable of accepting a charge. The battery charger shall feature:
      1) Selectable AC Power Voltage
      2) Selectable Battery Voltage
      3) Selectable Battery Type
      4) Charge Cycle Reset Push-button

8. Manufacturer: Provide one of the following:
   a. Master ECR-T.
   b. Firetrol FTA Series.
   c. Or approved equal.

E. Operation:
   1. Arrange controller circuitry with a "HAND/OFF/AUTO" selector switch, to permit both automatic and manual fire pump operation as follows:
      a. In "AUTO" mode, operation of fire pump is controlled from pressure switch, sensing protection system water pressure. Pump starts on low pressure. Provide a running timer to determine length of time the motor will run when started automatically provided the pressure switch has reached the cutout setting at or before the end of the timing interval. If not, the pressure switch shall govern the stopping of the motor. The fire pump shall also operate in "AUTO" mode, whenever the selector switch at the remote fire pump panel is in the "run" position.
      b. In "HAND" mode, operation of fire pump shall be manually controlled to permit an automatic start of the pump and continuous operation until manually shutdown.

   2. Provide monitoring and alarm functions for indicating fire pump operation. The controller shall be provided with the following features:
      a. Pump “RUN” (green) and failure (amber) indicating lights, including provisions to operate run indicating light at the fire pump panel.
      b. Auxiliary alarm contacts for remote indication of pump run and failure. In addition, monitor control power by Power-On lamp and supervised by dropout relay. Upon loss of control power, dropout relay shall close to activate remote alarm.
      c. Remote features shall be factory pre-wired to terminal strips identified.

   3. Field test fire pump controller, together with fire pump, in accordance with NFPA 20.
2.3 JOCKEY PUMP AND CONTROLLER

A. General: Provide jockey pump to maintain the system pressure and to make up water loss from system due to minor leakage without initiating main fire pump.

B. Design Conditions: Provide UL-listed jockey pump and controller for the jockey pump service under the following operating conditions:
   1. Type: Vertical Multi-stage In-line.
   2. Rated Capacity: As determined by fire pump system manufacturer.
   3. Total Head at Rated Capacity: As determined by fire pump system manufacturer.
   4. Motor Speed: As determined by fire pump system manufacturer.
   5. Motor Horsepower: As determined by fire pump system manufacturer.
   6. Manufacturer: Provide one of the following:
      a. Grundfos Pumps, Type CR.
      b. Aurora Pump.
      c. Or approved equal.

C. Pump: Provide vertical type jockey pump, cast-iron, stainless steel fitted housing and bronze impeller.
   1. Provide pump with grease-lubricated ball bearings, mechanical seals, and precision ground AISI 416 stainless steel shaft.
   2. Pump motor to conform to the requirements of Section 26 00 05, Electrical Work.
   3. Provide pump with pressure switch with separately adjustable cut-in and cutout pressure settings, adjusted to start pump approximately ten psi below main pump cut-in pressure, and to stop pump at a pressure approximately ten psi above cut-in pressure.
   4. Provide pump with casing relief valve in accordance with NFPA 20.

D. Fire Jockey Control Panel (FJCP): Provide a control panel for control and monitoring of the jockey pump, as required and shown. FJCP shall be of NEMA 12 construction with HP rated motor circuit protector and starting contactor, overload relay, pressure switch, "HAND/OFF/AUTOMATIC" selector switch, running period timer.
   1. Rate pump controller for 460-volt, 3-phase, 60-hertz operation, with 30,000-ampere rms symmetrical fault interrupting capability.
   2. Provide control power transformer with fused secondary power.
   3. Provide jockey pump controller listed and field-tested similar to fire pump controller.
   4. Provide monitoring and alarm functions for indicating jockey pump operation. The controller shall be provided with the following features:
      a. Pump “RUN” (green) and failure (amber) indicating lights.
   5. Manufacturer: Provide one of the following:
      a. Master PMC.
b. Firetrol FTA Series.
c. Or approved equal.

2.4 DIESEL FUEL TANK

A. Provide a UL-listed diesel fuel tank, meeting NFPA 20 requirements, which includes the following:
   1. Double wall construction.
   2. High/low fuel level alarms.
   3. Fuel tank rupture alarm.
   4. Emergency tank vents.
   5. Fuel spill containment.

2.5 SYSTEM ENCLOSURE

A. General: Provide as part of the packaged fire pump system, a completely prefabricated environmental enclosure of 1 hour rated construction. Enclosure shall be supplied complete, with all necessary component parts, including drill in foundation anchors, to form a complete building system. All enclosure work and materials shall be in full accordance with local and/or state ordinances, and all parts shall be new and free from defects or imperfections:
   1. Fire pump system supplier shall provide a complete set of building erection drawings showing a step-by-step construction sequence for the erection of the building. The erection drawings shall be prepared specifically for the building covered by these specifications showing the location of all roof and wall accessories and the exact anchor bolt locations required for each accessory.
   2. Enclosure shall include a 6 ft. by 7 ft. double door and louvers with insect screens.
   3. A prefabricated roof system shall be provided for the enclosure to provide a waterproof covering.
   4. Provide an NFPA 13 compliant sprinkler system including pendant style sprinkler heads, butterball isolation valve with tamper switch, check valve and vane type flow switch for alarm.

B. System Enclosure Power: Provide as part of the packaged fire pump system enclosure a complete electrical distribution system. System shall comply with NFPA 20 Standard. Enclosure shall come to site prewired, and only require connections for incoming power feed and status alarms.
   1. Power supply to System Enclosure shall be 460V/3 ph /60 Hz with surge protection devices on the incoming. Provide service entrance rated incoming lug panels with distribution blocks and necessary transformers, load centers and circuit breakers, etc. to power system enclosure equipment and appurtenances.
   2. Provide equipment disconnects as required by code.
3. Provide control power transformer and appropriate circuitry for operation of all included equipment.
4. (2) GFCI receptacles.
5. Weatherproof light switch at door.
6. Internal and external lighting.
7. Internal emergency/exit light.
8. Thermostat controlled exhaust fan.
9. Electric unit heater(s) as required to maintain a minimum of 40°F in the system enclosure.

2.6 ACCESSORIES

A. Comply with NFPA 20 Standard, Chapter 5, for pipe and fittings.
1. Install fire protection piping in accordance with National Fire Protection Association Standards.
2. Valves: Provide gate, check, globe and angle valves, UL listed and FM approved for fire protection service.
   a. Valves open when their handwheel is turned counterclockwise.
   b. Valves 2-Inch Size and Smaller: Provide screwed pattern bronze construction valve with union bonnet and rising stem.
   c. Valves 2-1/2-Inches and Larger: Provide valves of flanged or grooved pattern iron bodies with bronze trim, bolted bonnets, outside screw and yoke, and rising stem.
   d. Provide valves of same type from a single manufacturer.
3. Gate Valves: Provide UL listed and FM approved gate valves in piping to isolate each major item of equipment and, in general, to isolate each floor and each major portion of system.
   a. Manufacturers: Provide one of the following:
      1) Stockham Valves and Fittings Fig. No. 467.
      2) Crane, Fig. No. 467.
      3) Or approved equal.
4. Check Valves: Provide UL listed and FM approved check valves of the wafer, spring actuated type, designed with full pipe diameter water passage. Provide check valves having bronze disc, and stainless steel hinge bushing and pins.
   a. Check Valves: Provide one of the following:
      1) Nibco, KW-900-W.
      2) Or approved equal.
5. Tamper Switches: Provide tamper switches on all valves controlling the water supply to the fire pump system. Coordinate wiring and connection to the fire alarm control panel with Division 26, Electrical.
6. Fire pump system manufacturer shall furnish piping accessory items for the pump installation, which will adapt the pump connections to the fire protection system as follows. Fittings subjected to pump discharge pressure shall be ANSI 250 pound rating. Fittings subjected to suction pressure shall be ANSI 125 pound rating.
a. Eccentric tapered suction reducer.
b. Concentric tapered discharge increaser.
c. Pump casing relief valve.
d. Automatic air release valve.
e. Ball drip valve.
f. Suction and discharge pressure gages.
g. Main relief valve, direct acting of pilot operated.
h. Relief valve overflow cone.
i. Discharge tee.
j. Test header with one 2-1/2-inch hose valve tap for each 250 gpm of pump capacity.
k. Hose valves with approved threads complete with caps and chains.
l. Venturi type flow meter with direct reading 4-1/2-inch diameter dial, FM approved.

7. Gages: Provide bourdon tube type pressure gage with 4-1/2-inch minimum diameter case, suitable for 250 psig maximum pressure with markings in five psi increments, and in accordance with NFPA 20 Standard, Chapter 5.

8. Skid Base: All of the above equipment shall be mounted on a fabricated structural steel base.
a. All pumps, controllers, piping, pressure sensing lines, flow meter loop and shut-off valves, as well as approved suction and discharge valves shall be firmly anchored to the steel base by means of structural steel supports.

2.7 PACKAGED FIRE PUMP SYSTEM MANUFACTURERS

A. Manufacturers: Packaged fire pump system shall be manufactured by one of the following:
a. SyncroFlo.
c. Or approved equal.

2.8 SHOP TESTS

A. The entire fire pump system shall be hydrostatically tested and run tested prior to shipment in accordance with the requirements of NFPA, UL, and Factory Mutual. The pump shall be hydrostatically tested at a pressure of not less than one and one-half times the shut off head of the pump’s maximum diameter impeller plus the maximum allowable suction head, but in no case less than 200 psig.

B. All electrical wiring between controllers, motors, and engine shall be completed and tested at the factory.

C. Enclosure manufacturer shall provide drawings and calculation stamped by a Professional Engineer.
D. Shop test results, including a pump test curve shall be submitted showing the performance and horsepower requirements prior to final acceptance.

2.9 IDENTIFICATION SIGNS

A. Provide fire protection system identification signs in accordance with the NFPA Standards.

PART 3 – EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 UNLOADING AND SETTING

A. Fire pump system manufacturer shall inform the contractor, prior to system shipment, of the calculated weight of the pumping system.

B. Crane to off-load and set the fire pump system onto the concrete slab shall be provided by the CONTRACTOR.

C. Setting of the pumping system and connection to suction, discharge and power, anchoring of the pumping system, and thrust blocking of the suction and discharge piping that is connected to the pumping system shall be the responsibility of the CONTRACTOR.

3.3 INSTALLATION

A. General:
   1. Install all items as shown, specified, and as recommended by the manufacturer.
   2. Request instructions from manufacturer, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
   3. Do not modify structures to facilitate installation of equipment, unless specifically approved by manufacturer.
   4. Installation to conform to requirements of all local and state codes.

3.4 FIELD QUALITY CONTROL

A. CONTRACTOR shall check and approve the installation of all anchoring, piping, control system components, and all cable and wiring connections between the
various system components prior to placing the various processes and equipment into operation.

B. The CONTRACTOR shall field test the system in the presence of the ENGINEER to verify that the pumps conform to the specified requirements.

C. Field Tests:
   1. Fill all systems and fully test all equipment, valves, etc. in operation.
   2. Check for excessive vibration while all systems are operating.
   3. Installed systems and components will not be released to OWNER, unless all systems have been tested and approved by the ENGINEER.
   4. Suction piping and fittings shall be installed and tested in accordance with NFPA 24.
   5. Perform hydrostatic, flushing and field acceptance tests in accordance with NFPA 20 Standard, Chapter 14.

D. Inspection:
   1. Examine areas to receive equipment and accessories for:
      a. Defects that adversely affect execution and quality of the Work.
      b. Deviations beyond allowable tolerances for equipment and accessories.
      c. Start the Work only when conditions are satisfactory.
   2. The ENGINEER reserves the right to reject or authorize replacement of equipment and accessories found to defective, blistered, cracked or deviated from allowable tolerances as described above.

E. After inspection and field testing, the CONTRACTOR shall submit to the ENGINEER a certification letter. Letter shall certify that the equipment was installed per the manufacturer's recommendations and requirements and all field test data shall also be furnished.

3.5 ADJUSTING AND CLEANING

A. Adjusting:
   1. Adjust all controls for proper settings.
   2. While system is operable, balance all equipment, valves, etc. to achieve design conditions.

B. Cleaning:
   1. Thoroughly clean all equipment and accessories prior to installation.
   2. Remove all dirt, rust, dust, etc. from equipment in preparation for painting.
   3. Remove and dispose of all debris and waste from the Site resulting from installation.
3.6 PAINTING

A. All equipment and accessories shall be painted in accordance with Section 09 91 00, Painting.

3.7 MANUFACTURER’S SERVICES

A. A factory trained representative shall be provided for start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 1 visit, minimum 6 hours on-Site. The visit shall be for checking the completed installation, start-up, and training of the system. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. Costs associated with start-up/test services and operation and maintenance personnel training services shall be included in the bid price.

B. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals shown, specified, and required to complete the electrical Work except for following:
   a. Sodium Hypochlorite Control Panel (SHCP), which shall be the responsibility of the Chemical Feed System Skid manufacturer to provide. CONTRACTOR shall responsible for all labor, materials, and incidentals for the installation of the SHCP.
   b. Submersible Tank Mixer Control Panel, which shall be the responsibility of the Submersible Tank Mixer manufacturer to provide. CONTRACTOR shall be responsible for all labor, materials, and incidentals for the installation of the Mixer Control Panel. Coordinate with the Submersible Mixer Tank manufacturer the procurement, installation and testing requirements to support this equipment as the Mixer Systems have different requirements.
2. Utility Companies:
   a. Electric Utility Company: Perform the Work in connection with the electric service and utility metering in accordance with requirements of Suwannee Valley Electric. Suwannee Valley Electric, will furnish and install the following:
      1) 15kV primary cable, terminations, and splices.
      2) Transformers.
   b. CONTRACTOR shall furnish and install the following Work regarding electric service:
      1) 15kV primary circuit conduits and associated underground ductbanks.
      2) Transformer concrete pads and associated grounding.
      3) Secondary cable and terminations, conduits, and associated underground ductbanks.
   c. Telephone and Communications Utility Company: Perform the Work in connection with telephone service and communications services in accordance with requirements of Windstream Corporation. Windstream Corporations will furnish and install the following:
      1) Telephone cable and terminations
   d. CONTRACTOR shall furnish and install the following Work regarding telephone service:
1) Telephone terminal board complete with backboard and and underground telephone duct from telephone riser pole to the location shown or indicated.

B. Coordination:
1. Review installation procedures and schedules under other Specification Sections and coordinate with other trades the installation of electrical items that will be installed with or within formwork, walls, partitions, ceilings, and panels.
2. Coordination and Intent of Electrical Drawings:
   a. Dimensions on Drawings related to equipment are based on equipment of certain manufacturers. Verify the dimensions of equipment furnished to space available at the Site and allocated to the equipment.
   b. Drawings show the principal elements of the electrical Work, and are not intended as detailed working drawings for the electrical Work. Drawings supplement and complement the Specifications and other Contract Documents relative to principal features of electrical systems. When conflict exists CONTRACTOR is to notify ENGINEER and provide the more costly solution if chosen by ENGINEER or OWNER.
   c. Equipment and devices provided under this Contract shall be properly connected and interconnected with other equipment and devices for successful operation of complete systems, whether or not all connections and interconnections are specifically mentioned or shown in the Contract Documents.
   d. Drawings are provided for CONTRACTOR’s guidance in fulfilling the intent of the Contract Documents CONTRACTOR shall comply with Laws and Regulations, including safety and electrical codes, and provide materials, equipment, appurtenances, and specialty items necessary for complete and operable systems.

C. Related Sections:
1. Refer to structural drawings for Cast-in-Place Concrete, and Anchor Systems specifications.
2. Refer to general drawing for Excavation and Backfill specifications.
3. Section 26 05 45, Utility Services for Electrical Systems
4. Section 26 24 19, Motor Control Centers
5. Section 26 32 13, Engine Generators
6. Section 26 36 23, Automatic Transfer Switches
7. Section 40 60 05, Instrumentation and Control for Process Systems.

D. Area Classifications:
1. Materials, equipment, and incidentals shall be suitable for the area classification(s) shown, specified, and required.
2. Wet Locations: Comply with NEC and NEMA requirements for wet locations. Enclosures in wet locations shall comply with NEMA 3R unless specified otherwise.

3. Corrosive Locations: Comply with NEC and NEMA requirements for corrosive locations. Enclosures in corrosive locations shall conform to NEMA 4X requirements unless specified otherwise.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Electrical Subcontractor:
      a. Electrical Subcontractor shall have not less than five years experience installing electrical systems of the types required for the Project.
      b. Electrical Subcontractor shall possess a valid Florida electricians’ and contractors’ license in the jurisdiction where the Site is located.
      c. Submit the following information for not less than three successful, completed projects of similar size and type: project name and location; year completed; name and contact information for: prime contractor for whom electrical Subcontractor worked, project owner, and project engineer or architect, including addresses and telephone numbers.

B. Component Supply and Compatibility:
   1. Materials and equipment similar to each other shall be from the same manufacturer for uniformity.

C. Regulatory Requirements:
   1. Permits: Refer to the General Conditions, Supplementary Conditions, and other parts of the Contract Documents for responsibilities relative to obtaining and paying for permits, licenses, and inspection fees.

D. Products:
   1. Products and installation of products shall abide following regulatory requirements and standards:
      c. Underwriters Laboratory (UL), or Electrical Testing Labs (ETL).
      d. American National Standards Institute (ANSI)

1.3 SUBMITTALS

A. General:
   1. To the extent practical, submit Shop Drawings and other CONTRACTOR submittals for each Specification Section into the smallest number of submittals possible. Do not furnish partial submittals.
2. Review of equipment submittals does not relieve CONTRACTOR of responsibility for providing complete and successfully operating systems.

3. Submittals shall be bond and tabbed in a loose leaf binder. Tabs shall be coordinated with a Table of Contents at the beginning of the submittal. Table of contents will have submittal section, description and tab number. Any exceptions, deletions or substitutions will be noted on separate sheets at the beginning of the submittal.

4. Failure to do any of the above will be grounds for rejection of submittal.

B. Action Submittals: Submit the following:

1. Shop Drawings:
   a. Internal wiring diagram and drawings indicating all connections to components and numbered terminals for external connections.
   b. Dimensioned plan, section, elevations, and panel layouts showing means for mounting, conduit connection, and grounding.
   c. List of components including manufacturer’s name and catalog number (or part number) for each.

2. Product Data:
   a. Manufacturer's name and product designation or catalog number.
   b. Electrical ratings.
   c. Manufacturer’s technical data and specifications.
   d. Manufacturer’s indication of compliance with applicable reference standards.
   e. Painting and coating systems proposed.

3. Test Procedures: Proposed testing procedures and testing limitations for source quality control testing and field quality control testing.

C. Informational Submittals: Submit the following:

1. Manufacturer’s Instructions:
   a. Installation data and instructions.
   b. Instructions for handling, starting-up, and troubleshooting.

2. Source Quality Control Submittals: Results for required shop testing.

3. Field Quality Control Submittals: Results for required field testing.

4. Qualifications:
   a. Electrical Subcontractor.

D. Closeout Submittals: Submit the following:

1. Record Documentation:
   a. System Record Drawings: Include the following:
      1) One-line wiring diagram of the electrical distribution system.
      2) Actual, in-place conduit and cable layouts with schedule of conduit sizes and number, and size of conductors.
      3) Layouts of the power and lighting arrangements and the grounding system.
4) Control schematic diagrams, with terminal numbers and control devices identified, for all equipment.

b. Record documents shall indicate final equipment and field installation information.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Product Delivery.

1. When practical, factory-assemble materials and equipment. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.

2. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate the associated purchase order number, bill of lading number, contents by name, OWNER’s contract name and number, CONTRACTOR name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

3. Protect materials and equipment from exposure to the elements and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer’s instructions.

4. Do not ship materials and equipment until:
   a. Related Shop Drawings, Samples, and other submittals have been approved or accepted (as applicable) by ENGINEER, including, but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.
   b. Manufacturer’s instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by ENGINEER in accordance with the Specifications.
   c. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been reviewed and accepted by ENGINEER.
   d. Facilities required for handling materials and equipment in accordance with manufacturer’s instructions are in place and available.
   e. Required storage facilities have been provided.

5. Shipments shall be delivered with CONTRACTOR’s name, Subcontractor’s name (if applicable), Site name, Project name, and contract designation (example: “ABC Construction Co., City of Somewhere, Idaho, Wastewater Treatment Plant Primary Clarifier Improvements, Contract 25, General Construction”) clearly marked.

6. Site may be listed as the “ship to” or “delivery” address; but OWNER shall not be listed as recipient of shipment unless otherwise directed in writing by ENGINEER.
7. Provide CONTRACTOR’s telephone number to shipper; do not provide OWNER’s telephone number.

8. Arrange for deliveries while CONTRACTOR’s personnel are at the Site. CONTRACTOR shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when CONTRACTOR is not present will be refused by OWNER, and CONTRACTOR shall be responsible for the associated delays and additional costs, if incurred.

9. Have materials and equipment delivered in manufacturer’s original, unopened, labeled containers.

10. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

11. Immediately upon delivery, inspect shipment to verify that:
   a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
   b. Quantities are correct.
   c. Materials and equipment are undamaged.
   d. Containers and packages are intact and labels are legible.
   e. Materials and equipment are properly protected.

12. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment to furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.

13. Advise ENGINEER in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise ENGINEER of the associated impact on the Progress Schedule.

14. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by OWNER, by methods that prevent soiling or damaging materials and equipment and packaging.

15. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces.

16. Handle materials and equipment by methods that prevent bending and overstressing.

17. Lift heavy components only at designated lifting points.

18. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

B. Product Storage and Handling.

1. Store and protect materials and equipment in accordance with manufacturer’s recommendations and the Contract Documents.

2. CONTRACTOR shall make all arrangements and provisions necessary for, and
pay all costs for, storing materials and equipment. Excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to OWNER, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to allow easy access for inspection.

3. Store materials and equipment to become OWNER’s property to facilitate their inspection and ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and high temperatures with ambient temperatures as high as 100 degrees F. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to OWNER. When placing orders to Suppliers for equipment and controls containing computer chips, electronics, and solid-state devices, CONTRACTOR shall obtain, coordinate, and comply with specific temperature and humidity limitations on materials and equipment, because temperature inside cabinets and components stored in warm temperatures can approach 200 degrees F.

4. CONTRACTOR shall be fully responsible for loss or damage (including theft) to stored materials and equipment.

5. Do not open manufacturer’s containers until time of installation, unless recommended by the manufacturer or otherwise specified in the Contract Documents.

6. Do not store materials or equipment in structures being constructed unless approved by ENGINEER in writing.

7. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.

8. Equipment to be incorporated into the Work shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with above section 1.4.A.

9. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.

10. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of ENGINEER.
11. Protect electrical equipment, controls, and instrumentation against moisture, water damage, heat, cold, and dust. Space heaters provided in equipment shall be connected and operating at all times until equipment is placed in operation and permanently connected.

PART 2 – PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Performance Criteria:
   1. Electrical equipment shall be capable of operating successfully at full-rated load, without failure, with ambient outside air temperature of 32 degrees F to 100 degrees F and an elevation of 150 feet above mean sea level.
   2. Unless specified otherwise, electrical equipment shall have ratings based on 75 degrees C terminations.

B. Testing Laboratory Labels: Electrical material and equipment shall bear the label of Underwriters' Laboratories, Inc. or other nationally recognized, independent testing laboratory, where standards have been established and label service applies.

C. Products and installation of products shall abide following regulatory requirements and standards:
   3. Underwriters Laboratory (UL).
   4. American National Standards Institute (ANSI)

2.2 600 volt Cable

A. Insulated Cable In Raceways:
   1. Application: Use for circuits located indoors and outdoors.
   2. Manufacturers: Provide products of one of the following:
      a. Southwire.
      b. The Okonite Company.
      c. American Insulated Wire
      d. General Cable
   3. Material: Single conductor copper cable complying with ASTM B3 and ASTM B8 with flame-retardant, moisture- and heat-resistant insulation rated for 90 degrees C in dry or wet locations, listed by UL as Type XHHW-2 complying with UL 44.
   4. Wire Sizes: Not smaller than No. 12 AWG for power and lighting and No. 14 AWG for 120-volt control circuits.
   5. Stranding: 600-volt cable shall be stranded, except that solid cable, No. 10 and smaller may be used for lighting circuits.
B. Cable Splices:
   1. Products and Manufacturers:
      a. Compression-Type Splices: Provide one of the following:
         1) Burndy Hylink.
         2) T&B Color-Keyed Compression Connectors.
      b. Spring Connectors: Provide one of the following:
         1) Buchanan B-Cap.
         2) T&B Wire Connector.
   2. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings. Splices shall be taped and covered with materials recommended by cable manufacturer to provide insulation equal to that on conductors.
   3. For wire sizes No. 10 AWG and smaller, splices may be made up with pre-insulated spring connectors.
   4. For wet locations, splices shall be waterproof. Compression type splices shall be waterproofed by sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring thermosetting resin into mold that surrounds the joined conductor. Spring connector splices shall be waterproofed with sealant filler.
   5. Splices shall be suitably sized for cable, rated 90 degrees C, and 600 volts.

2.3 INSTRUMENT CABLE

A. Single Shielded Pair Instrument Cables:
   1. Manufacturers: Provide products of one of the following:
      a. Belden Company.
      b. Okonite Company.
      c. Dekoron Wire and Cable Company.
   2. Tinned copper, XLPE-insulated, stranded conductors, not less than no. 16 AWG, twisted pair, with overall shield, stranded tinned no. 18 AWG copper drain wire and overall PVC or CPE jacket. Rated for not less than 600 volts and complying with UL 1581.

B. Multi-Paired Shielded Instrument Cables:
   1. Manufacturers: Provide products of one of the following:
      a. Belden Company.
      b. Okonite Company.
      c. Dekoron Wire and Cable Company.
   2. Tinned copper, XLPE-insulated stranded conductors, not less than no. 16 AWG, twisted pairs with shield over each pair, stranded tinned no. 18 AWG copper drain wire, and overall PVC or CPE outer jacket. Rated for not less than 600 volts and complying with either UL 1581 or UL 13.
C. Multi-Conductor Shielded Instrument Cables:
   1. Manufacturers: Provide products of one of the following:
      a. Belden Company.
      b. Okonite Company.
      c. Dekoron Wire and Cable Company.
   2. Tinned copper, XLPE-insulated stranded conductors, not less than no. 16 AWG, stranded tinned no. 18 AWG copper drain wire, with overall 100 percent foil shield and overall PVC or CPE jacket. Rated for not less than 600 volts.

D. Cable Terminals:
   1. Manufacturers: Provide products of one of the following:
      a. T&B Sta-Kon.
      b. Burndy Insulug.
   2. Fork type copper compression terminals with nylon insulation for termination of cable at terminal blocks.

2.4 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

A. Bare Ground Cable:
   1. Manufacturers: Provide products of one of the following:
      a. Cablec Corporation.
      b. General Cable Corporation.
      c. Southwire Cable Company.
   2. Material: Soft-drawn, bare copper stranded cable complying with ASTM B8. No. 4/0 AWG minimum size unless otherwise shown or indicated on the Drawings.

B. Ground Rods:
   1. Manufacturers: Provide products of one of the following:
      a. Copperweld, Bimetallics Division.
      b. ITT Blackburn Company.
   2. Material: Copper-clad rigid steel rods, 3/4-inch diameter, ten feet long.

C. Grounding Connectors:
   1. Products and Manufacturers: Provide one of the following:
      a. Pressure Connectors:
         1) O.Z./Gedney, Division of General Signal Corporation.
         2) Burndy Corporation.
      b. Welded Connections:
         1) Cadweld by Erico Products, Incorporated.
         2) Therm-O-Weld by Burndy Corporation.
   2. Material: Pressure connectors shall be copper alloy castings, designed and fabricated specifically for items to be connected and assembled with Durium or silicone bronze bolts, nuts, and washers. Welded connections shall be by
exothermic process utilizing molds, cartridges, and hardware designed specifically for connection to be made.

D. Ground Test Well
1. Provide heavy-duty test well suitable for heavy-duty traffic.
2. Manufacturer
   a. Advanced Lightning Technology
3. Diameter and Material: 12.75-inch outside diameter, Schedule 80 PVC.
4. Depth: Two feet.
5. Cover: Provide test well with cast iron cover marked, “Ground” with cast iron ring to support lid.

E. Ground Bonding Jumpers
1. Braided copper tape, one inch wide, woven of No. 30 gage bare copper wire, terminated with copper ferrules.

F. Ground system components shall comply with UL 467.

2.5 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

A. Strut, Fittings, and Accessories:
1. General
   a. Unless otherwise shown or indicated, strut shall be 1-5/8 inches by 1-5/8 inches. Double struts shall be two pieces of the same strut, welded back-to-back at the factory.
   b. Attachment holes, when required, shall be factory-punched on hole centers approximately equal to the cross-sectional width and shall be 9/16-inch diameter.
   c. Fittings, braces, brackets, hardware, and accessories shall be Type 316 stainless steel.
   d. Strut nuts shall be spring captured Type 316 stainless steel.
   e. Square and round washers shall be Type 316 stainless steel.
2. Strut materials shall be suitable for area classifications indicated below:
   a. Wet Locations:
      1) Strut shall be 12-gage aluminum (Alloy 6063-T6).

B. Hanger Rods:
1. Material:
   a. Wet, Corrosive, or Hazardous Areas: Stainless steel.
2. Size: Not less than 3/8-inch diameter, unless otherwise shown on the Drawings or specified.
C. Beam Clamps for Attaching Threaded Rods or Bolts to Beam Flanges for Hanging Struts or Conduit Hangers:
   1. Beam clamps shall be stainless steel equipped with stainless steel square-head set screw, and shall include threaded hole sized for attaching the all-thread rod or threaded bolt.

D. Miscellaneous Hardware:
   1. Bolts, screws, and washers shall be stainless steel.
   2. Hex Nuts: Shall be stainless steel and include nylon inserts.

E. Conduit spans shall not exceed maximum allowable span as defined by the latest adopted National Electrical Code.

2.6 RIGID CONDUITS

A. Non-metallic Conduit and Fittings:
   1. PVC Plastic Conduit:
      a. Manufacturers: Provide products of one of the following:
         1) Amoco Chemicals Corp.
         2) Carlon Electrical Products.
         3) Or equal.
      b. Material: Schedule 40 PVC for belowground installations or Schedule 80 PVC for aboveground installations, rated for 90 degrees C, complying with NEMA TC3 and UL 514B and 651.
      c. Fittings: Form elbows, bodies, terminations, expansions, and fasteners of same material and manufacturer as base conduit. Provide cement by same manufacturer as base conduit.

B. Conduit Hubs:
   1. Manufacturers: Provide products one of the following.
      b. Or equal.
   2. Material: Threaded conduit hub, vibration-proof, weatherproof, with captive O-ring seal, zinc metal with insulated throat and bonding screw.
   3. Use: Provide for all conduit terminations to boxes, cabinets, and other enclosures in areas designated as wet locations.

C. Conduit Bushings and Locknuts:
   1. Manufacturers: Provide products one of the following:
      a. O-Z/Gedney.
      b. Appleton Electric Company.
   2. Insulated Bushings: Malleable iron body with plastic liner. Threaded type with steel clamping screw. Provide with bronze grounding lug, as required.
   3. Locknuts: Steel for sizes 3/4-inch through two-inch diameter and malleable iron for sizes 2.5-inch through four-inch diameter.
4. Use: Provide for all conduit terminations to boxes, cabinets and other enclosures except threaded type in areas designated as dusty locations.

D. Thruwall Seals
1. For new construction through exterior subsurface walls and exterior concrete walls.
   a. Manufacturer: Provide one of the following:
      1) Type WSK and WSCS by O-Z/Gedney.
2. For new construction passing through concrete floors and floor slabs.
   a. Manufacturer: Provide one of the following:
      1) Type FSK and FSCS floor seals by O-Z/Gedney.

2.7 FLEXIBLE CONDUITS

A. Flexible Conduit (Non-hazardous Areas and Class 1, Division 2, Hazardous Areas):
2. Products and Manufacturers: Provide one of the following:
   a. Anaconda Sealtite Type UA by Anamet Electrical, Inc.
   b. Liquatite Type L.A. by Electric-Flex Company.

B. Flexible Conduit Fittings:
1. Material and Construction: Malleable iron with cadmium finish. Fittings shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size and shall be UL listed.
2. Manufacturers: Provide products of one of the following:
   b. Appleton Electric Company.
3. Use: Provide on flexible conduit in non-hazardous and Class 1, Division 2 hazardous areas.

2.8 EXPANSION AND DEFLECTION FITTINGS

A. Products and Manufacturers: Provide one of the following:
1. Type DX for expansion/deflection or AX for expansion only, by O-Z Gedney Company.
2. Type XD for expansion/deflection or XJ for expansion only, by Crouse Hinds Company.
3. Type DF for expansion/deflection or XJ for expansion only, by Appleton Electric Company.
4. Or equal.
B. Cast gray iron alloy or bronze end couplings, malleable iron, or hot-dipped galvanized body, stainless steel clamps and tinned copper braid bonding jumper. Fitting shall be watertight, corrosion-resistant, UL-listed, and compatible with the conduit system.

C. Features:
   1. Expansion/Deflection Fittings:
      a. Axial expansion or contraction up to 3/4-inch.
      b. Angular misalignment up to 30 degrees.
      c. Parallel misalignment up to 3/4-inch.
   2. Expansion Fittings:

D. Expansion/Deflection fittings shall comply with UL 514B and UL 467.

2.9 PULL, JUNCTION AND TERMINAL BOXES

A. General:
   1. Materials and Construction - Wet Locations:
      a. Rating:
         1) Pull boxes in wet, corrosive, or outdoor areas shall be NEMA 4X.
         2) Boxes for areas classified as hazardous locations, where required by NEC, shall be explosion-proof and comply with UL 886.
      b. Material:
         1) Cast gray iron alloy with hot-dip galvanized finish, or cast malleable iron bodies and covers.
         2) Large boxes not generally available in cast iron construction shall be copper-free aluminum alloy or Type 316 stainless steel, as required by location.
         3) In corrosive locations, where the conduit system is PVC-coated, boxes shall be cast metal with factory-applied 40-mil PVC coating, Type 316 stainless steel, or non-metallic thermoplastic or fiberglass reinforced plastic material.
      c. Gasket:
         1) Provide neoprene gaskets for wet and corrosive locations.
         2) Gaskets shall be an approved type designed for the purpose. Improvised gaskets are not acceptable.
      e. Features:
         1) External mounting lugs.
         2) Drilled and tapped conduit holes.
         3) Boxes where conduits enter building or structure below grade shall have 1/4-inch drain hole at bottom of the box.
         4) Provide threaded connections for explosion proof boxes.
B. Terminal Blocks:
   1. Products and Manufacturers: Provide one of the following:
      b. General Electric Company, Model CR151K.
   2. Material and Construction:
      a. NEMA-rated nylon modular terminal blocks.
      b. 600-volt rated.
      c. Control and alarm circuit terminals shall be screwed type with
         permanently affixed numeric identifiers beside each connection.
      d. Power terminals shall be copper and rated for the circuit ampacity.
   3. Manufacturers: Provide products of one of the following:

2.10 IDENTIFICATION FOR ELECTRICAL SYSTEMS.

A. Engraved Identification Devices (Nameplates and Legend Plates):
   1. Nameplates:
      a. Laminated thermoset plastic, 1/16-inch thick, engraved condensed
         block black lettering on white background, square corners, and
         beveled front edges, or match existing.
      b. Size: As required.
      d. Nameplates one-inch or less in height shall have one mounting hole at
         each end. Nameplates greater than one-inch in height shall have
         mounting holes in the four corners.
   2. Legend Plates:
      a. Legend plates for pushbuttons, pilot lights, selector switches, and
         other panel-mounted devices shall be large size with dimensions of
         approximately 2-7/16 inches wide by 2-13/32 inches tall (Allen
         Bradley large automotive size), plastic, custom engraved with black
         letters on white background.
         1) Provide standard-size legend plates where devices are
            mounted on motor control centers and spacing of devices
            precludes using automotive-size legend plates.
      b. Lettering size and line weight shall be the same for all legend plates
         on the same panel or enclosure. Maximum size shall be 1/4-inch and
         minimum size shall be 1/8-inch.

B. Safety Signs and Voltage Markers:
   1. Provide high voltage signs for equipment operating over 600 volts.
   2. High-Voltage Safety Signs for Outdoor Applications:
      a. Products and Manufacturers: Provide one of the following:
         1) B-120-45471 by Brady.
b. Unless otherwise shown or indicated, high voltage safety signs shall be not less than 10 inches high by 14 inches wide, of fiberglass reinforced plastic, and shall comply with 40 CFR 1910.145. Signs shall resist fading from exposure to temperature extremes, ultraviolet light, abrasive, and corrosive environments, and shall read, “DANGER – HIGH VOLTAGE – KEEP OUT”

c. Mounting hardware shall be Type 316 stainless steel.

3. Low-Voltage Safety Signs:
   a. Products and Manufacturers: Provide one of the following:
      1) B-302-86060 by Brady.
   b. Low voltage safety signs shall be pressure-sensitive vinyl complying with 40 CFR 1910.145, five inches by 3.5 inches in size, and shall read, “DANGER – 480 VOLTS”.

4. Low-Voltage Markers:
   a. Products and Manufacturers: Provide one of the following:
      1) CV442xx by Brady.
   b. Low voltage markers shall be either pressure-sensitive vinyl or vinyl cloth with black lettering on orange background and shall read, “120 VOLTS”, “208 VOLTS”, “120/208 VOLTS”, or “240 VOLTS” as required.

C. Conduit Labels:
   1. Products and Manufacturers: Provide one of the following:
      a. B-915-xxxxx by Brady.
   2. Shall be pre-tensioned acrylic/vinyl construction coiled to completely encircle conduit for conduit up through five-inch diameter, or pre-molded to conform to circumference of conduit six-inch diameter and larger.
   3. Attach strap-on style for six-inch diameter conduit with stainless steel springs.
   4. Shall be blank for use with custom printed labels.
   5. Custom Labels:
      a. Shall have black lettering on yellow background.
      b. Shall not contain abbreviations in legend.
      c. Shall be custom printed on continuous tape with permanent adhesive using thermal printer specified below.

D. Wire Identification:
   1. Heat Shrinkable Wire and Cable Labeling System:
      a. Products and Manufacturers: Provide one of the following:
         1) B-341 PS-xxx-2W by Brady.
      b. White heat-shrinkable irradiated polyolefin shrink-on sleeves. Labels shall be thermal printed. Labels shall be not less than two inches wide.
   2. Wrap-Around Wire and Cable Labeling System:
a. Products and Manufacturers: Provide one of the following:
   1) THT-XX-427 by Brady.
b. Self-laminating white/transparent self extinguishing vinyl strips. Length shall be sufficient to provide at least 2.5 wraps. Labels shall be thermally printed and not less than two inches wide.

E. Detectable Underground Warning Tape:
   1. Products and Manufacturers: Provide one of the following:
      a. Indentoline by Brady.
   2. Material: Polyethylene or polyester with detectable metal core and polyester underlaminate.
   3. Width: Two inches.

F. Thermal Printing System:
   1. Utilize thermal transfer process to provide non-smearing labels and markers.
   2. Wire and Cable Markers:
      a. Portable, Products and Manufacturers: Provide one of the following:
         1) TLS2200 by Brady.
      b. Desktop, Products and Manufacturers: Provide one of the following:
         1) 200M by Brady.
   3. Cable Markers:
      a. Portable, Products and Manufacturers: Provide one of the following:
         1) Handimark by Brady.
         2) Or equal.
      b. Desktop, Products and Manufacturers: Provide one of the following:
         1) Labelizer PLUS by Brady.

2.11 LOW VOLTAGE RECEPTACLES.

A. Receptacles:
   1. Grounding receptacle, two-pole, three-wire, NEMA 5-20R configuration, ivory color.
      a. Single:
         1) Products and Manufacturers: Provide one of the following:
            a) HBL53611 by Hubbell, Inc.
            b) 5361-I by Pass & Seymour.
      b. Duplex:
         1) Products and Manufacturers: Provide one of the following:
            a) HBL53621 by Hubbell, Inc.
            b) PS5362-I by Pass & Seymour.
      c. Weather-resistant Duplex:
         1) UL-listed as weather-resistant.
2) Products and Manufacturers: Provide one of the following:
   a) HBL5362IWR by Hubbell, Inc.
   b) WR5362-I by Pass & Seymour.

B. Ground Fault Interrupting Receptacles:
   1. Duplex grounding receptacle, two-pole, three-wire, NEMA 5-20R configuration, 125-volt AC, 20 amperes, gray color with ground fault circuit interrupting (GFCI) protection.
   2. Ground fault interrupting receptacles shall comply with UL 943.
   3. Provide Type 302 stainless steel cover-plate conforming to UL 514D. Provide weatherproof-while-in-use cover where shown on the Drawings as “WP” or “WPU”, and provide where located in wet or corrosive location.
   4. Products and Manufacturers: Provide one of the following:
      a. GFR5362SGY by Hubbell, Inc.
      b. 2091-GRY by Pass & Seymour.
   5. Weather-resistant Ground Fault Interrupting Receptacles
      a. Products and Manufacturers: Provide one of the following:
         1) 2095TRWRGRTY by Pass & Seymour.

2.12 SNAP SWITCHES.

A. Switches for Non-Hazardous Locations:
      a. Products and Manufacturers: Provide one of the following:
         1) Catalog No. 1221-I, by Harvey Hubbel, Inc.
         3) Catalog No. 20AC1-I, by Pass & Seymour
      a. Products and Manufacturers: Provide one of the following:
         1) Catalog No. 1223-I, by Harvey Hubbell, Inc.
         3) Catalog No. 20AC3-I, by Pass & Seymour

B. Switch Covers:
   1. Indoor covers shall be Type 304 stainless steel.
   2. Outdoor, wet, or corrosive location covers shall be weatherproof and corrosion resistant.

2.13 DISCONNECT SWITCHES.

A. Single Throw, Circuit Disconnect Switches:
1. Type: Fused or unfused, horsepower rated, heavy-duty, single throw, quick-make, quick-break mechanism, visible blades in the "OFF" position and safety handle.
2. Rating: Voltage and current ratings and number of poles as required for motor or equipment circuits being disconnected. Switches shall bear a UL label and shall comply with the requirements of UL 98, NEMA KS 1 and NEMA 250.
3. Provide auxiliary dry contacts to indicate switch position.

2.14 CONTROL STATIONS.

A. Manufacturers: Provide products of one of the following:
   2. General Electric Company.
   4. Square-D Company.
   5. Or equal.

B. Type: 30.5 mm industrial, heavy duty, oil-tight construction with clearly-marked legend plates.

C. Emergency Stop or Lockout Stop: Lockout stop pushbuttons shall be two-position, push-pull type with maintained contact and mushroom head. Provide control stations with padlocking attachment and legend plate reading “PUSH-TO-STOP, PULL-TO-START”.

D. Pushbuttons: Momentary or maintained types, NEMA A600 contact rating.

E. Selector Switches: Rotary type with round or oval handles and positioning device to securely hold switch in selected position for maintained type and for spring return from left, right, or both left and right to maintained position.

F. Control stations shall comply with NEMA ICS 2, NEMA ICS 5, and UL 508, and shall bear the UL label.

G. Indicating Lights: 1LED Type, 120 VAC, push-to-test. Lens color shall be in accordance with this Section - Identification for Electrical Systems.

H. Enclosures: As required for area classifications specified in this Section, and complying with NEMA 250 and NEMA ICS 6.

I. Identification: Identify enclosures in accordance with this Section. Devices shall include front-mounted nameplates identifying function and equipment controlled, if not readily apparent.
2.15 LIGHTNING PROTECTION FOR STRUCTURES.

A. System Description:
   1. Each lightning protection system shall consist of a complete cable network on the roof or top of structure involving all air terminals, splices, and bonds with cable downleads routed concealed either directly in the building construction or in conduit to ground, and ground rods all connected together in an appropriate manner and certified by LPI to provide a zone of protection to entire building against lightning strikes, in accordance with NFPA 780.
   2. Provide complete, certified lightning protection system. Provide bonding connections and miscellaneous items for complete system.

B. Manufacturers: Provide products of one of the following:
   1. Heary Brothers Lightning Protection Company.
   2. Thompson Lightning Protection, Inc.

C. General:
   1. Size materials in accordance with NFPA 780, UL 96A, and LPI 176.
   2. Materials and equipment shall be labeled or listed by UL for use in Master Labeled lightning protection systems. Completed system shall conform to NFPA 70, NFPA 780, LPI 175, LPI 176, and UL96A.
   3. Materials shall comply in weight, size, and composition for class of structure to be protected in accordance with the following:
      a. Use Class I materials for systems on structures not exceeding 75 feet in height.
      b. Use Class II materials for systems on structures exceeding 75 feet above grade.
   4. Materials shall be corrosion-resistant, heavy-duty type. Unless otherwise specified, materials shall be Type 316 stainless steel, copper, or high copper-content bronze castings. Bolts, screws, and hardware shall be Type 316 stainless steel.
   5. Use aluminum materials in locations where system components are mounted on aluminum surfaces to avoid electrolytic corrosion of dissimilar metals.
   6. Provide fittings, mounting bases, couplings, connectors, fasteners, and other system devices required for complete system.

D. Ground Rods: Comply with the above section 2.4.

E. Ground Cables:
   1. Ground cables shall be copper, except in connections to aluminum surfaces as required to prevent dissimilar metals reaction.
   2. Ground cable stranding, number and size shall be suitable for classification of structure to be protected.
   3. Exposed ground cable shall be corrosion resistant.
F. Air Terminals:
1. Air terminals shall be stainless steel 5/8-inch diameter and minimum of 18 inches long.
2. Air terminals shall include a cast bronze point protector, stainless steel adapter, and copper base.

G. Non-Metallic Conduit and Fittings:
1. Non-metallic conduit shall be Schedule 80 PVC plastic, rated for 90 degrees C, conforming to UL 651.
2. Non-metallic fittings shall be of same material and manufacturer as base conduit. Provide cement for joining fittings to conduit. Fittings shall be by same manufacturer as base conduit.

2.16 SURGE PROTECTIVE DEVICE (Requirements for Sodium Hypochlorite Control Panel (SHCP), Potable Water Pump Control Panel (PWPCP), Fire Pump Control Panel (FPCP), Fire Jockey Control Panel (FJCP), Submersible Tank Mixer Control Panel)

A. Manufacturers: Provide equipment of one of the following:
1. General Electric.
2. Schneider Electric/Square-D Company.

B. General:
1. SPD shall be modular, high-energy, parallel design with fast-acting transient voltage suppression using metal oxide varistors. Equipment shall provide noise attenuation with electromagnetic interference filter.
2. SPD shall comply with requirements of the following:
   a. ANSI/UL 1449.
   b. UL 1283.
3. SPD shall be suitable for operation under the following environmental conditions:
   a. Relative Humidity: Zero to 95 percent, non-condensing.
   b. Frequency: 47 to 63 Hertz.
   c. Temperature: Zero to 149 degrees F.
4. SPD operating voltage and IEEE C62.41 and IEEE C62.45 Category A, B, and C application environments shall be suitable for the associated SPD location(s) shown or indicated on the Drawings.
5. SPD shall be suitable for internal and external mounting. SPD shall be field-mounted and integrated into distribution of equipment specified as follows:
   a. Sodium Hypochlorite Control Panel (SHCP) – See Section 46 33 44, Skid Mounted Peristaltic Metering Pump System
   b. Potable Water Pump Control Panel (PWPCP) – See Section 33 12 23, Packaged Potable Water Pump Station
c. Fire Pump Control Panel (FPCP) – See Section 21 30 00, Packaged Fire Pump System
d. Fire Jockey Control Panel (FJCP) – See Section 21 30 00, Packaged Fire Pump System
e. Submersible Tank Mixer Control Panel – See Section 46 41 23, Submersible Tank Mixing Equipment.

C. SPD shall include a surge suppression path for each mode as required for the system configuration shown on the Drawings. Each mode shall be individually fused and equipped with thermal cutouts. SPD short-circuit rating shall be 200 kA. Protection modes shall include, to the extent applicable, the following:
1. Line-to-line.
2. Line-to-neutral.
3. Line-to-ground.

D. SPD shall include electromagnetic interference/radio frequency interference (EMI/RFI) noise rejection filter with attenuation up to 30 dB from 10 kHz to 100 MHz.

E. SPDs and components in the operating path shall have maximum continuous operating voltage greater than 115 percent of nominal system operating voltage.

F. ANSI/UL 1449 minimum withstand rating shall be 20 kA per pole, and ANSI/UL 1449 voltage protection rating for SPD shall not exceed the following:

<table>
<thead>
<tr>
<th>Modes</th>
<th>120/240</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-N, L-G, N-G</td>
<td>800</td>
</tr>
<tr>
<td>L-L</td>
<td>1200</td>
</tr>
</tbody>
</table>

G. SPD surge capacity based upon IEEE C62.41 location category shall, as a minimum, be the following:

<table>
<thead>
<tr>
<th>Category</th>
<th>Application</th>
<th>Per Phase</th>
<th>Per Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Service entrance</td>
<td>240 kA</td>
<td>120 kA</td>
</tr>
<tr>
<td>B</td>
<td>High exposure locations (distribution equipment)</td>
<td>160 kA</td>
<td>80 kA</td>
</tr>
<tr>
<td>A</td>
<td>Branch locations</td>
<td>120 kA</td>
<td>60 kA</td>
</tr>
</tbody>
</table>

H. Provide SPD equipped with the following accessories:
1. Surge counter with display for indicating the number of surges detected.
2. LED indicators for monitoring device status.
3. Audible alarm and silence switch for indicating an inoperative condition.
4. Dry contacts, “Form C”, for remote annunciation of unit status.
5. Indicators, counter, alarm, and silence switch shall be visible and accessible from front of the SPD. When SPD is integral to switchgear, motor control center, panelboard, or other equipment, indicators, counter, alarm, and silence switch shall be visible and accessible from front of the equipment in which the SPD is installed.

6. Enclosure for each externally-mounted SPD: NEMA rating shall be as required for area classifications specified in the above section 1.1.D.

2.17 LIGHTING.

A. Type: Lighting fixtures required shall be in accordance with the Lighting Fixture Schedule on the drawings. Fixtures shall be complete with supports, ballasts, lamps, and incidentals, as required.

B. Fixtures in hazardous locations shall be listed in accordance with UL 1598 and UL 844.

C. Lamps:
   1. LED: Cool white, high-energy-efficient LED lamps with rain and dust tight enclosure and impact resistant lense with minimum 60,000 hours life expectancy unless indicated otherwise in the Lighting Fixture Schedule. Light fixture enclosure shall be UL listed and IESNA LM-79 and LM-80 compliant.
   2. Spare Parts and Extra Stock Materials: Ten percent spare lamps of each type and wattage.

D. Drivers:
   1. LED: Accepts 120V-240V, 60Hz input with adequate thermal management system.
   2. Spare Parts and Extra Stock Materials: Ten percent spare drivers of each type and quantity, but not less than one.

E. Fixtures located in area identified as wet location in above section 1.1.D., General Provisions for Electrical Systems, shall each be approved as a complete assembly, shall be clearly marked to indicate maximum wattage of lamps for which they are approved, and be protected against physical damage by suitable guards.

F. Hardware: Provide necessary hangers, supports, conduit adaptors, reducers, hooks, brackets, and other hardware required for safe fixture mounting. Hardware shall have protective, non-corrosive finish.

G. Outdoor Fixtures: Provide each fixture to be installed outdoors with cut-off lens to reduce the fixture’s light pollution emissions.

H. Photocell:
   1. Products and Manufacturers: Provide one of the following:
a. 2100 Series by Tork Time Controls, Inc.
b. Or equal.

2. Cadmium sulfide hermetically-sealed cell, fully temperature compensated, with time delay of not less than 15 seconds to prevent false switching.


PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work will be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:
   1. Install materials and equipment in accordance with the Contract Documents, Laws and Regulations, approved (and accepted, as applicable) Shop Drawings and other CONTRACTOR submittals, and manufacturer’s recommendations.
   2. Provide tools and equipment required to trace circuits necessary for proper execution of the Work.
   3. Define and identify all wiring, circuit terminations, and equipment to be modified to ensure proper interface of components. The Contract Price includes all costs associated with field services specified for a complete and functional system.

B. 600 Volt Cable Installation
   1. Install cables complete with proper terminations at both ends. Check and correct for proper phase sequence and proper motor rotation.
   2. Pulling:
      a. Use insulating types of pulling compounds containing no mineral oil.
      b. Pulling tension shall be within limits recommended by wire and cable manufacturer.
      c. Use dynamometer where mechanical means are used.
      d. Cut off section subject to mechanical means.
   3. Bending Radius: Limit to minimum of six times cable overall diameter.
   4. Slack: Provide maximum slack at all terminal points.
   5. Splices:
      a. Where possible, install cable continuous, without splice, from termination to termination.
b. Where required, splice as shown and also where required for cable installation. Splices below grade, in manholes, handholes, and wet locations shall be waterproof.

c. Splices are not allowed in conduits.

6. Identification:
   a. Identify conductors in accordance with above section 2.12.
   b. Identify power conductors by circuit number and phase at each terminal or splice location.
   c. Identify control and status wiring using numeral tagging system.

7. Color-code power cables as follows:
   a. No. 8 AWG and Smaller: Provide colored conductors.
   b. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, wrapped in overlapping turns to cover an area of at least two inches.
   c. Colors: Match color scheme in use at the Site. If the Site does not have an existing color scheme, use the following colors:

<table>
<thead>
<tr>
<th>System</th>
<th>Conductor</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Systems</td>
<td>Equipment Grounding</td>
<td>Green</td>
</tr>
<tr>
<td>240/120 Volts Single-Phase, Three-Wire</td>
<td>Grounded Neutral</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td>One Hot Leg</td>
<td>Black</td>
</tr>
<tr>
<td></td>
<td>Other Hot Leg</td>
<td>Red</td>
</tr>
<tr>
<td>208Y/120 Volts Three-Phase, Four-Wire</td>
<td>Grounded Neutral</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td>Phase A</td>
<td>Black</td>
</tr>
<tr>
<td></td>
<td>Phase B</td>
<td>Red</td>
</tr>
<tr>
<td></td>
<td>Phase C</td>
<td>Blue</td>
</tr>
<tr>
<td>240/120 Volts Three-Phase, Four-Wire</td>
<td>Grounded Neutral</td>
<td>White</td>
</tr>
<tr>
<td>Delta, Center Tap Ground on Single-Phase</td>
<td>Phase A</td>
<td>Black</td>
</tr>
<tr>
<td></td>
<td>High (wild) Leg</td>
<td>Orange</td>
</tr>
<tr>
<td></td>
<td>Phase C</td>
<td>Blue</td>
</tr>
<tr>
<td>480Y/277 Volts Three-Phase, Four-Wire</td>
<td>rounded Neutral</td>
<td>Gray</td>
</tr>
<tr>
<td></td>
<td>Phase A</td>
<td>Brown</td>
</tr>
<tr>
<td></td>
<td>Phase B</td>
<td>Orange</td>
</tr>
<tr>
<td></td>
<td>Phase C</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

C. Instrumentation Cable Installation
   1. Install cables complete with proper terminations at both ends.
   2. Install in conduit separate from power cables, unless shown or indicated otherwise.
   3. Ground shield on shielded cables at one end only and as recommended by instrument manufacturer.
   4. Identify conductors in accordance with above section 2.12.
   5. Install and terminate Supplier-furnished cable in accordance with equipment manufacturer requirements and cable manufacturer’s recommendations.
   6. Install in accordance with Laws and Regulations, including NEC.
D. Grounding and Bonding Installation
1. Provide ground grids as shown and indicated on the Drawings.
2. Provide No. 4/0 bare copper cable around exterior perimeter of structures at not less than 2.5 feet below grade, unless otherwise shown or indicated on the Contract Documents.
3. For structures with steel columns, provide No. 4/0 ground cable from grid to each column around perimeter of structure. Connect cable to steel with exothermic welds.
4. Connect grids to continuous underground water pipe system, when practical.
5. For new structures with concrete foundation or footings, connect structure’s reinforcing steel or other concrete-encased electrode to grounding grid.
6. Provide accessible test points for measuring the ground resistance of each grid.
7. Weld all buried connections except for test points.
9. Equipment grounding conductors shall be bare stranded copper cable of adequate size installed in metal conduit where required for mechanical protection. Ground conductors, pulled into conduits with non-grounded conductors, shall be insulated. Insulation shall be green.
10. Control panels grounding conductors shall be bare stranded copper cable of adequate size to ground grid from AC ground bus, and an insulated stranded copper cable of adequate size to ground grid from DC ground bus.
11. Connect ground conductors to conduit with copper clamps, straps, or with grounding bushings.
12. Connect to piping by welding or brazing. Use copper bonding jumpers on gasketed joints.
13. Connect to equipment by means of lug compressed on cable end. Bolt lug to equipment frame using holes or terminals provided on equipment specifically for grounding. Do not use hold-down bolts. Where grounding provisions are not included, drill suitable holes in locations recommended by equipment manufacturer or designated by ENGINEER.
14. Connect to motors by bolting directly to motor frames, not to soleplates or supporting structures.
15. Connect to service water piping by means of copper clamps. Use copper bonding jumpers on gasketed joints.
17. Fence Grounding: Provide at maximum intervals of 1,500 feet, except as follows:
   a. Ground fencing within 100 feet of buildings, structures, walkways, and roadways at maximum intervals of 750 feet.
      1) Gates and Other Fence Openings: Ground fence on each side of opening.
         a) Bond metal gates to gate-posts.
b) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2-gage wire and bury wire at least 1.5 feet below finished ground surface.

Protection at Crossings of Overhead Electrical Power Lines: Ground fencing at location of crossing and at maximum distance of 150 feet on each side of crossing.

Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2, unless otherwise shown or indicated.

Grounding Method: At each grounding location, drive ground rod vertically until the top is six inches below finished ground surface. Connect rod to fence with No. 6-gage conductor. Connect conductor to each fence component at grounding location, including the following:

1) Each Barbed Wire Strand: Make grounding connections to barbed wire with wire-to-wire connectors designed for this purpose.

Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Provide connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1) Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.

2) Make connections with clean, bare metal at points of contact.

3) Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4) Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.

5) Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor.

E. Hangers and Supports Installation

1. Provide hangers and supports for electrical systems with necessary channels, fittings, brackets, and related hardware for mounting and supporting materials and equipment. Provide anchor systems, concrete inserts, and associated hardware for proper support of electrical systems.

2. Install equipment and devices on hangers and supports as shown on the Drawings, as specified, and as required.

3. Install hangers and supports level, true, free of rack, and parallel and perpendicular to building walls and floors, so that the hangers and supports are installed in a neat, professional, workmanlike manner.
4. Holes in suspended ceilings for rods for hangers and supports and other equipment shall be provided adjacent to bars, where possible, to facilitate removal of ceiling panels.

5. Coordinate installation of hangers and supports with equipment, cabinets, consoles, panels, enclosures, boxes, conduit, cable tray, wireway, busway, cablebus, piping, ductwork, lighting fixtures, and other systems and equipment. Locate hangers and supports clear of interferences and access ways.

6. Anchor Bolts, Expansion Anchors, and Concrete Inserts: Shall be in accordance with structural drawings.

7. Mounting of Conduit:
   a. Provide space of not less than 1/4-inch between conduit surfaces and abutting or near surfaces except struts, cable trays, steel beams, and columns.
   b. Fasten conduit to struts, cable trays, steel beams, and columns using specified clamps and straps as shown, specified, and required.
   c. Devices shall be compatible with size of conduit and type of support. Following installation, size identification shall be visible and legible.
   d. Install conduit supports and fasteners in accordance with above section 2.5.

8. Freestanding: Unless otherwise specified or shown on the Drawings, provide supports for floor-mounted equipment, cabinets, consoles, panels, enclosures, and boxes. Such supports shall be 3.5-inch high concrete equipment base with a 45 degree chamfered edge. Base shall extend two inches beyond outside dimensions of equipment on all sides.

9. Wall-Mounted:
   a. Provide space not less than 1/4-inch between cabinets, consoles, panels, enclosures, and boxes and the surface on which each is mounted. Provide non-metallic or stainless steel spacers as required.
   b. Do not mount equipment, enclosures, panels, and boxes directly to beams or columns. Mount struts to beams or columns using beam clamps, and mount equipment, enclosures, panels, and boxes to the struts.

10. Floor Stand Rack:
    a. Where equipment, cabinets, consoles, panels, enclosures, and boxes cannot be wall-mounted, provide an independent floor stand rack.
    b. Floor stand rack shall consist of struts, plates, brackets, connection fittings, braces, accessories, and hardware assembled in a rigid framework suitable for mounting of intended materials and equipment.
    c. Equip floor stand racks with brackets and bases for rigidly-mounting the framework to the ceiling or floor, as applicable; or equip floor stand racks with beam clamps, angle plates, washers, and bolts for fastening to beam flanges, as applicable.
    d. When equipment, cabinets, consoles, panels, enclosures, and boxes weigh more than 100 pounds:
       1) Main vertical supports of floor stand rack assemblies shall be back-to-back struts.
2) Bracing, clamping and anchoring of each floor stand rack shall be sufficient to ensure rigidity of the floor stand rack with the intended equipment, enclosures, conduit, cable tray, busway, cablebus, and wireway installed. Floor stand racks shall not be deflected more than 1/8-inch by a 100-pound force applied at any point on the floor stand rack in any direction.

11. Drilling into beams or columns is not allowed unless authorized by ENGINEER.

12. Tighten nuts and bolts to the manufacturer’s recommended torque values.

13. Field Cutting:
   a. Cut edges of strut and hanger rod shall have rounded corners, edges beveled, and burrs removed. If field cutting the strut is required, use clean, sharp, dedicated tools. Remove oil, shavings, and other residue of cuttings prior to installation.
   b. Coatings: To prevent corrosion:
      1) Coat cut edges with epoxy-base touchup paint.
      2) Coat cut edges with zinc-rich paint.

F. Rigid Conduits
1. Supports:
   a. Rigidly support conduits by clamps, hangers, or Unistrut-type channels. Conduit supports and accessories shall be as specified herein.
   b. Support single conduits by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the support surface. Support multiple runs of conduits on trapeze type hangers.

2. Fastenings: Fasten raceway systems rigidly and neatly to supporting structures using specified materials.

3. Exposed Conduit:
   a. Install parallel or perpendicular to structural members or walls.
   b. Where possible, run in groups. Provide conduit racks of suitable width, length, and height, arranged to suit field conditions. Provide support every ten feet, minimum.
   c. Install on structural members in protected locations.
   d. Locate clear of interferences.
   e. Provide six inches of clearance from hot fluid lines and 1/4-inch from walls.
   f. Install vertical runs plumb. Unsecured drop length shall not exceed 12 feet.

4. Conduit Runs below Roadways and Parking Lot Areas:
   a. Provide protection for conduits run below roadways and parking lots, and in areas as shown in the drawings.
   b. Run conduit below structural concrete in center of slabs and above waterstops. Conduit connections shall be made watertight.
   c. Before placing concrete, arrange for observation of conduit installation by ENGINEER and make necessary conduit location measurements and
provide required information on record documents.

d. See Electrical details for installation requirements.

5. Underground Conduits:
   a. Install individual, underground conduits minimum of 24 inches below grade, unless otherwise shown or indicated.
   b. Perform excavation, bedding, backfilling, and surface restoration, including pavement replacement where required, in accordance with Section 31 20 00, Earth Moving, and Section 32 12 00, Flexible Paving.
   c. Install warning tape 12 inches below finished grade over buried conduits.

6. Empty Conduits:
   a. Install nylon pull wire in each empty conduit and cap conduits not terminating in boxes with permanent fittings designed for the purpose.

7. Field Bends: No indentations. Diameter of conduit shall not vary more than 15 percent at bends.

8. Joints:
   a. Apply conductive compound to joints before assembly.
   b. Make up joints tight and ground thoroughly.
   c. Use standard tapered pipe threads for conduit and fittings.
   d. Cut conduit ends square and ream to prevent damaging wire and cable.
   e. Use full threaded couplings. Split couplings are not allowed.
   f. Use strap wrenches and vises to install conduit. Replace conduit with wrench marks.
   g. Apply zinc-rich paint to exposed threads and other areas of galvanized conduit system where base metal is exposed.

9. Terminations:
   a. Install insulated bushings on conduits entering boxes or cabinets, except when threaded hubs are used.
   b. Provide locknuts on both inside and outside of enclosure, except when threaded hubs are used.
   c. Use of bushings in lieu of locknuts is not allowed.
   d. Install conduit hubs on conduits entering boxes or cabinets in wet and corrosive areas.

10. Moisture Protection:
    a. Plug or cap conduit ends at time of installation to prevent entrance of moisture and foreign materials.
    b. Underground and embedded conduit connections shall be watertight.
    c. Thruwall Seals and Conduit Sealing Bushings: Install for conduits passing through concrete slabs, floors, walls, or concrete block walls.
    d. Drainage: Conduit runs shall be fully drainable. Where possible install conduit runs to drain to one end and away from building. Avoid pockets or depressions in conduit runs.
    e. Seal conduit openings within control and instrumentation panels and distribution equipment with duct sealing compound to provide watertight seal.
11. Corrosion Protection:
   a. Conduit Curb:
      1) For conduits routed in concrete slabs or floors and stub-ups through
         floor, provide 4-inch high concrete curb, extending two inches from
         outer surface of conduit penetrating floor, to prevent corrosion. For
         floor-mounted equipment, concrete equipment base shall be in lieu of
         concrete curb.
      2) Conduit stub-ups shall be 90-degree, PVC-coated, rigid, galvanized
         steel conduit elbow. PVC-coated elbow shall extend a minimum of
         1/2-inch above top of concrete curb or equipment base. Should elbow
         not reach specified height, provide PVC-coated conduit extension to
         accommodate specified requirements. Provide coupling or fitting for
         transition from PVC conduit in slab to PVC-coated elbow.
      3) For conduits stubbing up and terminating at equipment enclosure
         mounted on concrete base, provide insulated grounding bushing on
         PVC-coated rigid steel elbow.
      4) For conduits stubbing up and extending to boxes, cabinets, and other
         enclosures above the concrete curb in wet and dusty areas, provide
         conduit coupling/fittings between the PVC-coated rigid steel elbow
         and rigid steel conduit for transition between the two conduit types.
      5) For conduits stubbing up and extending to boxes, cabinets, and other
         enclosures above the concrete curb or equipment base in corrosive
         areas, continue conduit system with PVC-coated rigid steel conduit
   b. Dissimilar Metals:
      1) Prevent occurrence of electrolytic action between dissimilar metals.
      2) Do not use copper products in connection with aluminum, and do not
         use aluminum in locations subject to drainage of copper compounds
         on bare aluminum.
      3) Back paint aluminum in contact with masonry or concrete with two
         coats of aluminum-pigmented bituminous paint.

G. Non-metallic Conduit:
   1. Install in accordance with manufacturer’s recommendations.
   2. Provide manufacturer’s recommended adhesives or sealants for watertight
      connections.
   3. Provide expansion fittings for expansion and contraction to compensate for
      temperature variations. Fittings shall be watertight and suitable for direct
      burial.
   4. Transition to PVC-coated rigid steel conduit before making turn up to
      enclosures.

H. PVC-coated Rigid Steel Conduit:
   1. Install in accordance with manufacturer’s recommendations.
   2. Install with manufacturer’s installation tools to avoid damage to PVC coating.
3. Repair damaged PVC coating with manufacturer’s recommended touch-up compound.

I. Identify conduits, including spares, in accordance with this Section.

J. Flexible Conduit Installation
   1. Install at motors, transformers, field instruments, and equipment subject to vibration or require movement for maintenance purposes. Provide necessary reducer where equipment furnished cannot accept 3/4-inch diameter flexible conduit. Limit flexible conduit length to three feet maximum.
   2. Install in conformance with the Laws and Regulations.

K. Expansion/Deflection Installation
   1. Install fittings in accordance with Laws and Regulations.
   2. Provide expansion fittings on exposed conduit runs crossing structural expansion joints and where necessary to compensate for thermal expansion and contraction. Provide expansion fittings on exposed conduit runs exceeding 200 feet.
   3. Provide expansion/deflection fittings on embedded conduit runs crossing structural expansion joints. Provide fittings above waterstops.
   4. Unless specifically shown or indicated otherwise, when crossing structural expansion joints larger than one inch, provide expansion fitting together with expansion/deflection fitting. Install fittings on each conduit run in accordance with manufacturer’s recommendations to accommodate additional movement necessary.
   5. Provide expansion/deflection fittings for underground conduit runs at penetrations of buildings, manholes, handholes, and outdoor concrete equipment pads.
   6. Where required in non-metallic conduit and duct systems, provide rigid metal conduit nipples and metal rigid-to-PVC adapters for connection to fittings. Ensure that joints exposed to water or other liquid are made watertight.

L. Pull, Junction, and Terminal Box Installation
   1. Mount boxes so that sufficient access and working space is provided and maintain clearance of not less than 1/4-inch from walls.
   2. Securely fasten boxes to walls or other structural surfaces on which boxes are mounted. Provide independent supports that comply with section 2.5, where boxes will not be mounted on walls or other structural surface.
   3. Install pull boxes where shown or indicated, and provide pull boxes where one or more of the following conditions exist:
      a. Conduit runs containing more than three 90-degree bends.
      b. Conduit runs exceeding 200 feet in length.
   4. Provide removable, flame-retardant, insulating cable supports in boxes with any dimension exceeding three feet.
   5. Field-apply PVC touch-up to scratched PVC boxes damaged during installa-
tion. Touch-up work shall be in accordance with manufacturer’s recommendations and instructions.

6. Size junction, pull, and terminal boxes in accordance with NEC Article 314 and other Laws and Regulations.

7. Provide terminal blocks in boxes where shown and where cable terminations or splices are required.

M. Identification Installation

1. Provide electrical identification in accordance with manufacturer recommendations and as required for proper identification of equipment and materials.

2. Engraved Identification Devices (Nameplates and Legend Plates):
   a. Unless otherwise indicated in the Contract Documents, attach permanent nameplates with permanent adhesive and with 3/16-inch diameter, round head, stainless steel machine screws into drilled and tapped holes.
   b. Provide nameplate with 1.5-inch high letters to identify each console, cabinet, panel, or enclosure as shown or indicated.
   c. Provide nameplates for field-mounted motor starters, disconnect switches, manual starter switches, pushbutton stations, and similar equipment operating components, which shall describe motor or equipment function and circuit number.
   d. Provide nameplates with 1/2-inch high letters to identify each junction and terminal box shown or indicated.

3. Except conduit, all electrical appurtenances including lighting panels, convenience outlets, fixtures, and lighting switches, shall be provided with nameplates indicating appropriate circuit breaker number(s).

4. Push Buttons:
   a. Provide legend plates for identification of functions.
   b. Provide nameplates for identification of controlled equipment.
   c. Provide red buttons for stop function.
   d. Provide black buttons for other functions.

5. Pilot Lights:
   a. Provide legend plates for identification of functions.
   b. Provide nameplates for identification of controlled equipment. Shall have lens colors as shown or indicated. Where no color is indicated, provide the following lens colors:

<table>
<thead>
<tr>
<th>Color</th>
<th>Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Running, Open</td>
</tr>
<tr>
<td>Red</td>
<td>Stopped, Closed</td>
</tr>
<tr>
<td>Amber</td>
<td>Alarm</td>
</tr>
<tr>
<td>Blue</td>
<td>Power</td>
</tr>
<tr>
<td>White</td>
<td>Status</td>
</tr>
</tbody>
</table>
6. Selector Switches:
   a. Provide legend plates for identification of functions.
   b. Provide nameplates for identification of controlled equipment.

7. Panel Mounted Instruments:
   a. Provide nameplates for identification of function.

8. Interiors of Cabinets, Consoles, Panels, Terminal Boxes, and Other Enclosures:
   a. Provide nameplates for identification.
   b. Provide each item inside cabinet, console, panel, terminal box, or enclosure with laminated plastic nameplate as shown on approved Shop Drawings and CONTRACTOR’s other submittals. Install nameplates with adhesive.
   c. Interior items requiring nameplates include:
      1) Terminal blocks and strips.
      2) Bus bars.
      3) Relays.
      4) Rear of face-mounted items.
      5) Rear of door-mounted items.
      6) Interior mounted items that require identification when mounted externally.
   d. Circuit Breaker Directory:
      1) Provide engraved laminated plastic directory listing function and load controlled for each circuit breaker within panel used for power distribution.

9. Safety Signs and Voltage Markers:
   a. Provide safety signs and voltage markers on and around electrical equipment as shown or indicated.
      1) Install rigid safety signs using stainless steel fasteners.
      2) Clean surfaces before applying pressure-sensitive signs and markers.
   b. Install high voltage safety signs on all equipment doors providing access to uninsulated conductors, including terminal devices, greater than 600 volts.
   c. Provide cable tray safety signs on both sides of cable trays at maximum intervals of 20 feet. Install signs on side rails of tray as acceptable to ENGINEER.
      1) Label cable trays that contain conductors greater than 600 volts with cable tray safety signs.
      2) Cable trays that contain conductors greater than 208 volts and less than 600 volts shall be labeled with low voltage safety signs.
      3) Cable trays that contain conductors of 120/208 volts shall be labeled with low voltage markers.
   d. Do not label cable trays that contain only instrument signal cables.
   e. Label cable trays that contain intrinsically safe wiring or cables in
accordance with NEC Article 504.

f. Install low voltage safety signs on equipment doors that provide access to uninsulated 480-volt conductors, including terminal devices.

g. Install low voltage markers on each terminal box, safety disconnect switch, and panelboard installed, modified, or relocated as part of the Work and containing 120/208 volt conductors.

10. Voltage System Identification Directories
a. Provide voltage system identification directories as required by NEC Article 210 and NEC Article 215.

b. Provide in each electrical room voltage system identification directory mounted on wall or door at each entrance to room.

c. For panelboards, switchboards, motor control centers, and other branch circuit or feeder distribution equipment that are not located in electrical rooms, provide voltage system identification directory mounted on equipment.

1) Directories shall be affixed using epoxy glue. Screws or bolts shall not penetrate equipment enclosures.

2) Directories shall be readily visible and not obscure labels and other markings on equipment.

11. Arc-flash Safety Signs:

a. Provide arc-flash safety signs as required by NEC Article 110.

b. Provide signs for switchboards, panelboards, motor control centers, and industrial control panels. Provide signs for control panels that contain 480 volt equipment. Provide arc flash warning signs on other equipment where the incident energy is greater than 1.2 calories per square centimeter.

12. Conduit Labels:

a. Provide conduits with conduit labels unless otherwise shown or indicated.

b. Do not label flexible conduit.

c. Do not label exposed single conduit runs of less than 25 feet between local disconnect switches and their associated equipment.

d. Conduit labels shall indicate the following information:

1) Contract Number: Alphanumeric, three or four digits, as applicable.

2) Conduit Number: Alphanumeric as shown on the Drawings, as assigned by CONTRACTOR for unlabelled conduits, and in accordance with approved submittals.

e. Conduits that contain intrinsically safe wiring shall have an additional pipe marker provided that has blue letters on white background and reads, “INTRINSICALLY SAFE WIRING”.

1) Install intrinsically safe pipe markers in accordance with NEC Article 504 along entire installation. Spacing between labels shall not exceed 25 feet.

f. Provide conduit labels at the following locations:
1) Where each conduit enters and exits walls, ceilings, floors, or slabs.
2) Where conduit enters or exits boxes, cabinets, consoles, panels, or enclosures, except pull boxes and conduit bodies used for pull boxes.
3) At maximum intervals of 50 feet along length of conduit.
g. Orient conduit labels to be readable.

13. Wire and Cable Identification:
   a. Color-coding of insulated conductors shall comply with above section 3.2
   b. Use heat-shrinkable wire labels where wire or cable is terminated. Use wrap-around labels where wire or cable is to be labeled but is not terminated.
   c. Do not provide labels for the following:
      1) Bare ( uninsulated) conductors, unless otherwise shown or indicated as labeled.
   d. Provide wire and cable labels for the following:
      1) New, rerouted, or revised wire or cable.
      2) Insulated conductors.
      3) Wire and cable terminations:
         a) Wire labels shall be applied between 1/2-inch and one inch of completed termination
         b) Apply cable labels between 1/2-inch and one inch of cable breakout into individual conductors.
         c) Label individual conductors in a cable after breakout as specified for wires.
   e. Wire or cable exiting cabinets, consoles, panels, terminal boxes, and enclosures.
      1) Label wires or cables within two inches of entrance to conduit.
   f. Wire or cable in junction boxes and pull boxes
      1) Label wires or cables within two inches of entrance to conduit.
   g. Wire and cable installed in cable tray.
      1) Wire and cable shall have labels at maximum intervals of 20 feet.
   h. Wire and cable installed without termination in electrical manholes.
      1) Wire and cable shall have wrap-around labels applied within one foot of exiting manhole.
   i. Wire and Cable Identification System:
      1) Wire and cable labels shall be imprinted with an identifying designator.
         a) Wire and cable extending between two devices or items and that does not undergo a change of function shall be identified by a single unique designator as specified below.

14. Wire and Cable Identification:
a. Color-coding of insulated conductors shall comply with above section 2.2.
b. Use heat-shrinkable wire labels where wire or cable is terminated. Use wrap-around labels where wire or cable is to be labeled but is not terminated.
c. Do not provide labels for the following:
   1) Bare ( uninsulated) conductors, unless otherwise shown or indicated as labeled.
d. Provide wire and cable labels for the following:
   1) New, rerouted, or revised wire or cable.
   2) Insulated conductors.
   3) Wire and cable terminations:
      a) Wire labels shall be applied between 1/2-inch and one inch of completed termination
      b) Apply cable labels between 1/2-inch and one inch of cable breakout into individual conductors.
      c) Label individual conductors in a cable after breakout as specified for wires.

e. Wire or cable exiting cabinets, consoles, panels, terminal boxes, and enclosures.
   1) Label wires or cables within two inches of entrance to conduit.
f. Wire or cable in junction boxes and pull boxes
   1) Label wires or cables within two inches of entrance to conduit.
g. Wire and cable installed in cable tray.
   1) Wire and cable shall have labels at maximum intervals of 20 feet.
h. Wire and cable installed without termination in electrical manholes.
   1) Wire and cable shall have wrap-around labels applied within one foot of exiting manhole.
i. Wire and Cable Identification System:
   1) Wire and cable labels shall be imprinted with an identifying designator.
      a) Wire and cable extending between two devices or items and that does not undergo a change of function shall be identified by a single unique designator as specified below.

15. Terminal Strip Labeling:
   a. Label panel side of terminal to match panel wire number.
   b. Label field side of terminal to match field wire number. Terminal number shall not include the Contract number.

N. Receptacle Installation
1. Non-hazardous Locations: Install receptacles at locations shown.
2. Install receptacles with ground pole in the down position.
3. Mount receptacles 18 inches above finished floor in non-hazardous locations and 4.5 feet above finished floor in hazardous locations, unless otherwise shown or indicated in the Contract Documents.

4. Identification:
   a. Identify each conductor with circuit number and lighting panel number in accordance with above section 2.12
   b. Identify each receptacle with permanent phenolic tag. Tags shall include circuit number and lighting panel number.

O. Snap Switch Installation
   1. Install switches at locations as shown or indicated in the Contract Documents in outlet or device boxes
   2. Mount wall switches 4.0 feet above finished floor unless otherwise noted.
   3. Identify each conductor with circuit number and lighting panel number. Identification shall be in accordance with above section 2.12.

P. Disconnect Switch Installation
   1. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
   2. Securely fasten equipment to walls or other structural supports on which they are mounted. Provide independent stainless steel supports where no wall or other structural surface exists. Mount disconnect enclosures at a height not exceeding six feet.
   3. Provide suitable 1/4-inch spacers to prevent mounting enclosure directly against walls.

Q. Lightning Protection for Structures Installation
   1. Install main conductors to provide two-way path from each air terminal horizontally or downward to connections with ground terminals.
   2. Install conductors free of excessive splices and sharp bends. Conductor bends shall form an included angle of not less than 90 degrees and shall not have bend radius less than eight inches. Secure conductors to structure at intervals not exceeding three feet.
   3. Conceal down conductors where possible in exterior wall construction. Space down conductors at intervals averaging not more than 100 feet around perimeter of structure. Provide at least two down conductors for each protected structure.
   4. For structural steel frame construction, down conductors at upper and lower extremities and at intervals not exceeding 200 feet shall be connected to structural steel. Make connections to steel frame with bonding plates having eight square inches of contact, or by exothermic weld connections.
   5. Provide air terminals at intervals not exceeding 20 feet along ridges and around perimeter of flat or gently-sloping roofs. Air terminals shall project a minimum of 10 inches above the area protected.
6. Protect flat or gently-sloping roofs exceeding 50 feet in width, by providing additional air terminals at intervals not exceeding 50 feet on flat or gently-sloping area. Locate air terminals within two feet of roof edges and outside corners of protected areas. Air terminal spacing exceeding these dimensions will be allowed if the area protected is within a “zone of protection” from lightning strikes.

7. Provide air terminals for stacks, flues, mechanical equipment, and other objects, having metal thickness less than 3/16-inch and not located within a “zone of protection”. Connect objects having metal thickness 3/16-inch or greater to lightning protection system.

8. Do not connect copper equipment to aluminum surfaces, except using bimetal transition fitting. Lead coating is unacceptable for bimetal transition.

9. Install roof penetrations using through-roof assemblies with solid bars and appropriate roof flashing. Conductors shall not pass directly through roof.

10. Grounded metal bodies shall be bonded to the system using bonding connections and fittings. When ground conductors are installed in conduit, conduit shall be non-metallic.

11. Bond building ground systems including electrical, communication, and telephone services and arresters.

12. Bond metal pipes and roof mounted metal structure to the roof ground loop or to downlead cables.

13. Provide ground electrodes for each down conductor dedicated for lightning protection system and bond electrodes to building or structure grounding system. Connect down conductor to ground rod using high-strength, removable ground clamp. Provide bronze ground rod clamp having at least 1.5 inches of contact between rod and conductor, measured parallel to the axis of the rod, at ground test wells.

R. Lighting Installation
1. General:
   a. Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to clear conflicts and obstructions.
   b. Mounting Heights: Mounting heights or elevations are to bottom of fixture or to centerline of device.
   c. Install fixtures in accordance with Laws and Regulations, the Contract Documents, and manufacturer instructions and recommendations.
   d. Mount fixtures so that sufficient access is available for ready and safe maintenance.
   e. Securely fasten equipment to walls or other surfaces on which equipment is mounted.

2. Suspended Fixtures:
   a. Pendant-mount using 1/2-inch diameter conduit stems.
   b. Ground to outlet box.
   c. Attach mounting to building structure with expansion anchors.
d. Fixtures shall not be dependent on the outlet box cover screws for support.

3. Surface Mounted Fixtures:
   a. Attach to appropriate outlet box.
   b. Attach to surface using fasteners and sealing washers when mounting fixture in damp or wet locations.

4. Boxes and Fixtures:
   a. For units mounted against masonry or concrete walls, provide suitable 1/4-inch spacers to prevent mounting back of box directly against wall.
   b. Bolt units rigidly to building with expansion anchors, toggle bolts, hangers, or Unistrut.
   c. Do not install boxes with open conduit holes.
   d. Cable each circuit and identify with tag.

5. Re-lamp all fluorescent fixtures provided under this Contract with new lamps following Substantial Completion.

6. Mount photocells as shown and adjust foot-candle setting for proper dusk and dawn photo-control. Provide wiring in conduit from photocell to controls.

3.3 FIELD QUALITY CONTROL

A. Field Quality Control – General:
   1. Perform field quality control for electrical Work in accordance with the Contract Documents.

B. Site Tests:
   1. Prior to requesting certificate of Substantial Completion, demonstrate to ENGINEER that electrical systems and electrically-operated equipment installed or modified under the Contract operates in accordance with the Contract Documents and operates as required
   2. Perform the following operational tests on electrical systems:
      a. Operate power circuits to verify proper operation and connection to electrical systems materials and equipment, including mechanical key-interlocks for circuit breakers.
      b. Remove and re-apply power supply to automatic transfer equipment to verify operation. Activate standby power systems to verify their automatic start-up, proper de-energization, and cool down upon resumption of normal power supply.
      c. Operate control circuits, including pushbuttons, indicating lights, and similar devices, to verify proper connection and function. Operate all devices, such as pressure switches, flow switches, and similar devices, to verify that shutdowns and control sequences operate as required.
      d. Operate lighting systems and receptacle devices to verify proper operation and connections.
3. Prepare and submit report on the equipment demonstration and operating field quality control tests. Report shall include complete information on the tests performed and results.

C. Manufacturer’s Services:
   1. Furnish at the Site qualified, factory-trained representative(s) of equipment manufacturers for the services indicated in the Contract Documents.

   + + END OF SECTION + +
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install motor control centers as shown within the drawings and as stated herein.
2. All materials and components described herein shall be provided by a single manufacturer, or to the greatest extent possible.

B. Coordination:
1. To properly size circuit breakers, starters, and control power transformers, obtain motor nameplate data on equipment being furnished under this and other contracts as required.
2. To properly size control power transformers, obtain data on motor space heaters and other accessories.
3. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before motor control center Work.
4. Notify other contractors in advance of installing motor control center equipment to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before motor control center Work.

C. Related Sections:
1. Section 26 00 05, Electrical Work (Small Scope)

1.2 REFERENCES

A. Standards referenced in this Section are:
3. NEMA ICS 18, Motor Control Centers.
4. NEMA ICS 1, Industrial Controls and Systems: General Requirements.
5. UL 845, Motor Control Centers.
1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have not less than five years experience of producing equipment substantially similar to that required and shall be able to submit documentation of not less than five installations in satisfactory operation for at least five years each.
   2. Factory Testing:
      a. Perform factory testing on each MCC section prior to shipping. Testing shall be designed to verify system operation and shall include verification of Drawings and Bill of Materials.
   3. Field Testing:
      a. Perform field testing as stated herein.

B. Regulatory Requirements: Comply with the following:
   1. NEC Article 430, Motors, Motor Circuits, and Controllers.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Outline and summary sheets with schedules of equipment in each unit.
      b. One-line diagrams indicating circuit breaker sizes, bus rating, motor controller ratings, and other pertinent information to demonstrate compliance with the Contract Documents.
      c. Unit control schematic and elementary wiring diagrams showing numbered terminal points and interconnections to other units.
   2. Product Data:
      a. Manufacturer specifications, cut sheets, dimensions, and technical data for all components, materials, and equipment proposed for use.
   3. Testing Plans, Procedures, and Testing Limitations:
      a. Not less than 30 days prior to actual factory testing, submit proposed testing methods, procedures, and apparatus.
      b. Not less than 30 days prior to actual field testing, submit proposed testing methods, procedures, and apparatus.

B. Informational Submittals: Submit the following:
   1. Supplier Instructions:
      a. Instructions for shipping, storing and protecting, and handling the materials and equipment.
      b. Installation data for the equipment, including setting drawings, templates, and directions and tolerances for installing anchorage devices.
      c. Instructions for start-up and troubleshooting.
   2. Source Quality Control Submittals:
a. Reports of completed factory testing, including procedures used and test results.

3. Site Quality Control Submittals:
   a. Reports of completed field testing, including procedures used and test results.

4. Supplier Reports:
   a. Submit written report of results of each visit to Site by Supplier’s service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.

5. Qualifications Statements:
   a. Manufacturer, when requested by ENGINEER.

C. Closeout Submittals: Submit the following:
   1. Operations and Maintenance Data:
      a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, and spare parts information.
      b. Manuals shall include record drawings of control schematics, including point-to-point wiring diagrams.
      c. Comply with Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Furnish the following:
   1. Spare Parts:
      a. Furnish, tag, and box for shipment and long term storage the following spare parts and special tools for each motor control center lineup furnished:

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity per Switchgear Lineup Furnished</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Starters and feeder breakers</td>
<td>Quantities and sizes as shown</td>
</tr>
<tr>
<td>2) Fuses</td>
<td>Six of each type and size used</td>
</tr>
<tr>
<td>3) Auxiliary control relays</td>
<td>Two, with at least two normally open and two normally closed contacts</td>
</tr>
<tr>
<td>4) Control power transformers</td>
<td>Two of each size used</td>
</tr>
<tr>
<td>5) Indicating lamps</td>
<td>Twelve</td>
</tr>
<tr>
<td>6) Covers for indicating lamps</td>
<td>Six of each color used</td>
</tr>
<tr>
<td>7) Starters: Contact kits for Size 1 motor starter</td>
<td>Five sets</td>
</tr>
<tr>
<td>8) Starters: Contact kits for Size 2, Size 3, and Size 4 motor starters</td>
<td>One set of each size</td>
</tr>
</tbody>
</table>
b. Furnish a list of additional recommended spare parts for an operating period of one year. Describe each part, the quantity recommended and current unit price.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Packing:
      a. Inspect prior to packing to assure that assemblies and components are complete and undamaged.
      b. Protect mating connections.
      c. Indoor containers shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.
      d. Cover all openings into enclosures with-vapor inhibiting, water-repellent material.
   2. Upon delivery, check materials and equipment for evidence of water that may have entered equipment during transit.
   3. Handling:
      a. Lift, roll or jack motor control center equipment into locations shown.
      b. Motor control centers shall be equipped to be handled by crane. Where cranes are not available equipment shall be suitable for placement on rollers using jacks to raise and lower the groups.

B. Storage and Protection:
   1. Store motor control center equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide equipment by one of the following:
   2. Schneider Electric/Square D Company.
   5. Or equal.

2.2 MATERIALS

A. General: Motor control center lineups shall comply with NEMA ICS 18 and be provided as shown with the following ratings:
1. Service: Voltage rating and number of wires shall be as shown or indicated on the Drawings. Motor control center shall operate from a three-phase, 60 Hertz system.
2. Wiring: NEMA Class II, Type B.
4. Interrupting Capacity Rating: Motor control center shall have an interrupting capacity rating as shown or indicated on the Drawings. Devices shall be suitable for minimum rating indicated.
5. Motor control center lineups shall be UL-rated as suitable for service entrance where shown or indicated on the Drawings and as required.

B. Construction: Provide equipment with the following:
1. Totally-enclosed structure, dead front, consisting of nominal 20-inch deep, 20-inch wide, 7.5-feet high vertical sections bolted together to form a unit assembly.
2. Vertical sections shall have side sheets extending the full height and depth of section.
3. Removable lifting angles for each shipping section.
4. Two removable floor sills for mounting.
5. Horizontal wireways top and bottom, isolated from horizontal bus and readily accessible.
   a. Wireway openings between sections shall have rounded corners and rolled edges.
6. Isolated vertical wireways with cable supports, accessible through hinged doors, for each vertical section.
   a. Wireway shall be separate from each compartment and remain intact when compartment is removed.
7. All-metal non-conducting parts electrically continuous.

C. Bus System:
1. Rating: Bus bracing and bus current capacities as shown or indicated on the Drawings.
2. Bus bars shall be tin-plated, copper-rated, and comply with UL heat rise standards.
3. Bus bar connections shall be easily accessible with simple tools.
4. Main Horizontal Bus:
   a. Continuous, edge-mounted, and isolated from wireways and working areas.
   b. Mount the bus in vertical center of motor control center to provide easy access and even heat distribution.
   c. Bus shall be supported, braced, and isolated by high-strength, non-tracking, FRP material.
5. Vertical Bus:
   a. Continuous, and isolated by glass polyester barrier.
b. Rated for 300 amperes continuous minimum, and at least equal to full-load rating of all installed units in the associated stack.

6. Grounding Bus: Full length mounted across the bottom, drilled with lugs of appropriate capacity as required.

7. Neutral Bus: Insulated, continuous through control center for four-wire services, drilled with lugs of appropriate capacity as required.

D. Unit Compartments:
1. Provide individual front door for each unit compartment. Fasten door to stationary structure, instead of the unit itself, so that door can be closed when unit is removed.

2. Starter and feeder unit doors interlocked mechanically with unit disconnect device to prevent unintentional opening of door while energized and unintentional application of power while door is open, with provisions for releasing interlock for intentional access and application of power.

3. Padlocking arrangement permitting locking disconnect device in the “OFF” position with at least three padlocks with door closed or open. Equip unit disconnect devices located in the top compartment, compartment sized 12 inches or higher, with extender handle complying with UL 845. Extender handle shall allow disconnect operating handle to be located above NEC’s height limitation of six-feet, seven-inches above floor.

4. Equip compartments as shown or indicated on the Drawings:
   a. Blank compartments, unused space, and compartments shown or indicated on the Drawings as “SPACE” shall have bus covers and be complete with necessary hardware for future installation of a plug-in unit.
   b. Provide shutters for each compartment that automatically open when unit is inserted and automatically close when unit is removed.

5. Provide wiring and device identification:
   a. Identify compartment doors, devices, and field wiring in accordance with Section 26 00 05. See paragraph on “Identification for Electrical Systems”.
   b. Identify internal control conductors with permanent wire markers. Each wire shall be identified by a unique number attached to wire at each termination point.
   c. Identify internal control devices with permanent markers. Each device shall be identified by a unique number attached to each device.
   d. Numbering system for each wire and control device shall be identified on the wiring diagrams in the Shop Drawings and shall reflect the actual designations used in the Work.

6. NEMA 1 minimum motor starter size. Starter units completely draw out type in Sizes 1 and 2 and draw out type after disconnecting power leads only in Sizes 3 and 4.

7. Motor starters shall be NEMA-rated and include magnetic contactor, with encapsulated magnet coils. Wound coils are unacceptable. Control shall be 120 vac unless indicated otherwise.
a. Starters shall be full-voltage non-reversing unless shown or indicated otherwise on the Drawings.

8. Overload Relays: Provide an overload relay for each motor starter. Overload relays shall be in accordance with the following:
   a. Electronic Overload Relays: Relays shall be electronic type. Electronic relays shall be multi-function, adjustable, current sensing, type, and include overload, phase-unbalance, phase-loss, and equipment type ground fault in one package.
   b. Each overload relay shall be manual reset type and shall include provisions for resetting by an insulating button on front of starter unit door.
   c. Each overload relay shall include a normally-open auxiliary contact for remote alarm purposes.
   d. Size each overload relay for full-load amperes and service factor of actual motors installed.

9. Individual control power transformers for all starters, capacity as required for all control circuit devices, 100 VA minimum, Class A insulation, two primary fuses, 120-volt secondary, one secondary fuse, and the other secondary leg grounded.

10. Separate Control: Where control power to starter is from a separate power source, provide control power fuse in unit and equip main disconnect with normally-open contact to isolate control circuit from source when controller disconnect is open.

11. Motor horsepower shown are preliminary. Circuit breaker trips and starter overload heaters to be coordinated with the actual equipment installed.

12. Auxiliary contacts for motor space heaters, remote signal status signals, and interlocks, relays, timers as required for specified control functions and those shown on Drawings.

13. Control and Indicating Devices
   a. Type: 30.5 mm industrial, heavy duty, oil-tight construction with clearly-marked legend plates.
   b. Emergency Stop or Lockout Stop: Lockout stop pushbuttons shall be two-position, push-pull type with maintained contact and mushroom head. Provide control stations with padlocking attachment and legend plate reading “PUSH-TO-STOP, PULL-TO-START”.
   c. Pushbuttons: Momentary or maintained types, NEMA A600 contact rating.
   d. Selector Switches: Rotary type with round or oval handles and positioning device to securely hold switch in selected position for maintained type and for spring return from left, right, or both left and right to maintained position.
   e. Indicating Lights: LED Type, 120 VAC, push-to-test. Lens color shall be in accordance with Section 26 00 05 – Electrical Work.
f. Identification: Devices shall include front-mounted nameplates identifying function and equipment controlled, if not readily apparent.

14. Current Sensing Devices:
   a. Current Switch:
      1) Produces a dry contact output when load current exceeds set point.
      2) Suitable for use measuring current on motor leads of 480-volt, 60 Hertz., up to 100-amp continuous.
      3) Variable trip point and time delay. Trip point settable via calibrated dial.
      4) Monitors currents from 10 mA to 100 AC Amps
      5) Output relay (Form C) rated up to 20 amps
      6) LED trip status indicator
      7) Dead band prevents relay chatter
      8) Contact Material: Silver-cadmium oxide
      9) Mechanical Life: 10 million operations, typical at rated load
      10) Electrical Life: 100,000 operations, typical at rated load
   b. Current Transducer:
      1) Produces four to 20 mA DC output current proportional to the input average RMS AC motor load current.
      2) Loop powered

15. Starter devices, including spare contacts, shall be wired to numbered terminal blocks.

16. Terminal blocks for field connections to unit compartments shall be plug-in/pull-apart type. Terminals shall be fully accessible from the front. Terminals shall be mounted near the front of vertical wireway.

17. Control devices shall be 600-volt heavy duty, NEMA A600. Relays shall have convertible contacts. Pilot devices shall be oiltight. Pilot lights shall be transformer type with six-volt secondary.

18. Feeder Circuit Breakers: Thermal magnetic type.
   a. Circuit breakers of 100 amp frame or less shall be mounted in a dual mount compartment (two breakers in one space factor) or shall mount in one-half space factor, unless otherwise shown or indicated on the Drawings.


20. Provide the following diagrams and tables inside of door for each compartment:
   a. Elementary wiring diagram.
   b. Table of overload heater sizes with correct heater highlighted.
   c. Table of motor circuit protector settings with correct setting highlighted.

21. Main Circuit Breakers: Thermal magnetic, molded case type, unless shown or indicated otherwise. Main circuit breakers shall be 100 percent amperage rated. Circuit breakers with frame ratings 800 amps and greater shall be electronic type with adjustable parameters and ground fault protection.
2.3 MAIN METERING DEVICE

A. Provide a main meter device as shown or indicated on the Drawings.
   1. Microprocessor based monitoring device shall include complete electrical metering in one package. Device shall include self-contained potential transformers and self-protected internal fuses.
   2. Device shall be mounted on compartment door to allow operations and maintenance personnel access to meter menu and display.
   3. Device shall include trend analysis, event logging, and recording. Device shall also include the following direct-reading metered values:
      a. Volts: 0.2 percent accuracy.
      b. Amperes: 0.2 percent accuracy.
      c. Watts, Vars and VA: 0.5 percent accuracy.
      d. Power Factor: 1.0 percent accuracy.
      e. Frequency: 0.05 percent accuracy.
      f. Watt, and VA Hours: 0.5 percent accuracy.
      g. Var Hours: 1.0 percent accuracy.
      h. Watt, Var and VA Demand: 0.4 percent accuracy.
      i. THD-Voltage: 50th harmonic.
      j. THD-Current: 50th harmonic.
      k. Individual Ampere Harmonics: 50th harmonic.
      l. Individual Voltage Harmonics: 50th harmonic.
   4. Metering device shall have the following additional features:
      a. Trend analysis that displays minimum and maximum values for each metered parameter with date and time of each occurrence.
      b. Input range of device shall accommodate external current transformers with ranges from 100/5 to 5000/5 and potential transformers from a ratio of 120:120 to 500,000:120. Three current transformers suitably rated shall be included.
      c. Historical log/event memory triggered by complex conditions.
      d. Alarm contacts rated five amps at 120 VAC.
      e. Three analog outputs programmable to reflect the metered parameters, except kilowatt hours and kilovar hours.
   5. Control power shall be drawn from monitored incoming AC line. Device shall have non-volatile memory and not require battery backup. During power failure, device shall retain preset parameters.

2.4 SURGE PROTECTIVE DEVICES

A. Manufacturers: Provide equipment of one of the following:
   1. General Electric.
   2. Schneider Electric/Square-D Company.
B. General: Provide a surge protective device for each motor control center bus shown on the Drawings. Surge protective devices shall be included and factory-mounted within the motor control center by motor control center manufacturer. Surge protective device monitoring and display shall be visible from the motor control center front.

1. SPD shall be modular, high-energy, parallel design with fast-acting transient voltage suppression using metal oxide varistors. Equipment shall provide noise attenuation with electromagnetic interference filter.

2. SPD shall comply with requirements of the following:
   a. ANSI/UL 1449.
   b. UL 1283.

3. SPD shall be suitable for operation under the following environmental conditions:
   a. Relative Humidity: Zero to 95 percent, non-condensing.
   b. Frequency: 47 to 63 Hertz.
   c. Temperature: Zero to 149 degrees F.

4. SPD operating voltage and IEEE C62.41 and IEEE C62.45 Category A, B, and C application environments shall be suitable for the associated SPD location(s) shown or indicated on the Drawings.

5. SPD shall be suitable for internal and external mounting. Where shown on the Drawings, SPD shall be factory-mounted and integrated into distribution equipment.

C. SPD shall include a surge suppression path for each mode as required for the system configuration shown on the Drawings. Each mode shall be individually fused and equipped with thermal cutouts. SPD short-circuit rating shall be 200 kA. Protection modes shall include, to the extent applicable, the following:

   1. Line-to-line.
   2. Line-to-neutral.
   3. Line-to-ground.

D. SPD shall include electromagnetic interference/radio frequency interference (EMI/RFI) noise rejection filter with attenuation up to 30 dB from 10 kHz to 100 MHz.

E. SPDs and components in the operating path shall have maximum continuous operating voltage greater than 115 percent of nominal system operating voltage.

F. ANSI/UL 1449 minimum withstand rating shall be 20 kA per pole, and ANSI/UL 1449 voltage protection rating for SPD shall not exceed the following:
Modes | 208Y/120 | 480Y/277  
---|---|---
L-N, L-G, N-G | 800 | 1200  
L-L | 1200 | 2000  

G. SPD surge capacity based upon IEEE C62.41 location category shall, as a minimum, be the following:

<table>
<thead>
<tr>
<th>Category</th>
<th>Application</th>
<th>Per Phase</th>
<th>Per Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Service entrance</td>
<td>240 kA</td>
<td>120 kA</td>
</tr>
<tr>
<td>B</td>
<td>High exposure locations (distribution equipment)</td>
<td>160 kA</td>
<td>80 kA</td>
</tr>
<tr>
<td>A</td>
<td>Branch locations</td>
<td>120 kA</td>
<td>60 kA</td>
</tr>
</tbody>
</table>

H. Provide SPD equipped with the following accessories:
1. Surge counter with display for indicating the number of surges detected.
2. LED indicators for monitoring device status.
3. Audible alarm and silence switch for indicating an inoperative condition.
4. Dry contacts, “Form C”, for remote annunciation of unit status.
5. Indicators, counter, alarm, and silence switch shall be visible and accessible from front of the SPD. When SPD is integral to switchgear, motor control center, panelboard, or other equipment, indicators, counter, alarm, and silence switch shall be visible and accessible from front of the equipment in which the SPD is installed.

2.5 DRY-TYPE LOW VOLTAGE TRANSFORMER

A. Dry Type Two-Winding Transformer:
1. Type: Dry type, air cooled, low temperature rise. Transformers 15 kVA and larger shall be energy efficient, complying with NEMA TP-1 Class 1 efficiency levels. Transformers less than 15 kVA shall be general purpose.
2. Rating: KVA, primary voltage and connection, secondary voltage and connection, frequency and number of phases shall be as shown on the Drawings.
3. Insulation: Insulation and average winding temperature rise (in a 40 degree C maximum ambient) for rated kVA per the following table. Energy efficient transformers shall be capable of 15 percent continuous overload at 150 degrees C temperature rise.

<table>
<thead>
<tr>
<th>kVA Rating</th>
<th>Insulation Class (degrees C)</th>
<th>Temperature Rise (degrees C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 15 kVA</td>
<td>185</td>
<td>115</td>
</tr>
<tr>
<td>25 to 500 kVA</td>
<td>220</td>
<td>115</td>
</tr>
</tbody>
</table>
4. Winding Taps, Transformers 15 kVA and Less: Two 5-percent below rated voltage, full capacity taps on primary winding.
5. Winding Taps, Transformers 25 kVA and Larger: Two 2-1/2-percent above rated voltage and four 2-1/2+ percent below rated voltage, full capacity taps on primary.
6. Basic impulse level shall be 10 kV.
7. Sound Level: NEMA ST-20 standard.
8. Enclosure: UL listed for the application.
9. Identification: Identify transformers in accordance with below Section 2.12, with the transformer number and voltages, connection data, kVA ratings, impedance, and overload capacity.
10. Transformers shall comply with NEMA ST-20, NEMA TP-1, NEMA TP-2, and UL 1561.
11. Transformers shall bear the label of the Underwriters’ Laboratories, Inc.

B. Manufacturers: Provide products of one of the following:
1. Square D Company.
2. General Electric Company.

2.6 PANELBOARDS

1. Manufacturers: Provide products of one of the following:
   a. Schneider Electric/Square D Company.
   c. General Electric Company.
2. Rating: Voltage rating, current rating, number of phases, number of wires and number of poles as shown or indicated on the Drawings.
3. Circuit Breakers: Molded case, bolt-in thermal magnetic type with number of poles and trip ratings as shown or indicated. Where indicated on the Drawings, circuit breakers shall be ground fault circuit interrupting type equipped with solid state sensing and five-milliamp sensitivity.
4. Circuit breakers for 480-volt panelboards shall have minimum interrupting rating of 14,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings. Circuit breakers for other panelboards shall have minimum interrupting rating of 10,000 ampere RMS symmetrical, unless otherwise indicated on the Drawings.
5. Bus Bars: Bus bars shall be 98 percent conductivity copper. Four-wire panelboards shall have solid neutral bar. Each panel shall have ground bus bar.
6. Main: Panelboards shall have main circuit breaker, unless the Drawings specifically indicate main lugs only.
7. Connect branch circuit breakers for sequence phasing.
8. Directory: Typed or computer-printed card, with transparent protective cover in frame on back of door giving circuit numbers and area or equipment served.
9. Identification: Identify panelboards in accordance with below section 2.12. Identification shall indicate panel number and voltage.
10. Directory of Existing Panelboards: When adding or removing breakers or loads from existing panelboards, provide a new typed or computer-generated directory card, indicating the circuit numbers and equipment served.

2.7 SOURCE QUALITY CONTROL

A. Prior to shipping, perform factory tests on motor control centers. Tests shall include manufacturer’s standard tests and the following:
   1. Physical inspection and checking of components.
   2. Mechanical operation and device functionality tests.
   3. Primary, control, and secondary wiring hi-pot tests.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install materials and equipment at locations shown or indicated on the Drawings. Install equipment on concrete bases in accordance with the Contract Documents and manufacturer’s recommendations and instructions.

B. For installations against masonry walls, provide an insulation board, 1/4-inch minimum thickness, between motor control center and wall for corrosion protection. Trim board neatly within outline of motor control center.

C. Openings in top or side of motor control centers for other than conduit entrance are not allowed.

D. Bundle cable circuits together within enclosures and identify with durable tag secured to cabling twine.

E. Set motor circuit protectors at lowest setting that allows motor starting without nuisance tipping.

F. Verify that wiring diagrams on inside of door of each compartment reflect the circuitry actually provided and that correct overload heater size and motor circuit protector setting are noted.
G. Install in conformance with manufacturer’s recommendations, Laws and Regulations, and the Contract Documents.

3.3 FIELD QUALITY CONTROL

A. Site Tests:
   1. Perform field testing and inspection of motor control centers. Inspect and test each motor control center after installation. Testing and inspection shall be in accordance with the manufacturer's recommendations and the Contract Documents, and be performed by manufacturer's factory-trained representative, Inform OWNER and ENGINEER when equipment is correctly installed, prior to testing. Do not energize equipment without permission of OWNER.
   2. Test Equipment, Calibration and Reporting: All test equipment, instrument calibration and test reports shall be in accordance with ANSI/NETA ATS.
   3. Perform the following minimum tests and checks before energizing equipment:
      a. Verify all overload and device settings.
      b. Inspect mechanical and electrical interlocks and controls for proper operation.
      c. Check tightness of bolted connections.
      d. Measure insulation resistance of each bus section, phase-to-phase and phase-to-ground.
      e. Measure insulation resistance of each starter, phase-to-phase and phase-to-ground.
      f. Measure insulation resistance of each control circuit with respect to ground.
      g. Perform other tests recommended by equipment manufacturer.

B. Manufacturer’s Services: Provide a qualified, factory trained serviceman to perform the following:
   1. Supervise unloading and installation of equipment.
   2. Instruct CONTRACTOR in installing equipment.
   3. Inspect, test, and adjust equipment after installation and ensure proper operation.
   4. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
   5. Manufacturer’s technician shall make visits to the Site as follows:
      a. First visit shall be for supervising unloading and handling of equipment and for instructing CONTRACTOR in proper equipment installation, and assisting in installing equipment. Technician shall train installing personnel in advance in proper handling and rigging of equipment. Minimum number of hours on-Site: 8 hours.
      b. Second visit shall be for checking completed installation, start-up of system; and performing field quality control testing. Technician shall test the system as specified in Article 3.3.A of this Section. Technician shall
operate and test the system in the presence of ENGINEER and verify that equipment complies with the Contract Documents and manufacturer’s requirements. Technician shall adjust the system to initial settings as specified in Article 3.4 of this Section. Minimum number of hours on-Site: 4 hours.

c. Third visit shall be to instruct operations and maintenance personnel.
   1) Furnish services of manufacturer’s qualified, factory-trained specialists to instruct OWNER’s operations and maintenance personnel in recommended operation and maintenance of equipment.
   2) Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.
   3) Number of hours on-Site shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

d. Technician shall revisit the Site as often as necessary until installation is acceptable.

e. Furnish services of manufacturer’s factory-trained service technicians to correct defective Work within 72 hours of notification by OWNER during the correction period.

6. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.4 ADJUSTING

A. Calibrate, set, and program all protective devices. Coordinate protective devices furnished under this Section and provide proper settings of devices in accordance with the study performed under Section 26 05 73, Electrical Power Distribution System Studies.

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. Provide all labor, materials, equipment, and incidentals as shown specified and required to furnish and install 480-volt standby power generator system with 309 gallon double wall steel sub-base tank, aluminum enclosure 87dB @ 7 meters, automatic transfer switch and appurtenances for complete and operational system. Generator capable of standby and prime rating function.
2. The following generator system(s) are included in this Section:
   a. Standby Rating: 100 KW, 125 KVA, Prime Rating: 90KW, 113KVA, 0.8 power factor, 480 volts, 3-phase, 3 wires, outdoor, non-walk-in, weather protective aluminum enclosure, engine generator, located where shown in the drawings.
3. Provide automatic transfer switch as shown in the drawings and as specified in the following Section:
   a. 26 36 23 – Automatic Transfer Switches

B. Coordination:
1. Review installation procedures under other Sections and coordinate installation of items that must be installed with or before engine generator Work.

C. Related Sections:
1. Section 05 05 33, Anchor Systems.

1.2 REFERENCES

A. Standards referenced in this section are:
3. NEMA MG-1, Motors and Generators.
5. NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
6. NFPA 70E, Electrical Safety in the Workplace.
8. UL 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
10. UL 2200, Standard for Safety Stationary Engine Generator Assemblies (rated 600 volts or less)

1.3 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer:
   a. Shall have minimum of five years of experience of producing substantially similar equipment to that specified and shall document at least five installations in satisfactory operation for at least five years.
   b. Shall possess valid ISO 9001 certification.
   c. Supplier shall have complete parts and service facilities, factory-trained service staff available for 24-hour emergency service, and be authorized to administer the warranty for all components of engine generator systems.

B. Component Supply and Compatibility:
1. Obtain all equipment included in this Section regardless of component manufacturer from a single generator set manufacturer. Materials, equipment, and parts shall be new, of current production of a firm that manufactures the generator set as a matched system. Manufacturer shall have full responsibility for engine generator performance. Generator set manufacturer shall prepare or approve all Shop Drawings and other submittals for all components furnished under this Section.
2. Engine generator shall be factory-assembled and factory tested. Verify in the factory that system is free from electrical and mechanical defects and conforms to the Contract Documents.

C. Regulatory Requirements: Comply with applicable provisions of authorities having jurisdiction, including the following:
2. Local Ordinances: Systems shall conform to Laws and Regulations relative to noise control and emissions.
3. Local and State Building Codes: Installations shall conform to applicable codes including requirements of local fire marshals.
4. Permits: Obtain and pay for required permits, fees, and inspections by authorities having jurisdiction

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
   a. Installation drawings specific to the Project.
b. Bill of material for all equipment and spare parts.
c. Electrical wiring and interconnection diagrams with all external connections identified.
d. Control panel data shall include:
   1) Description of control features.
   2) Operator panel control switches and functions.
   3) Alarm and status displays.
   4) Provisions for remote start signal and remote status and alarm.
   5) Compliance with UL 508.
e. Enclosure data shall include the following:
   1) Plan and elevation drawings showing overall dimensions, interior equipment arrangement, and working spaces.
   2) Construction details and hardware specifications.
   3) Exhaust piping and silencer mounting arrangement.
   4) Sound attenuation provisions and decibel levels.
f. Fuel storage system data shall include:
   1) Belly tank arrangements.
   2) Storage capacity and hours of operation at rated load and 3/4 load.
   3) Alarm devices.
   4) Construction details including secondary containment provisions for fuel tank.
   5) Piping arrangements and details.
   6) Compliance with UL 142 and local codes.
g. Provide the following relative to installation:
   1) Vibration isolators and anchor bolt requirements.
   2) Seismic restraint requirements.
   3) Provisions for fuel piping, electrical conduits, and other external connection requirements.

2. Product Data:
   a. Manufacturer’s literature, specifications, engineering data sheets, and standard drawings, necessary to fully describe the engine generator sets and appurtenances, and substantiate compliance with the Contract Documents. Information shall be annotated to clearly indicate ratings, features, and options specific to the Project.
   b. Generator data shall include:
      1) Listed to UL 2200.
      2) Heat rejection to room
      3) Combustion air requirements.
      4) Factory painting specifications.
   c. Engine data shall include:
      1) Fuel flow at rated load.
      2) Fuel consumption at 1/4, 1/2, 3/4, and full load.
      3) Engine Type: Naturally aspirated or turbocharged and after-cooled.
      4) Maximum exhaust backpressure.
      5) Silencer attenuation rating.
6) Jacket water heater system.
7) Gaseous emissions data measurements for hydrocarbons, carbon monoxide, particulate matter, and NOx conforming to 40 CFR 89, Subpart D.
d. Alternator data shall include:
   1) Winding insulation class and temperature rise in accordance with NEMA MG-1-1.65
   2) Standby and continuous KW/KVA ratings.
   3) Motor starting KVA at 90 percent sustained voltage.
   4) Surge KW capacity.
   5) Machine reactances and time constants.
e. Starting system data shall include:
   1) Battery system.
   2) Battery charger.
   3) Cycle cranking configuration.

3. Testing Procedures:
a. Source Quality Control Testing Procedures: For Units 501 kW and larger, provide factory testing procedures and dates at least thirty days prior to testing.
b. Site Quality Control Testing Procedures: Testing procedures, provided at least thirty days prior to scheduled start of testing.

B. Informational Submittals: Submit the following:
   1. Manufacturer’s Instructions:
      a. Manufacturer’s unloading, rigging, installing, testing, and startup instructions. Information shall be specific to and indicate options for the Project
   2. Source Quality Control Submittals:
      a. For Units 500 kW and Smaller: Prototype testing certification.
      b. For Units 501 kW and Larger: Provide factory testing results within seven days of completing factory test.
   3. Site Quality Control Submittals:
      a. Services to be performed by Supplier’s representative, provided at least thirty days prior to start of Site testing.
      b. Report on results of testing at the Site, provided within seven days of completion of testing.
   4. Manufacturer Reports: Reports of visits to Site by Supplier’s representative, including purpose of visit, problems encountered, and resolutions.
   5. Qualifications Statements:
      a. Manufacturer: When requested by ENGINEER, submit data documenting compliance with qualifications requirements of the Contract Documents.
C. Closeout Submittals:
   1. Operation and Maintenance Manuals: Provide in accordance with Section 01 78 23, Operations and Maintenance Data. Include the following information:
      b. Performance Parameters: Provide nominal values and acceptable limits for output voltage, frequency, load, engine temperature, and oil pressure. Include circuit drawings with component identifications for reference.
      c. Maintenance Instructions: Procedures for daily, weekly, monthly, and annual basis, or on an hours-run basis. Include guidance for selecting fuel oil, lubricating oil, use of water treatment additives, and anti-freeze.
   2. Warranty Documentation.

D. Maintenance Materials:
   1. Provide the following spare parts for each generator set:
      a. Two sets of primary and secondary fuel filters.
      b. One set of air filters.
      c. Two control circuit fuses of each size used.
      d. Two sets of lube oil filters.
      e. One set of fan belts.

1.5 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents. Obligations of CONTRACTOR under the Contract Documents shall not be limited by provisions of the specified special warranty.

B. Special Warranty:
   1. Provide manufacturer’s written warranty, running to the benefit of OWNER, agreeing to correct or, at option of OWNER remove or replace materials or equipment specified in this Section found to be defective during a period of five years after date of Substantial Completion or 3,000 hours of operation.
   2. Products supplied under this Section shall be covered by a single warranty for the coverage period. Warranty shall provide for free replacement or repair of parts for five years or 3,000 hours of operation, and free labor for the first two years.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

Suwannee County WTP
Engine Generators
40039002.0000

26 32 13-5
1. Cover all generator air and exhaust openings with vapor inhibiting and water repellent material.
2. Deliver anchorage devices that are to be embedded in cast-in-place concrete in ample time to prevent delaying the Work.
3. Inspect equipment for shipping damage or loose parts upon delivery. Check for evidence of water that may have entered equipment during transit.
4. Notify ENGINEER of loss or damage to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

B. Handle equipment in accordance with manufacturer’s instructions. Furnish at least one copy of instructions with equipment at time of shipment.

C. Storage:
   1. Store equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
   2. Store materials for easy access for inspection and identification. Keep all materials off the ground, using pallets, platforms or other supports. Protect equipment from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Quantity and ratings of the systems shall be as indicated in Paragraph 1.1.A.2 of this Section.

B. Generators shall be rated for standby operation for duration of normal utility outage as defined by ISO 8528 for limited time operation. Generators shall be capable of operating for up to 500 hours per year, of which maximum of 300 hours is continuous running, and no overload is allowed.

C. Generator assemblies shall be UL 2200-listed, control panels shall be UL 508-listed and above-ground fuel tanks shall be UL 142-listed.

D. Generators shall be rated for the specified KW, without overload, at the following Site conditions:
   1. Maximum Ambient Temperature: 40 degrees C.
   2. Altitude: 500 feet above mean sea level.

2.2 MANUFACTURERS

A. Provide generator systems of one of the following:

Suwannee County WTP
Engine Generators
40039002.0000  26 32 13-6
1. Cummins/ONAN
2. Caterpillar
3. Kohler
4. No equal.

2.3 ENGINE

A. Engine Type: Four-cycle compression ignition, water cooled diesel 1800 RPM. Two-cycle engines are not acceptable.

B. Engine Construction:
   1. Steel-backed bearings.
   2. Crank Case: Reinforced cast iron.
   3. Crank Shaft: Forged alloy steel with hardened journals, finished and dynamically balanced.
   4. Cylinder Head: Cast iron.
   5. Pistons: Aluminum alloy with chrome faced rings.
   6. Replaceable cylinder liners and valve seat inserts for engines rated over 200 horsepower.
   7. Single-block construction. Bolted, multiple blocks are not acceptable.

C. Cooling System:
   1. Radiator: Engine-mounted with engine-driven blower fan capable of cooling the engine under full load conditions in an ambient temperature of 104 degrees F without de-rating.
   2. Thermostatic valve in jacket water outlet between radiator and engine to maintain proper jacket water temperature. Engine-driven pump to circulate water through cooling system.
   3. Coolant: Fill system with 50 percent solution of ethylene glycol.
   4. Coolant water temperature gauge.
   5. High engine temperature shutdown.
   7. Fan guard.
   8. Radiator face duct connection.
   9. Engine coolant heaters, thermostatically controlled, capable of keeping jacket water at temperature not less than 90 degrees F in compliance with NFPA 110. Coolant heaters shall operate at 240 volts, single phase. House contactor for controlling heater in NEMA 4X stainless steel enclosure mounted on unit.

D. Lubrication System: Positive displacement, mechanical, full pressure lube pump, full flow and bypass lubrication filters with replaceable spin-on canister elements, oil drain line with valves and dipstick oil level indicator.
E. Fuel System: Suitable for operation on No. 2 diesel fuel oil. System to include primary and secondary fuel filters, fuel/water separator, fuel priming pump, flexible fuel lines and fuel pressure gauge.

F. Governor: Electronic system to provide automatic isochronous frequency regulation. System dynamic capabilities to be controlled as function of engine temperature for fast stable operation at varying engine operating conditions. System to actively control fuel rate and excitation. Fuel rate to be regulated as function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.

G. Fuel Oil Sub-base Tank
   2. Comply with the following:
      a. UL142-listed and labeled.
      b. NFPA 30, NFPA 37, and NFPA 110.
      c. Codes for FDEP generator fuel tanks.
   3. Fittings: NPT for fuel supply and return; two-inch diameter NPT for normal vent, manual fill and level alarm; NPT for emergency vents, level gauge, basin drain, and leak detection alarm.
   4. Fuel level gauge and leak detector switch with alarm lights and contacts for remote annunciation of low fuel level and leak detection.
   5. Mushroom-type cap and screen for normal vent openings and pressure relief-type caps for emergency vent openings.
   6. Manufacturers: Provide sub-base tank of one of the following:
      a. Pryco, Inc.
      b. Tramont Corp.
      c. Or equal.

H. Air Supply/Exhaust Systems:
   1. Critical grade silencer
   2. Heavy duty air cleaner with service (air restriction) indicator.
   3. Aluminized steel exhaust.

I. Air Emissions:
   1. Comply with United States Environmental Protection Agency (USEPA) standards for non-road engines and with state and local requirements.
   2. Submit emissions data measurements for hydrocarbons (HC), carbon monoxide (CO), particulate matter (PM) and oxides of nitrogen (NOx) conforming to USEPA test procedures. Include USEPA not-to-exceed requirements for each pollutant.
J. Starting System: DC system complete with engine mounted batteries, locally mounted charger and connecting cables between batteries and engine and between charger and batteries.
   1. Batteries: Lead-acid or calcium/lead antimony, engine cranking type, rated in accordance with engine manufacturer’s requirements for minimum of three 15-second cranking cycles at firing speeds without recharging, and to accommodate DC power requirements of control panel and other accessories requiring DC power.
   2. Battery racks, cables, connectors, and disconnect switch.
   3. Engine-mounted battery charging alternator and solid state voltage regulator.
   4. Battery Charger:
      a. UL-listed, voltage regulated and equipped with float, taper and equalize charge settings.
      b. Analog DC ammeter and voltmeter; 12-hour equalize timer; AC and DC fuses.
      c. Loss of AC power, low battery voltage and high battery voltage alarm lights and contacts for remote annunciation; power on light.

2.4 ALTERNATOR

A. Construction: Synchronous generator, four-pole, 2/3 pitch, revolving field, self ventilated, drip-proof construction, single bearing, dynamically balanced rotor with amortisseur windings to minimize voltage deviations and heating effects under unbalanced load conditions. Rotor directly connected to engine flywheel housing to ensure permanent alignment.

B. Winding Insulation Systems: Class H in accordance with NEMA MG-1. Temperature rise not to exceed 125 degrees C over 40 degrees C ambient at rated load. Epoxy coating for fungus resistance and abrasion protection.

C. Excitation System: Brushless construction. Excitation support system, permanent magnet type, to sustain 300 percent rated current for up to 10 seconds under short circuit conditions. Provide surge suppressors to protect against voltage spikes.

D. Voltage Regulator: Automatic solid state system to maintain generator output voltage within plus or minus 0.5 percent from no load to full load. Control voltage buildup, provide volts per Hertz regulation, protect from over-excitation, limit voltage overshoot on startup, and be environmentally sealed.

E. Provide anti-condensation heater to maintain temperature approximately five degrees Fahrenheit above ambient when generator is idle.
2.5 CONTROL PANEL

A. Controls shall be in accordance with NFPA 110, Level 1, and control panel shall conform to the following:
   1. Install control panel on vibration isolators with controls, instruments, lights, and devices necessary to manually and automatically start, stop, monitor, and protect the generator.
   2. Controls shall be UL 508-listed and microprocessor-based with programmable adjustments. Control power from starting battery system. Panel shall include the following:
      a. Emergency stop pushbutton.
      b. Adjustable cycle cranking.
      c. KW, KVA, KVAR, and power factor meters.
      d. Engine coolant temperature readout.
      e. Engine oil pressure readout.
      f. Running time readout.
      g. RPM meter.
      h. Cool down timer.
   3. Readouts and dry contact outputs shall be provided as required by NFPA 110, Level 1.
   4. Provide readouts and output dry contacts for remote monitoring and control for the following:
      a. Generator running
      b. Generator common warning alarm.
      c. Generator common shutdown alarm.
      d. Low main tank fuel (warning alarm).
      e. Liquid leak in containments areas, including tank, double walled piping, and other fuel supply components (warning alarm).
   5. Reset Control: Remote restarts are not allowed and alarm lamps shall remain in alarm state until manual reset is accomplished even if alarm condition has been corrected.
   6. Provide control panel anti-condensation space heater.

2.6 CIRCUIT BREAKERS

A. General: Provide main and exciter circuit breakers, sized for protecting the engine-generator.

B. Type: UL-listed, molded case with interchangeable electromechanical trip unit for sizes 225-amp and larger. Provide NEMA 1 enclosed units and mount on engine generator.

2.7 ENCLOSURE

A. Provide engine-generator system with outdoor, aluminum weatherproof enclosure
where indicated in Paragraph 1.1.A.2 of this Section.

B. Non-walk-in enclosure shall be constructed of minimum 14-gauge, reinforced sheet steel and shall attach directly to engine-generator base or sub-base fuel tank. Enclosure shall be factory assembled structure with key-lockable access doors for performing normal maintenance operations. Hardware and fasteners shall be stainless steel. Lube oil and coolant drains shall be extended to exterior of enclosure and terminated with drain valves, capped with pipe nipples on flanged connections.

2.8 ACCESSORIES

A. Engine Generator Mounting:
   1. Vibration Isolators: Steel springs in combination with rubber pads.
   2. Vibration Isolation: Provide flexible connections between engine-generator set and fuel lines, exhaust system, electrical conduits, and other externally connected support systems.
   3. Anchor Bolts: Type 316 stainless steel, conforming to Section 05 05 33, Anchor Systems.
   4. Template shall be furnished by manufacturer for setting anchorages devices, pipe sleeves, and nuts for mounting spring-type isolators to concrete foundation. Provide bolts and nuts for bolting isolators to channel frame base of engine-generator set.

2.9 FINISHING

A. Engine generator ferrous metal surfaces shall be prime-coated for corrosion protection and finish-painted in accordance with manufacturer’s standard painting system.

B. Color of finish paint to be selected by ENGINEER from manufacturer’s standard colors.

2.10 SOURCE QUALITY CONTROL

A. Factory Tests
   1. Provide results of tests and evaluations previously performed on prototype generator sets representative of the models to be provided, in accordance with NFPA 110.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine the conditions under which the Work is to be installed and notify
ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install engine generator system in accordance with the Contract Documents, approved Shop Drawings, and manufacturer’s recommendations.

3.3 SITE QUALITY CONTROL

A. Site Testing: Test engine-generator set in accordance with NFPA 110. Provide all materials and equipment, including load banks, fuel, lubricants and material required for Site testing. Completely fill fuel tank at conclusion of testing.

B. Manufacturer’s Services: Provide qualified, factory-trained serviceman to perform the following:
   1. Supervise unloading and installation of equipment.
   2. Instruct CONTRACTOR in the installation of equipment.
   3. Inspect and adjust equipment after installation and ensure that equipment operates properly.
   4. Instruct OWNER’s personnel in operating and maintaining the equipment.
   5. Service representative shall make a minimum of 2 visits, with a minimum of 8 hours at the Site for each visit. First visit shall be for unloading supervision and instruction of CONTRACTOR in installing equipment; second visit shall be for assistance in installation of equipment; third visit shall be for checking completed installation and start-up of system; fourth visit shall be to instruct operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install automatic transfer switches.
   2. Switches specified under this Section shall be provided by the engine generator manufacturer as specified in Section 26 36 13 – Engine Generators.

B. Related Sections:
   1. Section 26 00 00, Electrical Work (Small Scope Project).
   2. Section 26 36 13, Engine Generators.

1.2 REFERENCES

A. Standards referenced in this Section are:
   4. NEMA ICS1 109, Tests and Procedures.
   5. NEMA ICS10, AC Automatic Transfer Switches.
   6. UL 1008, Transfer Switch Equipment.
   7. UL 508, Industrial Control Equipment
   8. UL 61010B-1 (previously UL 3111-1), Electrical Measuring and Test Equipment; Part 1: General Requirements.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. NEC Article 702, Optional Standby Systems.
1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Listing of transfer switches to be provided, including ratings and location of each.
      b. Equipment dimensions, and construction details of enclosures with conduit entry locations.
   2. Product Data:
      a. Manufacturer’s technical information for products proposed, including catalog cut sheets.
   3. Test Procedures:
      a. At least thirty days prior to actual factory and field testing, submit proposed testing procedures, methods and apparatus.

B. Informational Submittals:
   1. Source Quality Control Submittals:
      a. Submit reports of completed factory tests, including test results and procedures used for testing.
   2. Field Quality Control Submittals:
      a. Submit reports of completed field tests, including test results and procedures used for testing.
   3. Supplier Instructions:
      a. Manufacturer’s written instructions for transporting, handling, storing, and installing the products.
   4. Supplier Reports:
      a. Written report of each visit to Site by supplier’s service representative.

C. Closeout Submittals
   1. Operation and Maintenance Data:
      a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, and spare parts information.
      b. Manuals shall include record drawings of control schematics, including point-to-point wiring diagrams.
      c. Furnish operation and maintenance manuals per Section 01 78 23, Operations and Maintenance Data.

D. Maintenance Material Submittals: Furnish the following:
   1. Spare Parts and Extra Stock Materials: Provide as specified in this Section.
1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices to be embedded in cast-in-place concrete in time to prevent delay of the Work.

B. Shipping sections shall be designed to be shipped by truck, rail, and ship. Indoor sections shall be bolted to skids.

C. Equipment shall be equipped to be handled by crane. Where cranes are not available equipment shall be suitable for skidding in place on rollers using jacks to raise and lower the sections.

D. Comply with Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements.

1.6 MAINTENANCE

A. Spare Parts and Extra Stock Materials:

1. Furnish, tag, and box for shipment and long term storage the following spare parts for each switch:

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity per Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Control relay</td>
<td>Two of each type used</td>
</tr>
<tr>
<td>b. Pilot light</td>
<td>Two per ten of each type used</td>
</tr>
<tr>
<td>c. Fuses</td>
<td>Two set of each type and size used</td>
</tr>
</tbody>
</table>

2. Furnish a list of additional recommended spare parts for an operating period of one year. Describe each part, quantity recommended, and current unit price of each.

3. Package spare parts in suitable containers bearing labels clearly indicating contents and equipment with which they are to be used. Deliver spare parts at same time as switchgear.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Provide automatic transfer switches as specified for transferring loads from one power source to another.
2.2 MANUFACTURERS

A. Manufacturers: Provide products of one of the following:
   1. As provided by the engine generator manufacturer

2.3 SWITCH

A. Ratings:
   1. Switches shall be capable of switching all classes of loads and rated for continuous duty when installed in a non-ventilated enclosure.
   2. Switches shall be rated with continuous ampere rating, number of poles and voltage as shown on Drawings.
   3. Switches shall be rated to withstand the magnitude of fault current available without welding of contacts in compliance with ANSI C37.90a and IEEE C62.41.

B. Standards and Performance:
   1. Switches shall comply with UL Standard 1008, NEMA Standard ICS10, and applicable requirements of NEC Article 700, IEEE 446, IEEE C62.41, UL 508, and UL 61010B-1. Switches shall be UL labeled with performance meeting or exceed the following:
      a. Temperature Rise: Measurements shall be made after overload and endurance tests.
      b. Withstand: UL listed to withstand magnitude of fault current available at switch terminals when coordinated with respective protective devices shown on Drawings at an X/R ratio of 6.6 or less. Main contacts shall not trip open or weld when subjected to fault currents.
   1) As a condition for approval, manufacturer of automatic transfer switches shall verify that switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with three-cycle short circuit closing and withstand as follows:

<table>
<thead>
<tr>
<th>RMS Symmetrical Amperes at 480 VAC</th>
<th>3 Cycle Closing &amp; Withstand</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 to 400</td>
<td>42,000</td>
</tr>
<tr>
<td>600 to 800</td>
<td>65,000</td>
</tr>
<tr>
<td>1000 to 1200</td>
<td>85,000</td>
</tr>
<tr>
<td>1600 to 4000</td>
<td>100,000</td>
</tr>
</tbody>
</table>

   2) During three-cycle closing and withstand tests, there shall be no contact welding or damage. Three-cycle tests shall be performed without using current limiting fuses, and oscillograph traces across main contacts shall be furnished to verify that contact separation has not occurred, and there is contact continuity across all phases.
after completion of testing. Test procedures shall be in accordance with UL-1008, and testing shall be certified by UL.

3) When conducting temperature rise tests to UL-1008, Supplier shall include post-endurance temperature rise tests to verify ability of transfer switch to carry full rated current after completing overload and endurance tests.

c. Dielectric: Measurements shall be made at 1960 VAC RMS minimum following the withstand current rating test.

d. Transient Withstand: Control panel shall pass the voltage surge withstand test per IEEE Standard 472 and voltage impulse withstand test per NEMA ICS1 109.

C. Construction:

1. Switch shall be double throw actuated by non-fused, momentarily energized operating mechanism(s).

2. Accomplish mechanical locking of main contacts in each direction without aid of latching solenoids, toggle mechanisms, or gear arrangements.

3. An overload or short-circuit shall not cause switch to go to a neutral position.

4. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

5. Switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

6. Main contacts shall be silver-tungsten composition. Switches shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

7. Inspection of contacts shall be possible from front of switch without disassembly of operating linkages and without disconnecting power conductors. Switches rated 600 amps and higher shall have front-removable and -replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors or bus bars.

8. Transfer switch shall be equipped with a safe manual operator designed to prevent injury to operating personnel. Manual operator shall provide same contact-to-contact transfer speed as electrical operator to prevent a flash-over from switching main contacts slowly. Manual operation shall be safe even if electrical operator becomes energized and shall not require prior disconnection of operators or control wiring. Safe manual transfer shall be possible under all load conditions, energized or non-energized. Manual operator shall be an external type, operable through door of transfer switch enclosure. Operating personnel shall not be required to open transfer switch door to facilitate manual transfer. Manual operator shall be functional at all times, regardless of switch position or status. Manually initiated electrical operation does not meet intent of this requirement. Manual operator is not required on closed transition type switches.
D. Enclosure: Enclosed switches shall be NEMA 12 at minimum.
   1. Standard and optional door-mounted switches and pilot lights shall be 30.5-
   mm industrial grade type or equivalent.

E. Identification: Identify switches per Section 26 00 05, Electrical Work (Small
   Scope Project).

2.4 TRANSFER SWITCHING FEATURES

A. Delay Transition (Open): Provide automatic delayed open transition transfer for
   each switch. Switch shall transfer load in delayed transition (break-before-make)
   mode. Transfer shall be accomplished with a user-defined interruption period in
   both directions adjustable from one second to five minutes in at least 5 second
   increments.

2.5 SEQUENCE OF OPERATION

A. When voltage on any phase of normal source is outside of specified parameters
   and after a programmable time delay period to allow for momentary dips, engine
   starting contacts shall close to start generating supply.

B. Transfer switch shall transfer to emergency source when generating supply has
   reached specified (adjustable) voltage and frequency on all phases.

C. After restoration of normal supply on all phases to within specified (adjustable)
   parameters, an adjustable time delay shall delay retransfer to normal to assure
   stabilization of normal supply. After expiration of the time delay period, transfer
   switch shall retransfer to normal. Should emergency supply source fail during the
   time delay period, switch shall bypass time delay and automatically return to
   normal source. Provide an adjustable time delay between opening of closed
   contacts and closing of open contacts during transfers to allow loads to be
   demagnetized.

D. After retransfer to normal, engine generator shall be allowed to operate at no load
   for a programmable period to cool down.

E. Should transfer to emergency source be initiated by test switch rather than an
   actual source failure, transfer from normal to emergency shall be as described
   above.

2.6 MICROPROCESSOR CONTROLLER

A. Each switch shall include a microprocessor controller for operation of the switch.
   Equip controller with the following:
1. Provide controller’s sensing and logic by a built-in microprocessor with ability to communicate serially through an optional serial communication module.

2. Controller shall provide a minimum of five selectable nominal voltages. Voltage sensing shall be true RMS type and be accurate to plus/minus one percent of nominal voltage. Frequency sensing shall be accurate to plus/minus 0.2 percent. Controller shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

3. Connect controller to transfer switch by an interconnecting wiring harness that shall include a keyed disconnect plug to enable controller to be disconnected from transfer switch for routine maintenance. Interfacing relays shall be industrial grade plug-in type with dust covers. Enclose controller with a protective cover. Mount controller internally but separately from transfer switch.

4. Customer connections shall be wired to a common terminal block.

B. Controller Display and Keypad:
   1. Display and keypad shall be an integral part of controller for viewing available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through serial communications input port. The following parameters shall be adjustable:
      a. Nominal line voltage and frequency
      b. Single- or three-phase sensing
      c. Operating parameter protection
      d. Transfer operating mode configuration: Open transition, closed transition or delayed transition
   2. Instructions and controller settings shall be easily accessible, readable, and accomplished without using codes, calculations, or instruction manuals.

C. Controller Voltage, Frequency and Phase Rotation Sensing:
   1. Voltage and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities values shown as a percent nominal unless otherwise specified:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sources</th>
<th>Dropout/Trip</th>
<th>Pickup/Reset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under-voltage</td>
<td>Normal and Emergency, three-phase</td>
<td>70 to 98%</td>
<td>85 to 100%</td>
</tr>
<tr>
<td>Over-voltage</td>
<td>Normal and Emergency, three-phase</td>
<td>102 to 115%</td>
<td>2% below trip</td>
</tr>
<tr>
<td>Under-frequency</td>
<td>Normal and Emergency, three-phase</td>
<td>85 to 98%</td>
<td>90 to 100%</td>
</tr>
<tr>
<td>Over-frequency</td>
<td>Normal and Emergency</td>
<td>102 to 110%</td>
<td>2% below trip</td>
</tr>
<tr>
<td>Voltage Unbalance</td>
<td>Normal and Emergency</td>
<td>5 to 20%</td>
<td>1% below dropout</td>
</tr>
</tbody>
</table>
2. Repetitive accuracy of all settings shall be within plus/minus 0.5 percent over an operating temperature range of -20 degrees C to +60 degrees C.
3. Voltage and frequency settings shall be field adjustable in one percent increments, either locally with the display and keypad or remotely via serial communications port access.
4. When activated by keypad or through serial port, controller shall be capable of sensing phase rotation of both normal and emergency sources. Source will be unacceptable if phase rotation is not preferred rotation selected (ABC or CBA).
5. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all three phases, frequency, and phase rotation.

D. Controller Time Delays:
1. Provide controller with time delays below. Time delay settings shall be adjustable over a range of zero to 9999 seconds (factory set at three seconds) unless specified otherwise.
   a. Normal source failure, for engine starting.
   b. Transfer to emergency on availability of emergency source.
   c. Emergency source failure, retransfer on availability of normal source.
   d. Engine cool down following retransfer to normal.
   e. Time delay to control contact transition time during open transition transfer to either source.
   f. All timers can be bypassed via operation on processor’s keypad.
2. Provide adjustable time-delay on retransfer to normal. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.
3. Time delay and sensing functions shall be field adjustable and operate with drift that does not exceed plus/minus one percent of set frequency, plus/minus two percent of set voltage, and plus/minus ten percent of set time delay, over the temperature range of -20 degrees C to +70 degrees C.
4. Time delays shall be adjustable in one-second increments, except extended parallel time, that shall be adjustable in 0.01-second increments.
5. Time delays shall be adjustable by using display and keypad or with a remote device connected to serial communications port. Time delay value displayed shall be time remaining until next event occurs.
6. For (open) delay transition transfer switches controller shall include the following built-in time delays for delayed transition operation:
   a. Zero to five-minute time delay for load disconnect position for delayed transition operation.

2.7 ACCESSORY FEATURES:

A. Provide each switch with the following:
1. A two-position maintained-type test switch for test/automatic/modes. Test position shall simulate a normal source failure.

2. A SPDT silver-tungsten contact, rated five amps at 30 VDC, for a low-voltage engine start signal. Start signal shall prevent dry cranking of engine by requiring generator set to reach proper output and run for duration of cool down setting regardless of whether normal source restores before load is transferred.

3. Auxiliary contacts, rated ten amps at 250 VAC, consisting of the following:
   a. (1) NO/NC for switch is connected to normal source
   b. (1) NO/NC for switch is connected to emergency source
   c. (1) NO/NC for Utility Source available
   d. (1) NO/NC for Emergency Source Available

4. LED indicating lights (30.5 mm, industrial heavy duty, oil-tight, NEMA rated to match automatic transfer switch enclosure). One shall indicate when switch is connected to normal source (green) and one to indicate when the switch is connected to emergency source (red).

5. LED indicating lights (30.5 mm, industrial heavy duty, oil-tight, NEMA rated to match automatic transfer switch enclosure), energized by controller outputs. Lights shall provide true source availability of normal and emergency sources as determined by voltage sensing trip and reset settings for each source.

6. Provide the following built-in to controller, capable of being activated through keypad programming or serial port only when required by user:
   a. Provide ability to select “commit/no commit to transfer” to determine whether load should be transferred to standby generator if normal source restores before generator is ready to accept load.
   b. Provide terminals for a remote contact that opens to signal switch to transfer to emergency, and for remote contacts that open to inhibit transfer to emergency or retransfer to normal. Provide ability to activate both inhibit signals through keypad or serial port.
   c. Controller shall be capable of accepting a normally open contact that will allow transfer switch to function in a non-automatic mode using an external control device.
   d. Engine Exerciser: Controller shall provide an internal engine exerciser that allows user to program up to seven different exercise routines. For each routine, user shall be able to:
      1) Enable or disable routine.
      2) Enable or disable transfer of load during routine.
      3) Set start time.
      4) Time of day
      5) Day of week
      6) Week of month (first, second, third, fourth, last, alternate, and every)
      7) Set duration of run.
8) At end of specified duration, switch shall transfer load back to normal and run generator for specified cool down period. A ten-year life battery that supplies power to real time clock in event of a power loss shall maintain time and date information.

7. System Status: Controller display shall include a “System Status” screen that shall be readily accessible from all points in the menu by a maximum of two key strokes. System status screen shall display a clear description of active operating sequence and switch position.

8. Self-Diagnostics: Controller shall contain a diagnostic screen for detecting system errors. Screen shall provide information on status input signals to controller that may be preventing completion of load transfer commands.

9. Communications Interface: Controller shall be capable of interfacing, through an optional full-duplex RS 485 serial communication module, with a network of transfer switches, within 4,000 feet (locally) and remotely through modem serial communications. Standard software specific for transfer switch applications shall be available from transfer switch manufacturer. Software shall include monitoring, control, and setup of parameters.

10. Data Logging: Controller shall have ability to log data and to maintain last 99 events, even during total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
   a. Event Logging
      1) Date and time and reason for transfer normal to emergency.
      2) Date and time and reason for transfer emergency to normal.
      3) Date and time emergency source available.
   b. Statistical Data
      1) Total number of transfers.
      2) Last ten numbers of transfers due to source failure.
      3) Total number of hours both normal and emergency sources are available.

11. Terminate control wires with crimp lugs and identify with sleeve type markers. Provide suitable copper connector lugs for each service and load connections.

2.8 SOURCE QUALITY CONTROL

A. Perform manufacturer’s standard factory tests that shall include:
   1. Physical inspection and checking of components.
   2. Mechanical operation and device functional tests.
   3. Control operation and functionality tests.
   4. Primary, control, and secondary wiring hi-pot tests.
PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Install equipment in accordance with Contract Documents and manufacturer recommendations.

C. Securely fasten equipment to floors, walls, or other surfaces on which equipment will be mounted. Install freestanding switches on raised concrete pad at locations shown on Drawings. Install in accordance with manufacturer’s recommendations.

3.3 FIELD QUALITY CONTROL

A. Perform field testing and inspection of each automatic transfer switch. Testing and inspection shall be in accordance with manufacturer’s recommendations and be performed by manufacturer’s factory-trained representative, who shall inform OWNER and ENGINEER when equipment has been correctly installed. Do not energize equipment without permission of OWNER.

3.4 MANUFACTURER SERVICES

A. Manufacturer Services:
   1. Unloading and Installation: Manufacturer’s factory-trained representative shall be present during unloading of equipment and installation at equipment’s final location. In advance of installation, representative shall train installing personnel in proper handling and rigging of equipment, for at least 2 hours at the Site.
   2. Manufacturer’s factory-trained representative shall test the system as specified in Article 3.3 of this Section. Representative shall operate and test system in the presence of ENGINEER and verify that equipment conforms to requirements. These services shall be at least 4 hours day at the Site.
   3. Manufacturer’s factory-trained representative shall adjust the system to initial settings specified in Article 2.6 of this Section.
   4. Representative shall revisit the Site as often as necessary until all deficiencies are corrected, prior to readiness for final payment.
5. Provide services of manufacturer’s factory-trained representatives to correct defective Work within 72 hours of notification by OWNER during the Correction Period specified in the General Conditions as amended by the Supplementary Conditions.

6. Replacement parts or equipment installed during the Correction Period shall be equal to or better than the original.

B. Training: Furnish services of qualified factory trained specialists from manufacturer to instruct OWNER’s operations and maintenance personnel in recommended operation and maintenance of the products. Training requirements, duration of instruction, and other qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

++ END OF SECTION ++
SECTION 31 20 00
EARTH MOVING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment, and
   incidentals required to perform all excavating, filling, and grading, and
   disposing of earth materials as shown, specified, and required for
   construction of structures, Underground Facilities, roads, and other facilities
   required to complete the Work.
2. Preparation of subgrade for slabs and pavements is included under this
   Section.
3. No classification of excavated materials will be made. Excavation includes
   all materials regardless of type, character, composition, moisture, or
   condition thereof.

B. Related Sections:
1. Section 03 00 05, Concrete.

C. General:
1. The CONTRACTOR shall examine the site and review the available test
   borings or undertake his own soil borings prior to submitting his bid, taking
   into consideration all conditions that may affect his work. The OWNER and
   ENGINEER will not assume responsibility for variations of subsoil quality
   or conditions at locations other than places shown and at the time the
   investigation was made. Boring log data and subsurface conditions are
   available for examination in Geotechnical Engineering Services Report,
   dated July 18, 2013, prepared by Cal-Tech Testing, Inc.
2. The soil conditions have been classified as highly variable

1.2 REFERENCES

A. Standards referenced in this Section are:
2. ASTM D422, Test Method for Particle-Size Analysis of Soils.
3. ASTM D698, Test Methods for Laboratory Compaction Characteristics of
   Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
4. ASTM D1556, Test Method for Density and Unit Weight of Soil in Place by
   the Sand-Cone Method.
5. ASTM D1557, Test Methods for Laboratory Compaction Characteristics of
   Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
7. ASTM D4253, Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
8. ASTM D4254, Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
10. ASTM D6938, Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
   1. “Subgrade” is the uppermost surface of native soil material unmoved from cuts; the bottom of excavation.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. CONTRACTOR’s Testing Laboratory:
      a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials specified in this Section.
      b. Testing laboratory shall comply with ASTM E329 and requirements of Section 01 45 29.13, Testing Laboratory Services Furnished by Contractor.
      c. Testing laboratory shall be experienced in the types of testing required.
      d. Selection of testing laboratory is subject to ENGINEER's acceptance.

B. Quality Assurance Testing:
   1. Quality assurance testing is in addition to field quality control testing required under Part 3 of this Section.
   2. Materials used in the Work may require testing and retesting, as directed by ENGINEER, during the Project. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be performed at OWNER's expense, including retesting of rejected materials and installed Work, shall be performed at CONTRACTOR’s expense.
   3. CONTRACTOR’s Testing Laboratory Scope:
      a. Collect samples and perform testing of proposed fill materials in the laboratory and in the field to demonstrate compliance of the Work with the Contract Documents.
b. Testing laboratory shall perform testing required to obtain data for selecting moisture content for placing and compacting fill materials.
c. Submit to ENGINEER and CONTRACTOR written report results of each test.

4. Required Quality Assurance Material Testing by CONTRACTOR’s Testing Laboratory:
   a. Gradation in accordance with ASTM D422. Perform one test for every 1,000 cubic yards of each material incorporated into the Work.
   b. Atterberg limits in accordance with ASTM D4318. Perform one test for every 1,000 cubic yards of the following types of materials incorporated into the Work: general fill, and pipe bedding material.
   c. Moisture/density relations in accordance with ASTM D698, ASTM D1557, ASTM D4253, or ASTM D4254, as applicable. Perform one test for every 5,000 cubic yards of each material incorporated into the Work.
   d. Moisture content of stockpiled or borrow material in accordance with ASTM D2216. Perform one test for every 1,000 cubic yards of each material incorporated into the Work.

C. Regulatory Requirements:
   1. Perform excavation work in compliance with requirements of authorities having jurisdiction and Laws and Regulations, including:
   2. Obtain required permits and approvals for excavation and fill Work, including work permits from right-of-way owners and permits from environmental authorities having jurisdiction over discharge of water from excavations.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Modifications to the Work proposed due to intended excavation plan.

B. Informational Submittals: Submit the following:
   1. Procedure Submittals:
      a. Excavation Plan: Prior to starting excavation operations, submit written plan to demonstrate compliance with OSHA 29 CFR Part 1926.650. As a minimum, excavation plan shall include:
         1) Name of CONTRACTOR’s “competent person” in responsible charge of excavation and fill Work.
         2) Excavation method(s).
         3) Copies of required permits and approvals, from authorities having jurisdiction and affected utility owners, for excavation methods proposed.
b. Proposed compaction procedure and compaction equipment proposed for use. Where different procedures or equipment will be used for compacting different types of material or at different locations at the Site, indicate where each procedure and equipment item will be used.

2. Quality Assurance Test Results Submittals:
   a. Submit results of quality assurance testing performed by in accordance with Paragraph 1.4.B of this Section, unless included as part of another submittal under this Section. Submit results for the following quality assurance testing:
      1) Tests on borrow fill material.
      2) Optimum moisture – maximum dry density curve for each type of fill material.

3. Field Quality Control Submittals:
   a. Submit results of testing and inspection performed in accordance with the field quality control Article in Part 3 of this Section, including:
      1) Field density testing.
      2) Tests of actual unconfined compressive strength or bearing tests of each stratum.

4. Qualifications Statements:
   a. Quality Assurance Testing laboratory. Submit name and qualifications of testing laboratory to be employed, and qualifications of testing laboratory’s personnel that will perform quality assurance testing required in this Section.
   b. Field Quality Control Testing Laboratory: Names and qualifications of testing laboratory employed, and qualifications of testing laboratory’s personnel that will perform field quality control testing as required under this Section.

1.6 SITE CONDITIONS

A. Subsurface Information: The Supplementary Conditions indicate information available relative to subsurface conditions at the Site. Such information and data is not intended as a representation or warranty of continuity of conditions between soil borings or test pits, nor of groundwater levels at dates and times other than date and time when measured, nor that purpose of obtaining the information and data were appropriate for use by CONTRACTOR. OWNER will not be responsible for interpretations or conclusions drawn therefrom by CONTRACTOR.

B. Soil borings and other exploratory operations may be made by CONTRACTOR, at no additional cost to OWNER. Coordinate CONTRACTOR-performed test borings and other exploratory operations with OWNER and utility owners as appropriate. Perform such explorations without disrupting or otherwise adversely affecting operations of OWNER or utility owners. Comply with Laws and Regulations relative to required notifications.
C. Existing Structures:
   1. CONTRACTOR shall explore ahead of the excavation to determine the exact location of any existing structures and Underground Facilities. Existing structures and Underground Facilities shall be supported and protected from damage by CONTRACTOR. Immediately repair and restore existing structures and Underground Facilities damaged by CONTRACTOR without additional cost to OWNER.
   2. Movement or operation of construction equipment over Underground Facilities shall be at CONTRACTOR’s sole risk and only after CONTRACTOR has prepared and submitted to ENGINEER and utility owners (as applicable), and received acceptance therefrom, a plan describing CONTRACTOR’s analysis of the loads to be imparted and CONTRACTOR’s proposed measures to protect structures and Underground Facilities during the Project.
   3. Coordinate with utility owners as required for shut-off of services in active piping and conduits. When required by utility owner, OWNER will assist CONTRACTOR with utility owner notifications.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Backfill and Fill:
   1. Materials acceptable for use as backfill against walls, foundations, underground ductbanks, and other structures shall be stockpiled native sandy clay or granular soils obtained from on-site excavations and which are uniformly mixed, contain no organic matter, nor contain rocks or fragments greater than 4-inches in size, nor have greater than 12 percent passing the 200 sieve.
   2. All materials for use as backfill and fill material shall be tested by the laboratory and approved by ENGINEER.
   3. If on-site material is unsuitable as determined by ENGINEER, select backfill or approved imported fill shall be used.
   4. Fill adjacent to structures is classified as backfill to a distance measured horizontally from the structure that is equal to the depth from the finished grade. Outside these limits the fill is classified as embankments, unless otherwise specified.

B. Select Fill:
   1. Select Fill for use beneath structures, concrete slabs and asphalt pavements (and where shown or specified below and around structures) shall be crushed rock or aggregate conforming to the requirements below:
### Sieve Sizes (Square Openings)

<table>
<thead>
<tr>
<th>Sieve Sizes (Square Openings)</th>
<th>Percentage by Weight Passing Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25-inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>38 to 65</td>
</tr>
<tr>
<td>No. 8</td>
<td>25 to 60</td>
</tr>
<tr>
<td>No. 30</td>
<td>10 to 40</td>
</tr>
<tr>
<td>No. 200</td>
<td>3 to 12</td>
</tr>
</tbody>
</table>

C. General Fill:
1. Material shall be free of: rock and gravel larger than three inches in any dimension, debris, waste, frozen materials, organic material, and other deleterious matter.
2. Fill shall have a liquid limit not greater than 45, and plasticity index not greater than 25.
3. Previously-excavated materials complying with the Contract Documents requirements for general fill may be used for general fill.
4. When on-Site materials are found unsuitable for use as general fill, provide select fill or approved off-Site general fill materials. Prior to using off-Site material as general fill, furnish submittal for and obtain ENGINEER’s approval of the material proposed for use.

D. Subbase Material:
1. Material shall be naturally- or artificially-graded mixture of natural or crushed gravel, crushed stone, or natural or crushed sand, complying with the gradation requirements below. Crushed slag is unacceptable.

E. Drainage Fill:
1. Material shall be washed, uniformly-graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing 1.5-inch sieve and not more than five percent passing a No. 4 sieve.

F. Pipe Bedding Material:
1. Aggregate material shall be crushed stone and gravel, free of: rock or gravel larger than one-inch in any dimension, debris, waste, frozen materials, organic material and other deleterious matter. Material shall comply with gradation requirements below:
<table>
<thead>
<tr>
<th>Sieve Sizes (Square Openings)</th>
<th>Percentage by Weight Passing Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-inch</td>
<td>100</td>
</tr>
<tr>
<td>3/8-inch</td>
<td>30 to 65</td>
</tr>
<tr>
<td>No. 4</td>
<td>25 to 55</td>
</tr>
<tr>
<td>No. 10</td>
<td>15 to 40</td>
</tr>
<tr>
<td>No. 40</td>
<td>8 to 20</td>
</tr>
<tr>
<td>No. 200</td>
<td>2 to 8</td>
</tr>
</tbody>
</table>

2. Sand material, where required, shall consist of natural or manufactured granular material and shall contain no organic material. Sand shall be non-plastic, when tested in accordance with ASTM D4318, 100 percent shall pass a 1/2-inch screen and not more than five percent shall pass a No. 200 screen.

2.2 SOURCE QUALITY CONTROL

A. Perform quality assurance testing, and submit results to ENGINEER, in accordance with the ‘Quality Assurance” Article in Part 1 of this Section.

PART 3 – EXECUTION

3.1 INSPECTION

A. Provide ENGINEER with sufficient notice and with means to examine areas and conditions under which excavating, filling, and grading will be performed. ENGINEER will advise CONTRACTOR in writing when ENGINEER is aware of conditions that may be detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 TEST PITS

A. General:
   1. In advance of the construction, excavate, make observations and measurements, and fill test pits to determine conditions or location of the existing Underground Facilities and structures. Perform all work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, filling, and replacing pavement for test pits. CONTRACTOR shall be responsible for the definite location of each existing Underground Facility involved within the area of excavation for the Work. Exercise care during such location work to avoid damaging and disrupting the affected Underground Facility or structure. CONTRACTOR shall be responsible for repairing, at his expense, damage to Underground Facility or structure caused during the Work.
3.3 PREPARATION

A. Site Preparation:
   1. Clear areas to be occupied by permanent construction of all trees, brush, roots, stumps, logs, wood and other materials and debris. Clean and strip vegetation, sod, topsoil, and organic matter from subgrades where fills will be placed, and from areas where structures will be constructed. Remove from the Site and properly dispose of all waste materials.
   2. Do not burn clearing debris at the Site unless approved by OWNER and authorities having jurisdiction. If burning is permitted, comply with requirements of authorities having jurisdiction and Laws and Regulations. If burning is permitted at the Site, also comply with OWNER's requirements.

B. Use of Explosives:
   1. Use of explosives is not allowed.

C. Dust Control:
   1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, and other actions. To minimize airborne dust, apply water or use other methods subject to ENGINEER's acceptance and approval of authorities having jurisdiction.

D. Maintenance and Protection of Traffic:
   1. Keep all streets and traffic ways open for passage of traffic and pedestrians during the Project, unless otherwise approved by owner of the street, traffic way, or right-of-way, as applicable.
   2. When required to cross, obstruct, or temporarily close a street or traffic way, provide and maintain suitable bridges, detours, and other acceptable temporary expedients to accommodate traffic. Closings of street or traffic way shall be for shortest time practical, and passage shall be restored immediately after completion of fill and temporary paving or bridging.
   3. Give required advance notice to fire department, police department, and other emergency services as applicable of proposed construction operations.
   4. Give reasonable notice to owners or tenants of private property who may be affected by construction operations. Give such notice not less than seven days prior to construction that will affect the property.
   5. Hydrants, valves, fire alarm boxes, postal boxes and delivery service boxes, and other facilities that may require access during construction shall be kept accessible for use.
   6. Provide temporary signage, signals, barricades, flares, lights and other equipment, service, and personnel required to regulate and protect traffic and warn of hazards. Such Work shall comply with requirements of owner of right-of-way and authorities having jurisdiction at the Site. Remove
3.4 DEWATERING

A. Dewatering – General:
1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work and work areas. Keep each excavation dry during excavation, subgrade preparation, and continually thereafter until the structure to be built therein is acceptable to ENGINEER and backfilling operations are completed and acceptable to ENGINEER.
2. Keep all working areas at the Site free of surface water at all times. Provide temporary drainage ditches and temporary dikes, and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
3. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.
4. CONTRACTOR shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.
5. Remove water from excavations as fast as water collects.

B. Disposal of Water Removed by Dewatering System:
1. CONTRACTOR’s dewatering system shall discharge to the onsite borrow area, in accordance with Laws and Regulations.
2. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
3. Dispose of water in manner that causes no inconvenience to OWNER, others involved in the Project, and adjacent and downstream properties.

3.5 EXCAVATION

A. Perform all excavation required to complete the Work as shown, specified, and required. Excavations shall include removing and handling of earth, sand, clay, gravel, hardpan, soft, weathered or decomposed rock, pavements, rubbish, and other materials within the excavation limits.
B. Excavation Protection:
   1. Provide excavation protection system(s) in accordance with Laws and Regulations to prevent injury to persons and property, including Underground Facilities.
   2. Excavation Less Than Five Feet Deep: Excavations in stable rock or in soil conditions where there is no potential for a cave-in may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
   3. Excavations Greater Than Five Feet Deep: Excavations shall be sloped and benched, shielded, or shored and braced.

C. Maintain excavations in dry condition in accordance with “Dewatering” Article in Part 3 of this Section.

D. Elevation of bottom of footings shown is approximate. ENGINEER may direct such minor changes in dimensions and elevations as may be required to secure a satisfactory footing.

E. When excavations are made below required grades without written order of ENGINEER, fill such excavations with compacted select fill, as directed by ENGINEER, at CONTRACTOR’s expense.

F. Extend excavations sufficiently on each side of structures, footings, and similar construction to allow setting of forms, installation of excavation supports, and the safe sloping of banks, as necessary.

G. Subgrades – General:
   1. Subgrades shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations.
   2. If, in ENGINEER’s opinion, subgrade becomes softened or mucky because of construction delays, failure to dewater properly, or other cause within CONTRACTOR’s control, subgrade shall be excavated to firm material, trimmed, and backfilled with select fill material at CONTRACTOR’s expense.

H. Pipe Trench Preparation:
   1. Not more than 150 feet of trench may be opened in advance of installing pipe in trench.
   2. Trench width shall be minimized to greatest extent practical, and shall comply with the following:
      a. Trench width shall be sufficient to provide space for installing, jointing and inspecting piping. Refer to the Drawings for trench requirements. In no case should trench be wider at top of pipe than pipe barrel OD plus two feet, unless otherwise shown or indicated.
b. Enlargement of trench width at pipe joints may be made when required and approved by ENGINEER.
c. Trench width shall be sufficient for shoring and bracing, or shielding and dewatering.
d. Trench width shall be sufficient to allow thorough compaction of fill adjacent to bottom half of pipe.
e. Do not use excavating equipment that requires the trench to be excavated to excessive width.

3. Depth of trench shall be as shown or indicated. If required and approved by ENGINEER in writing, depths may be revised.
4. Where ENGINEER considers existing material beneath bedding material unsuitable, remove and replace such unsuitable material with select fill material.

3.6 UNAUTHORIZED EXCAVATION

A. All excavations outside lines and grades shown or indicated and that are not approved by ENGINEER, together with removing and disposing of the associated material, shall be at CONTRACTOR's expense. Fill unauthorized excavations with properly-compacted select fill material at CONTRACTOR’s expense.

3.7 SHEETING, SHORING, AND BRACING

A. General:
1. Provide sheeting, shoring, bracing, and similar excavation supports as shown, specified, and required for the Work.
2. CONTRACTOR is responsible for adequacy of all sheeting, shoring, bracing, and similar excavation supports.
3. Materials:
   a. Previously-used materials shall be in good condition, and shall not be damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary sheeting, shoring, and bracing.
   b. All steel work for sheeting, shoring, bracing, cofferdams and other excavation supports, shall be in accordance with ANSI/AISC 360, except that field welding will be allowed.
4. As excavation progresses, carry down shoring, bracing, and similar excavation supports to required elevation at bottom of excavation.
5. Comply with Laws and Regulations regarding sheeting, shoring, bracing, and similar excavation supports.
6. Maintain sheeting, shoring, bracing, bracing, and other excavation supports in excavations regardless of time period excavations will be open.
7. Unless otherwise shown, specified, or directed, remove materials used for temporary construction when the Work is completed. Perform such removal in manner not injurious to the structures and Underground Facilities, their appearance, and adjacent construction.
B. Removal of Sheeting and Bracing:
   1. Remove sheeting and bracing from excavations, unless otherwise directed by ENGINEER in writing. Perform removal to avoid damaging the Work and adjacent construction. Removal shall be equal on both sides of excavation to ensure no unequal loads on structures and Underground Facilities.
   2. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until the following conditions are satisfied:
      a. Concrete has cured for not less than seven days.
      b. Wall and floor framing, up to and including grade level floors, is in place.

3.8 TRENCH SHIELDS

A. Excavation of earth material below bottom of trench shield shall not exceed the limits established in Laws and Regulations.

B. When using a shield for installing piping:
   1. Portions of trench shield extending below the mid-diameter of an installed, rigid pipe, such as prestressed concrete pipe and other types of rigid pipe, shall be raised above the pipe’s mid-diameter elevation prior to moving the shield along the trench for further construction.
   2. Bottom of shield shall not at any time extend below mid-diameter of installed pipe that is flexible or has flexing capability, such as steel, ductile iron, PVC, CPVC, polyethylene, and other pipe that has flexing capability.

C. When using a shield for installing structures, bottom of the shield shall not extend below the top of the bedding for the structures.

D. When removing the shield or moving the shield ahead, exercise extreme care to prevent moving piping, structures, and other Underground Facilities, and prevent disturbance of bedding material for piping, structures, and other Underground Facilities. When piping, structures, or Underground Facilities are disturbed, remove and reinstall the disturbed items in accordance with the Contract Documents.

3.9 FILL AND COMPACTION – GENERAL PROVISIONS

A. Provide and compact all fill required for the finished grades as shown and as specified in this Section.

B. Place fill in excavations as promptly as progress of the Work allows, but not until completing the following:
1. ENGINEER’s authorization after observation of construction below finish grade, including dampproofing, waterproofing, perimeter insulation, and similar Work.
2. Inspection, testing, approval, and recording of locations of Underground Facilities.
5. Removal of trash and debris.
6. Permanent or temporary horizontal bracing is in place on horizontally-supported walls.
7. Field testing of tanks, Underground Facilities including piping and conduits, and water-retaining structures.

C. Fill that includes organic materials or other unacceptable material shall be removed and replaced with approved fill material in accordance with the Contract Documents.

D. Placement – General:
   1. Place fill to the grades shown or indicated. Bring up evenly on all sides fill around structures and Underground Facilities.
   2. Place fill materials at moisture content and density as specified in this Article’s requirements on compaction density. Furnish and use equipment capable of adding measured amounts of water to the fill materials to bring fill materials to a condition within required moisture content range. Furnish and use equipment capable of discing, aerating, and mixing the fill materials to ensure reasonable uniformity of moisture content throughout the fill materials, and to reduce moisture content of borrow materials by air drying, when necessary. When subgrade or lift of fill materials requires moisture-conditioning before compaction, fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of specified limit shall be dried by aeration or stockpiled for drying.
   3. Perform compaction with equipment suitable for the type of fill material placed. Select and use equipment capable of providing the minimum density required in the Contract Documents. Use light compaction equipment, with equipment gross weight not exceeding 7,000 pounds within horizontal distance of ten feet from the wall of completed, below-grade structures. Furnish and use equipment capable of compacting in restricted areas next to structures and around piping and Underground Facilities. Effectiveness of the equipment selected by CONTRACTOR shall be tested at start of compacted fill Work by constructing a small section of fill within the area where fill will be placed. If tests on the test section of fill indicate that required compaction is not obtained, do one or more of the following: increase the amount of coverages, decrease the lift thicknesses, or use different compactor equipment.
4. Place fill materials in horizontal, loose lifts, not exceeding specified uncompacted thickness. Place fill in a manner ensuring uniform lift thickness after placing. Mechanically compact each lift, by not less than two complete coverages of the compactor. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of compactor’s compacting surface. Compaction of fill materials by inundation with water is unacceptable.

5. Do not place fill materials when standing water is present on surface of the area where fill will be placed. Do not compact fill when standing water is present on the fill to be compacted. Do not place or compact fill in a frozen condition or on top of frozen material. Fill containing organic materials or other unacceptable material previously described shall be removed and replaced prior to compaction.

6. If required densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly-functioning compaction equipment, CONTRACTOR shall perform all work required to provide the required densities. Such work shall include, at no additional cost to OWNER, complete removal of unacceptable fill areas and replacement and re-compaction until acceptable fill is provided.

7. Repair, at CONTRACTOR’s expense, observed or measured settlement. Make repairs and replacements as required within 30 days after being so advised by ENGINEER.

E. Fill Against Concrete:
   1. Placing fill against concrete below finished grade is not allowed until the concrete has attained its specified strength, as determined by duration of concrete curing and testing of field-cured concrete cylinders. Requirements for strength and curing time are in Section 03 30 00, Cast-in-Place Concrete.
   2. Elevation of fill placed against concrete walls shall not differ by more than two feet on each side of walls, unless walls are adequately braced or all floor framing is in place up to and including grade level slabs.
   3. Backfill structural foundation units as soon as practicable, in accordance with this Section, after concrete has gained sufficient strength to avoid damage, to avoid ponding of surface water and accumulation of debris.
   4. Where fill is placed against waterproofed surface, exercise care that waterproofing material is not damaged.

F. Fill in Electrical Ductbank Trenches:
   1. Provide general fill for full depth of electrical ductbank trench, below and above electrical ductbank. Where one ductbank passes beneath another pipe or ductbank, provide select fill to the elevation of the bottom of upper ductbank or pipe, as applicable.
   2. Placing and compacting fill in electrical ductbank trenches shall comply with requirements of Paragraph “G. Fill in Pipe Trenches”, of this Article.
G. Fill in Pipe Trenches:

1. Piping Installed in Fills Above Pre-construction Grade:
   a. Prior to installing piping, place the fill in accordance with the Contract Documents until the fill reaches a minimum elevation two feet higher than the top of piping to be installed. Excavate the trench; install the piping, and backfill. Subsequently provide the remainder of the fill required for the Work.

2. Piping trenches may be backfilled prior to testing of piping, unless nature of the test requires observation of pipe during testing. Do not construct building or structure over piping until piping has been successfully tested and passed.

3. Pipe Bedding: Pipe bettering material shall be as follows:
   a. Install PVC, CPVC, and HDPE piping on a layer of sand. Sand shall extend to 12 inches above top of pipe and to the trenchwalls on each side of the pipe.
   b. Unless otherwise shown, install other types of piping on not less than six-inch layer of aggregate pipe bedding material. Aggregate pipe bedding material shall extend 12 inches above top of the pipe.

4. Placing and Compacting Pipe Trench Fill: Unless otherwise shown, placement and compaction of pipe trench fill materials shall comply with the following:
   a. Pipe bedding material shall be spread and the surface graded to provide a uniform and continuous support beneath piping at all points between bell holes or pipe joints. Slight disturbance of installed pipe bedding material surface during withdrawal of pipe slings or other lifting tackle is acceptable.
   b. After each pipe’s bedding material has been graded, and the piping has been aligned, joined in accordance with the Contract Documents, and placed in final position on bedding material, provide and compact sufficient pipe trench fill material under and around each side of the pipe and back of the bell or end thereof to hold piping in proper position and maintain alignment during subsequent pipe jointing and embedment operations. Deposit and compact pipe trench fill material uniformly and simultaneously on each side of piping to prevent lateral displacement of piping. Place and compact pipe trench fill material to an elevation 12 inches above top of pipe, unless otherwise shown or specified.
   c. Each layer of pipe trench fill material shall be compacted by at least two complete coverages of all portions of surface of each lift using appropriate compaction equipment.
   d. Method of compaction and compaction equipment used shall be appropriate for material to be compacted and shall not transmit damaging shocks to the piping.
H. Temporary Pavement:
   1. Place 1.5 inches of temporary asphalt concrete pavement immediately after
      filling excavations in paved roadways and other paved areas that will remain
      for permanent use.
   2. Maintain surface of paved area over the fill in good and safe condition
      during progress of the Work, and promptly fill depressions over and
      adjacent to the fill area caused by settlement of fill.
   3. Permanent replacement pavement shall be equal to that of the existing
      roadways, unless otherwise shown or specified.

I. Subbase Placement:
   1. Provide subbase material where shown to the limits shown or indicated.
   2. Place subbase material in compacted lifts not exceeding depth of six inches
      each.

J. Drainage Fill Placement:
   1. Provide drainage fill material where shown to the limits shown or indicated.
   2. Place drainage fill material in compacted layers of uniform thickness not
      exceeding depth of six inches each. Compact lifts of drainage fill using
      suitable compaction equipment.

K. Compaction Density Requirements:
   1. Minimum density for fill materials shall be 98 percent of maximum density
      obtained in the laboratory in accordance with ASTM D1557. Compaction
      of fill materials less than five feet below final grade, behind concrete walls,
      and pipe bedding materials when not located below structures or pavement
      shall be 90 percent of maximum density in accordance with ASTM D1557.
   2. Place fill in trenches below Underground Facilities, foundations or paved
      areas in horizontal, uncompacted lifts not greater than eight inches deep, and
      thoroughly compact each lift before placing the next lift. In other pipe
      trenches, horizontal uncompacted lifts shall be six inches deep.
   3. Fill shall be wetted and thoroughly mixed to achieve optimum moisture
      content plus-or-minus three percent, with the following exceptions:
      a. On-site clayey soils: Optimum to plus three percent.
   4. Replace natural, undisturbed soils or compacted soil subsequently disturbed
      or removed by construction operations with materials compacted as
      indicated.
   5. Field quality control testing for density; to verify that specified density was
      obtained, will be performed during each day of compaction Work. Responsibility
      for field quality control testing is specified in the “Field Quality Control” Article
      in Part 3 of this Section.
   6. When field quality control testing indicates unsatisfactory compaction,
      provide additional compaction necessary to obtain the specified compaction.
      Perform additional compaction Work at no additional cost to OWNER until
      specified compaction is obtained. Such work includes complete removal of
      unacceptable (as determined by ENGINEER) fill areas and replacement and
re-compaction until acceptable fill is provided in accordance with the Contract Documents.

L. Replacement of Unacceptable Excavated Materials: In cases where over-excavation to replace unacceptable soil materials is required, backfill the excavation to required subgrade with select fill material and thoroughly compact in accordance with the “Compaction Density Requirements” in this Article. Slope the sides of excavation in accordance with the maximum inclinations specified for each structure location.

3.10 GRADING

A. General:
1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
2. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces shall be free of irregular surface changes, and shall comply with the following:
1. Grassed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than one inch above or below the required subgrade elevations.
2. Sidewalks: Shape surface of areas under sidewalks to line, grade, and cross section, with finish surface not more than one inch above or below the required subgrade elevation.
3. Pavements: Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than 1/2-inch above or below the required subgrade elevation.

C. Grading Surface of Fill Under Concrete Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a ten foot straight edge.

D. Compaction:
1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.11 PAVEMENT SUBBASE COURSE

A. General:
1. Place subbase material, in layers of specified thickness, over ground surface to support pavement base course.
2. After completing filling and grading, shape and compact pavement subgrade to an even, firm foundation in accordance with this Section. Remove unsuitable subgrade materials, including soft materials, boulders, vegetation, and loose stones, and replace with compacted fill material as directed by ENGINEER.

B. Grade Control:
   1. During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Placing of Pavement Subbase Course:
   1. Place subbase course material on prepared subgrade in layers of uniform thickness, in accordance with indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placing operations.
   2. After completing compaction, other than that necessary for bringing material for the next course, do not haul or drive over the compacted subbase.
   3. Do not install pavement subbase in excess of 500 feet in length without compacting to prevent softening of the subgrade.
   4. If subgrade material becomes churned up into or mixed with the subbase material, remove the mixed material and replace with clean, compacted subbase material.

3.12 DISPOSAL OF EXCAVATED MATERIALS

A. General:
   1. CONTRACTOR shall haul away material removed from excavations that does not comply with requirements for fill, or is in excess of the quantity required for fill.
   2. Disposal of materials shall be in compliance with Laws and Regulations, at no additional cost to OWNER.

3.13 FIELD QUALITY CONTROL

A. Site Tests: Employ a testing laboratory to perform field quality control testing.
   1. Testing Laboratory Scope:
      a. Perform field moisture content and density tests to ensure that the specified compaction of fill materials has been obtained.
      b. Tests of actual unconfined compressive strength or bearing tests on each stratum.
      c. Report results of each test to ENGINEER and CONTRACTOR.
   2. Required Material Tests:
      a. Compaction: Comply with ASTM D1556 and ASTM D6938, as applicable.
   3. Authority and Duties of Testing Laboratory:
a. Technicians representing the testing laboratory shall inspect the materials in the field, perform testing, and report findings to ENGINEER and CONTRACTOR. When materials furnished or the Work performed does not comply with the Contract Documents, technician will direct attention of ENGINEER and CONTRACTOR to such failure.

b. Technician will not act as foreman or perform other duties for CONTRACTOR. Work will be checked as it progresses, but failure to detect defective Work or non-complying materials shall not in any way prevent later rejection when defect is discovered, nor shall it obligate ENGINEER for Substantial Completion or final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, or to approve or accept any portion of the Work.

4. Responsibilities and Duties of CONTRACTOR:
   a. Use of testing laboratory shall in no way relieve CONTRACTOR of the responsibility to provide materials and Work in full compliance with the Contract Documents.
   b. To facilitate testing laboratory, CONTRACTOR shall advise testing laboratory at least two days in advance of filling operations to allow for completion of field quality control testing and for assignment of personnel.
   c. It shall be CONTRACTOR’s responsibility to accomplish the specified compaction for fill and other earthwork. CONTRACTOR shall control construction operations by confirmation tests to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the Contract Documents relative to compaction, control.
   d. CONTRACTOR shall demonstrate adequacy of compaction equipment and procedures before exceeding one or more of the following quantities of earthwork. Each test location shall include tests for each layer, type, or class of fill to finish grade.
      1) 200 linear feet of trench fill.
      2) 10 cubic yards of select fill.
      3) 100 cubic yards of general fill.
      4) 50 cubic yards of subbase material.

5. Testing laboratory will inspect and indicate acceptable subgrades and fill layers before construction work is performed thereon. Testing of subgrades and fill layers shall be taken as follows:
   a. Trenches for Structures, and Underground Facilities (including buried ductbanks):
      1) In Open Fields: Two locations every 1,000 linear feet.
      2) Along Dirt or Gravel Roads or Off Traveled Right-of-Way: Two locations every 500 linear feet.
      3) Crossings Paved Roads: Two locations along each crossing.
      4) Under Pavement Cuts or Within Two Feet of Pavement Edges: One location every 400 linear feet.
b. Footing Subgrade: For each stratum of soil on which footings will be placed, perform not less than one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to ENGINEER.

c. For Select Fill: On 30-foot intervals on all sides of the structure for every compacted lift, but not less than one per lift on each side of the structure for structures less than 60 feet long on a side.

d. For General Fill: One per 1,000 square feet on every compacted lift.

e. Subbase Material: One per 1,000 square feet on every compacted lift.

6. Periodic compliance tests will be made by ENGINEER to verify that compaction is complying with the requirements specified, at no cost to CONTRACTOR. CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall fill and re-compact the excavation after testing is complete.

7. If testing laboratory reports or inspections indicate subgrade, fills, or bedding compaction below specified density, CONTRACTOR shall remove unacceptable materials as necessary and replace with specified materials and provide additional compaction at CONTRACTOR’s expense until subgrades, bedding, and fill are acceptable. Costs for retesting of subgrade, fills, or bedding materials that did not originally comply with specified density shall be paid by CONTRACTOR.

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to furnish and install fencing.
2. Extent of fencing is shown or indicated.
3. Types of materials required under this Section include:
   b. Galvanized steel framework.
   c. Barbed wire.
   d. Grounding and bonding.
   e. Auxiliary system components, gates, accessories, fasteners, and fittings.
4. Substitutions: Structural shapes of satisfactory sections and equal strengths may be substituted upon ENGINEER’s approval of CONTRACTOR’s substitution request.

B. Related Sections:
1. Section 03 30 00, Concrete.
2. Section 26 00 05, Electrical Work.

1.2 REFERENCES

A. Standards referenced in this Section are:
1. ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A123, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
10. ASTM B6, Specification for Zinc.
17. ASTM F567, Practice for Installation of Chain-Link Fence.
18. ASTM F626, Specification for Fence Fittings.
19. ASTM A653, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
20. ASTM F668, Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
22. ASTM F1083, Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
24. ASTM F1664, Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used with Chain-Link Fence.
25. ASTM F1665, Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used With Chain-Link Fence.
27. CLFMI, Step-by-Step Installation Guide.
30. UL 467, Grounding and Bonding Equipment.

1.3 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning.
1. “Knuckling” describes the type of selvage obtained by interlocking adjacent pairs of wire ends and then bending the wire ends back into a closed loop.
2. “Fencing” describes an assembly of metal components, including wire chain-link fabric fastened to top, bottom and intermediate horizontal rails and to vertical line posts, corner posts and terminal posts. This assembly includes all auxiliary components, gates, fittings, fasteners, and other accessories, all with specified protective coatings.

B. Terminology used in this Section and not defined in this Article will be construed in accordance with the terminology used in CLF 2445 and ASTM F552.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Erector/Installer:
      a. Engage a single erector that is skilled and trained, and possesses successful and documented experience installing fencing, and employs only workers with specific skill and successful experience in the type of Work required.
      b. Erector shall be acceptable to fencing manufacturer,

B. Component Supply and Compatibility:
   1. Provide fencing as complete system with all gates, hardware, appurtenances and other components produced by a single manufacturer, including custom erection accessories, fittings, clamps, and fastenings as required for complete system.

C. Regulatory Requirements:
   1. Comply with Laws and Regulations, including:
      b. Homeland Security requirements for water treatment plant security.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Drawings of typical fence assembly, identifying all materials, dimensions, sizes, weights, and finishes of rails, posts, braces, supports and other fencing components. Show fence heights, and locations of gates. Show gate swing, or other operation, hardware, and accessories. Include plans, elevations, and sections, with required installation and operating clearances, and details of post anchorage, attachments, and bracing.
2. Product Data:
   a. Copies of manufacturer’s technical product information and specifications for all fencing components.
   b. Data substantiating that materials proposed comply with the following:
      1) Weight of aluminum coating on wire fabrications, in compliance with ASTM A428.
      2) Weight of zinc coating on pipe fabrications, in compliance with ASTM A90.

B. Informational Submittals: Submit the following:
   1. Manufacturer’s Instructions:
      a. Manufacturer’s installation instructions.

C. Closeout Submittals: Submit the following:
   1. Warranty documentation.
   2. Keys: Submit three sets of keys for locksets and/or padlocks.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:
   1. Packaging and Marking: Comply with CLFMI CLF 2445.
   2. Deliver materials in manufacturer’s original, unopened packaging with all factory-applied tags, labels and other identifying information intact, legible and accurately representing material on approved submittals.

B. Storage of Materials:
   1. Store all materials under weatherproof cover, off the ground and away from other construction activities.
   2. Do not store material in a manner that would create a humidity chamber. Provide for free movement of air under protective cover and between components of the fencing.

C. Handling of Materials:
   1. Handle material in manner that is in compliance with manufacturer’s recommendations and that avoids damaging coatings.

1.7 PROJECT CONDITIONS

A. Utilities: Do not damage or interrupt underground utilities during fencing installation.

B. Obtain measurements at the Site to verify layout information and dimensions for fencing and gates in relation to reference points provided by OWNER or indicated in the Contract Documents.
PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Considerations:
   1. Verify size of framing members shown or indicated in the Contract Documents. Where structural analysis indicates the need, provide additional members, or increased member size, thickness or weight.
   2. Modifications may be made only as necessary to meet Site conditions to ensure proper fitting and support of the Work and only upon submittal of Shop Drawings and receipt of approval by ENGINEER.

2.2 MATERIALS

A. General:
   1. Tube sizes specified are nominal outside dimension.
   2. Roll-formed section sizes are nominal outside dimensions.
   3. Wire gages shall conform to American Steel and Wire Company gage.
   4. Heat-form arcs and chords before applying protective coatings to metal.
   5. Sizes specified are given for uncoated metal. Protective coatings are in addition to specified metal dimensions, gages, and sizes.
   6. Provide weights of zinc and aluminum coatings on wire and pipe fabrications in accordance with CLFMI CLF 2445.

B. Chain-Link Fence Fabric:
   1. One-piece fabric widths, for fencing less than or equal to 12 feet in height, complying with CLFMI CLF 2445.
   2. Wire mesh shall be woven throughout in form of approximately-uniform square mesh with parallel sides and horizontal and vertical diagonals of approximately-uniform dimensions, of size and gage specified and in compliance with ASTM A817, Type 1, cold-drawn carbon steel wire with minimum breaking strength of 2,170 pounds and coated with aluminized finish, as specified. Fabric shall be as recommended by CLFMI for heavy industrial usage.
   3. Provide fence fabric imprinted with manufacturer’s trade name, country of origin, core wire gage, and finished outside diameter gage.
   5. Fabric Gage: Provide the following:
      a. No. 9-gage wires.
   6. Mesh Size: Provide the following:
      a. Two-inch mesh.
2.3 FRAMEWORK

A. General: The following table presents actual OD and equivalent nominal NPS size and trade size of round members:

<table>
<thead>
<tr>
<th>Actual OD (inches)</th>
<th>NPS Size (inches)</th>
<th>Trade Size (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.315</td>
<td>1.0</td>
<td>1-3/8</td>
</tr>
<tr>
<td>1.660</td>
<td>1.25</td>
<td>1-5/8</td>
</tr>
<tr>
<td>1.900</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>2.375</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>2.875</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>3.500</td>
<td>3.0</td>
<td>3.5</td>
</tr>
<tr>
<td>4.000</td>
<td>3.5</td>
<td>4</td>
</tr>
<tr>
<td>6.625</td>
<td>6.0</td>
<td>6-5/8</td>
</tr>
<tr>
<td>8.625</td>
<td>8.0</td>
<td>8-5/8</td>
</tr>
</tbody>
</table>

B. Pipe shall be commercial grade, plain-end steel pipe with standard-weight walls. Steel strip used for manufacture of pipe shall comply with ASTM F1083, Schedule 40 pipe with minimum yield strength of 25,000 psi and protected with zinc, as specified.

C. Fittings: Comply with ASTM F626.

D. End, Corner, and Pull Posts: Provide end, corner, and pull posts of following minimum sizes:
   1. Up to six feet fabric height:
      a. 2.375 inches OD pipe weighing 3.65 pounds per linear foot.

E. Line Posts: Provide line posts of following minimum sizes and weights:
   1. Up to six feet fabric height:
      a. 1.90 inches OD pipe weighing 2.72 pounds per linear foot.

F. Gate Posts: Provide gate posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as follows:
   1. Up to six feet wide:
      a. 2.875 inches OD pipe weighing 5.79 pounds per linear foot.
   2. Over six feet wide and up to 13 feet wide:
      a. Four inches OD pipe weighing 9.11 pounds per linear foot.
   3. Over 13 feet wide and up to 18 feet wide:
      a. 6.625 inches OD pipe weighing 18.97 pounds per linear foot.

G. Top Rail: Provide top rails, unless otherwise shown or indicated, conforming to the following:
   1. 1.900 inch OD pipe weighing 2.72 pounds per linear foot.
2. Provide in manufacturer's longest lengths, with expansion-type coupling 0.051-inch thick rail sleeves, approximately seven inches long, for each joint.
3. Provide means for attaching top rail securely to each gate, corner, pull, and end post.

H. Roll-Formed Steel: Provide rolled steel shapes produced from structural-quality steel conforming to ASTM A1011, Grade 45, with minimum yield strength of 45,000 pounds psi. Protective coating system shall conform to ASTM F1043, as specified.

I. Post Brace Assembly: Provide bracing assemblies at end and gate posts, and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric.
   1. Use 1.900-inch OD pipe weighing 2.72 pounds per linear foot for horizontal brace and 3/8-inch diameter rod with turnbuckle for diagonal truss.

2.4 Gates

A. Swing gates shall comply with ASTM F900.

B. Gate hinges shall be double clamping offset type. To hold gate in the open or closed positions, provide each gate frame with a keeper that automatically engages gate shoe set in concrete. Gates shall have drop latch with provision for padlock.
   1. Gate Hinges: Pressed or forged steel or malleable iron to suit gate size, non-lift-off type, 180-degree offset heavy-industrial hinges, 1.5 pair per leaf.
   2. Latch: Forked-type or plunger bar type to permit operation from either side of gate, with padlock eye as integral part of latch.

C. Padlocks: Provide each gate with heavy-duty bronze padlock and shackle chain as follows:
   1. Product and Manufacturer: Provide one of the following:
      b. Or equal.
   2. Provide three keys for each padlock. Where more than one gate is required for same enclosure, padlocks shall be keyed identically.

D. Provide gate frames with intermediate horizontal rails. Gate frames shall be welded construction and shall be galvanized after fabrication. Provide single gates six feet or greater in width, and double gates 12 feet or greater in width, with diagonal bracing in one direction, extending from top to bottom rail.

E. Fabricate gate perimeter frames of tubular members. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric,
hardware, and accessories. Space so that frame members are not more than eight feet apart. Fabricate as follows:

1. Up to six feet high, or leaf width of eight feet or less:
   a. 1.660-inch OD pipe weighing 2.27 pounds per linear foot.

F. Gate Stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete and designed to engage a center drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch, using one padlock for locking both gate leaves.

G. Assemble gate frames by welding or with special malleable or pressed steel fittings and rivets for rigid connections. Use same fabric as provided for fence. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretchers to gate frame at not more than 15 inches on centers. Attach hardware with rivets or by other means that will provide security against removal and breakage.

H. Install diagonal cross-bracing on gates consisting of 1/2-inch diameter adjustable length truss rods provided with turnbuckles to ensure frame rigidity without sag or twist.

I. Where barbed wire is shown or indicated above gates, extend end-members of gate frames one foot above top member and prepare to receive three strands of wire. Provide necessary clips for securing wire to extensions.

2.5 AUXILIARY FENCING MATERIALS AND ACCESSORIES

A. Wire Ties:
   1. For tying fabric to line posts, use nine-gage, aluminum alloy 1100-H4, wire ties to match fence fabric, spaced 12 inches on centers.
   2. For tying fabric to rails and braces, use nine-gage, aluminum alloy 1100-H4, wire ties to match fence fabric, spaced two feet on centers.
   3. For tying fabric to tension wire, use 11-gage, aluminum alloy 1100-H4, wire hog ring ties to match fence fabric, spaced two feet on centers.

B. Barbed Wire Supporting Arms: Pressed steel for three rows of barbed wire attached to each arm, complete with provisions for anchorage to posts. Supporting arms shall be integral with post-top weather cap. Provide following type:
   1. Single 45-degree arm, one for each post.

C. Barbed Wire: Commercial quality steel, two-strand, 11-gage line wire with 14-gage, four-point twisted aluminum alloy barbs spaced five inches on centers.
D. Post Caps: Pressed steel, wrought iron, or cast aluminum alloy, designed as weather-tight closure cap, for tubular posts. Provide one cap for each post unless equal protection is afforded by combination post-top cap and barbed wire supporting arm, where barbed wire is required.
   1. Provide caps with openings to allow through-passage of top rail.
   2. Provide cone-type caps for terminal posts and loop-type caps for line posts.

E. Stretcher Bars: One-piece lengths equal to full height of fabric, with minimum cross-section of 3/16-inch by 3/4-inch. Provide one stretcher bar for each gate and end-post, and two for each corner- and pull-post, except where fabric is integrally woven into the post.

F. Stretcher Bar Bands: Pressed steel, galvanized, 0.078-inch to 0.108-inch thick depending on post diameter, spaced not greater than 15 inches on centers to secure stretcher bars to end-, corner-, pull-, and gate-posts.
   1. Bands may also be used with special fittings for securing rails to end-, corner-, pull-, and gate-posts.

G. Truss Rods: Steel rods, 3/8-inch diameter, merchant quality with turnbuckle.

H. Concrete: In accordance with Section 03 30 00, Concrete.

2.6 FENCE GROUNDING

A. Conductors: Refer to Section 26 00 05, Electrical Work, for fence grounding conductor requirements.

B. Connectors and Ground Rods: Refer to Section 26 00 05, Electrical Work, for fence grounding connectors and ground rod requirements.

2.7 FINISHING

A. Chain-Link Fence Fabric:
   1. Aluminized finish with not less than 0.40 ounces aluminum per square foot, complying with ASTM A491, Class II.

B. Framework and Appurtenances: Provide the following finishes for steel framework, auxiliary system components, and miscellaneous accessories:
   1. Galvanizing: Zinc for galvanizing shall be of High Grade or Special High Grade conforming to ASTM B6 with maximum aluminum content of 0.01 percent. Galvanize metal using hot-dip process in accordance with the following:
      a. Structural Iron and Steel Shapes: ASTM A123
      b. Rolled-Form Sheet Steel: ASTM A653
      c. Hardware and Accessories: ASTM A153
2. Provide minimum weights of zinc as follows:
   a. Pipe: 1.8-ounces of zinc per square foot. Apply Type A coating both inside and outside according to ASTM F1043, as determined by ASTM A90.
   b. Rolled-Form Sheet Steel: 4.0-ounces of zinc per square foot of surface area.
   c. Hardware and Accessories: Zinc weights in compliance with Table 1 of ASTM A153.

C. Welded Joints:
   1. Repair zinc coatings at welded joints by applying zinc-rich paint, as specified in Section 09 91 00, Painting, and ASTM A780.

2.8 SOURCE QUALITY CONTROL

   A. Fabrication Tolerances:
      1. Fabric, posts, rails, and other supports shall be straight or uniformly curved to provide the profiles shown, to dimensional tolerance of 1/16-inch in 10 feet without warp or rack in the finished Work.

PART 3 – EXECUTION

3.1 INSPECTION

   A. Examine conditions under which the Work will be erected and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 ERECTION

   A. Comply with CLFMI Step-by-Step Installation Guide and ASTM F567. Do not begin installation and erection of fencing until final grading is completed.

   B. Excavation: Drill holes of diameters specified, for post footings in firm, undisturbed or compacted soil.
      1. For posts set in cast-in-place concrete, provide hole diameters dug or drilled a minimum of four times the largest cross section of post.
         a. Unless otherwise shown or indicated, excavate hole depths approximately three inches lower than bottom of post, with bottom of posts set not less than two feet below the surface of finished grade when in firm, undisturbed soil, plus an additional three inches for each foot increase in the fence height over four feet.
2. Spread soil from excavations uniformly adjacent to fence line, or on adjacent areas of the Site, as directed by ENGINEER.

3. When solid rock is encountered at ground surface, drill into rock at least 12 inches for line-posts and at least 1.5 feet for end-, pull-, corner-, and gate-posts. Drill hole at least one inch greater diameter than largest dimension of post to be placed.
   a. If solid rock is below soil overburden, drill to full depth required, except penetration into rock need not exceed the minimum depths specified above for rock encountered at ground surface.

C. Setting Posts: Remove loose and foreign materials from sides and bottoms of holes, and moisten soil prior to placing concrete.
   1. Center and align posts in holes 3-inches above bottom of excavation.
   2. Posts shall be set in concrete footings, except as otherwise shown or specified. Place concrete around posts in continuous pour, and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
   3. Extend concrete to two inches above ground surface, or to two inches below ground surface if cover of sod, bituminous asphalt paving, or other material is shown or indicated to conceal concrete. Crown to shed water away from posts.
   4. Extend footings for gate posts to underside of bottom hinge. Set keeps, stops, sleeves, and other accessories into concrete as required.
   5. Keep exposed concrete surfaces moist for at least seven days after placement, or cure with membrane curing materials, or other acceptable curing method.
   6. Grout posts set in sleeved holes, concrete constructions, or rock with grout, as specified in Section 03 00 05, Concrete, and as recommended in CLFMI CLF 2445.

D. Concrete Strength: Allow concrete to attain at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than seven days after placement, before installing rails, tension wires, barbed wire, or chain-link fabric.
   1. Do not stretch and tension fabric and wires, and do not hang gates, until concrete has attained its full design strength.

E. Posts and Rails:
   1. Line Posts: Set posts in cast-in-place concrete footings as specified, spaced not more than ten feet on centers. Provide caps on top of each post to exclude moisture and to receive top rail, unless equal protection is afforded by combination post-top cap and barbed wire supporting arm, where barbed wire is required.
   2. Top Rails: Run rail continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as
recommended by fencing manufacturer to form continuous rail between terminal posts.

3. Brace Assemblies: Install braces so posts are plumb when diagonal rod are under proper tension. Install brace assemblies at end-posts and at both sides of corner- and pull-post panels. Panels adjacent to gates shall have intermediate horizontal rails and diagonal bracing. Diagonal bracing shall run from center of first line-post to bottom of terminal-post.

F. Chain-Link Fabric:
1. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released. Fasten to terminal posts and gate posts with tension bars threaded through mesh and secured with tension bands at maximum intervals of 14 inches.
2. Tie to line-posts, gate frames and top and bottom rails with tie wires spaced at maximum 12 inches on posts and two feet on rails.
3. Connect tension bars to posts and frames by means of adjustable bolts and bands spaced not more than 14 inches apart.
4. Leave approximately two inches between finish ground surface and bottom selvage, except where bottom of fabric extends into concrete.
5. Join roll of chain-link fabric by weaving a single picket into the ends of roll to form continuous mesh.

G. Barbed Wire:
1. Install three parallel wires on each extension arm; on security side of fence, unless otherwise shown or indicated
2. Pull wire taut to remove sag and firmly install in slots of extension arms to prevent movement or displacement.
3. Secure wire to terminal posts utilizing terminal post band arms or brace bands.
4. Extend vertical members of gates to receive barbed wire.

H. Stretcher Bars: Thread through or clamp to fabric four inches on centers, and secure to posts with metal bands spaced 15 inches on centers.

I. Gates: Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage, as shown on approved Shop Drawings. Adjust hardware for smooth operation and lubricate where necessary.

J. Tie Wires: Use U-shaped wires conforming to diameter of pipe. Clasp pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons and clothing.

K. Fasteners: Install nuts for tension band and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
3.3 GROUNDING AND BONDING

A. Refer to Section 26 00 05, Electrical Work, for fence grounding requirements.

3.4 FIELD QUALITY CONTROL

A. Site Tests: Refer to Section 26 00 05, Electrical Work, for fence grounding site test requirements.

3.5 ADJUSTMENT AND CLEANING

A. Repair coatings damaged in the shop or at the Site by recoating with manufacturer’s recommended repair compound, applied in accordance with manufacturer’s directions. Repair hot-dip galvanized coatings in accordance with ASTM A780.

B. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, and malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

C. Lubricate operating equipment and clean exposed surfaces.

D. Repair and replace broken or bent components.

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all lawns and meadows.
   2. Extent of area to include sod is shown.
   3. Types of products required include the following.
      a. Sod.
      b. Fertilizers.
      c. Accessories.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, lawns and meadows.

C. Related Sections:
   1. Section 33 11 00, Clearing and Grubbing.
   2. Section 32 31 00, Fences.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
      b. ASTM D 75, Practice for Sampling Aggregates.
      c. ASTM D 422, Test Method for Particle Size Analysis of Soil.
      d. ASTM D 977, Specification for Emulsified Asphalt.
      e. ASTM D 2487, Practice for Classification of Soils for Engineering Purposes (United Soil Classification System).
f. ASTM D 5268, Specification for Topsoil Used for Landscape Purposes.
g. ASTM E 329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
h. ASTM E 548, Guide for General Criteria Used for Evaluating Laboratory Competence.

a. Guideline Specifications to Turfgrass Sodding.

1.3 DEFINITIONS

A. The term “finish grade” shall be used to describe the finished surface elevation of planting soil.

B. The term “manufactured topsoil” shall be used to describe soil produced off-Site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil acceptable as a component of loam.

C. The term “loam” shall be used to describe topsoil that has been mixed with additional organic and inorganic additives, as specified.

D. The term “subgrade” shall be used to describe the surface of subsoil remaining after completing excavation; or the top surface of a fill or backfill immediately beneath topsoil and which has not been tested for acceptable use as topsoil.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage a single landscape installer skilled, trained and with successful and documented experience in the planting of lawns and meadows and with specific skill and successful experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work.

2. Installer’s Site Supervisor: Require installer to maintain an experienced full-time landscape supervisor on-Site during the time of preparation for, and planting of, lawns and meadows. Supervisor shall have achieved landscape or horticultural certification acceptable to governing authorities having jurisdiction at the Site.

3. Ratio of laborers to certified landscape supervisors shall not exceed 12 to one. Certified landscape supervisor shall be on-Site throughout the day-to-day performance of the Work of this Section.

4. Application of herbicides, chemicals and insecticides shall be done by personnel licensed to perform such applications by governing authorities having jurisdiction at the Site and in accordance with each manufacturer’s instructions provided on each product label.
B. References: Comply with the applicable requirements referenced in Section 01 42 00, Reference Forms.

C. Source Quality Control:
   1. Provide sod procured from areas having growing conditions similar to location of Site.
   2. Verify that sod contains no noxious weeds or other material that might be detrimental to the proposed planting.
   3. Machine-cut sod into rectangular sections, exercising care to retain the native soil on the roots of the sod, during stripping, transportation and planting.
   4. Cut and move sod only when soil moisture conditions are such that favorable results can be expected.
   5. Rectangular sections of sod may vary in length but shall be equal in width and of a size that permits the sod to be lifted and rolled without breaking.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Schedule for lawn and meadow-planting showing anticipated planting dates for each type of Work.
   2. Product Data:
      a. Manufacturer's product data, specifications and installation instructions for all required materials.
      b. Composition and analysis of commercial fertilizers.

B. Informational Submittals: Submit the following:
   1. Test Reports: Submit the following:
      a. Soil analysis reports for existing soil and imported manufactured topsoil, as specified. Include recommendations for remediating existing soil into acceptable topsoil.
   2. Qualifications Data: Submit qualifications data for the following:
      a. Landscape installer.
      b. Landscape supervisor.
      c. Testing agency.
   3. Source Quality Control Submittals
      a. Written statement providing the locations of the property from which the sod is to be obtained and the names and addresses of the suppliers.

C. Closeout Submittals: Submit the following:
   1. Warranty Documentation:
      a. Submit written warranty, signed by CONTRACTOR and landscape installer, as specified.
1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
   1. Do not deliver sod until Site conditions are ready for installation.
   2. Deliver fertilizer materials in packages or containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery.
   3. Sod: Time delivery so that sod will be placed within 24 hours after stripping. Comply with requirements of TPI for harvesting, delivery, storage and handling of sod.
   4. Inspect all materials upon arrival at Site. Immediately and permanently remove unacceptable materials from Site.

B. Storage of Materials:
   1. Store and cover materials to prevent deterioration. Remove packaged materials that become wet or show deterioration or water marks from the Site.
   2. Protect sod against drying and breaking of rolled strips.
   3. If sod is stacked, place roots to roots or grass to grass.
   4. Protect sod from exposure to wind and sun and from freezing.

C. Handling of Materials: Do not dump sod from vehicles.

1.7 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Proceed with and complete lawn and meadow planting as rapidly as portions of the Site become available, working within the seasonal limitations for each type of lawn, grass and wildflower planting required.
   2. Proceed with planting only when current and forecasted weather conditions are favorable to successful planting and establishment of lawns and meadows.
   3. Herbicides, chemicals and insecticides shall not be used on areas bordering wetlands.

B. Scheduling:
   1. Coordinate planting with specified extended service periods to provide required service from date of Substantial Completion. Only plant during periods recommended by source sod farm.
   2. Do not begin lawn and meadow planting until water, acceptable for use and adequate in supply, is available on-Site and can be successfully transported to the areas of Work. Coordinate provision of adequate and acceptable water supply with Project Schedule.
C. Pre-installation Conference:
   1. Prior to commencement of lawn and meadow planting and associated Work, CONTRACTOR shall schedule and meet at the Site with the landscape installer, the installers of other Work in and around lawn and meadow areas that follows the lawn and meadow Work, including fencing Work specified in Section 32 31 00, Fences; and ENGINEER and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the lawn and meadow Work, including the following:
      a. Review Project requirements and the Contract Documents.
      b. Review required submittals, both completed and yet to be completed.
      c. Review availability of water and methods of delivery.
      d. Review status of below-grade work and required access during lawn and meadow planting and establishment.
      e. Review Project Schedule and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
      f. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
      g. Review procedures required for protection of lawns and meadows during the remainder of the construction period.
      h. Review required inspection, testing, and certifying procedures.
   2. Record the discussions of the Pre-installation Conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending. Record all revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

1.8 WARRANTY

A. General Warranty: The special warranties specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents.

B. Special Warranties: Warranty lawns and meadows through the specified extended service period.

1.9 EXTENDED SERVICE

A. Extended Lawn Service:
   1. Begin extended service immediately after each lawn area is acceptably established. Provide extended service for not less than the following periods:
   2. Sodded Lawns: Thirty days from date after lawn areas are acceptably established.
3. Service lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

4. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources. Keep newly germinated plants uniformly moist to a depth of 4-inches, applied at a minimum rate of 1-inch per week, or greater as required to maintain minimum moisture depth specified.
   a. Schedule watering to prevent wilting, puddling, erosion, and displacement. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   b. After plants have their first true leaves and grasses show mature blades, watering shall be performed to provide moisture to a depth of 6-inches, and not performed again until top 1-inch of loam has dried.
   c. During first week, water sod daily or more frequently as necessary to maintain moist loam to a minimum depth of 4-inches below bottom of sod blanket.

5. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass-leaf height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowing to maintain the following grass height:
   a. Mow grass 2 to 3-inches high.

6. Lawn Fertilization: Apply fertilizer after initial mowing and when grass is dry.
   a. Use fertilizer that will provide actual nitrogen of at least one pound for each 1000 square feet of lawn area.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Turf grass Sod:
   1. Certified Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes and insects, complying with TPI specifications and guidelines.
   2. Provide strongly rooted machine-cut sod, not less than two years old of uniform density, color and texture. Provide only sod capable of vigorous growth and development when planted (viable, not dormant) and in strips not more than 18-inches wide by 14 feet-0 inches long by 3/4-inch thick (excluding top growth and thatch). Provide sod composed principally of the following:
      a. Bahiagrass (Paspalum notatum Flugge).
B. Fertilizers:
   1. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.

C. Accessories:
   1. Provide herbicides, chemicals and insecticides as needed for disease, fungus or pest control. All herbicides, chemicals and insecticides shall be bear approval labels indicating they are approved by the United States Department of Agriculture for the intended uses and application rates.
   2. Post Emergent Crab Grass and Plantain Chemical: Provide recommended post emergent crab grass and plantain control throughout the maintenance period to ensure germinated and established lawns free of crab grass and other undesirable grasses and forbs.

D. Water: Acceptable for lawn and meadow application and containing no material harmful to plant growth and establishment.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the areas and conditions under which lawn and meadow Work is to be performed, and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, fencing, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Excavate or fill subgrade, as required, to bring subgrade to elevations shown. Maintain all angles of repose. Confirm that subgrade is at proper elevations and that no further earthwork is required to bring the subgrade to proper elevations. Provide subgrade elevations that slope parallel to finished grade and towards subsurface drains shown.
D. Remove all construction debris, trash, rubble and all extraneous materials from subgrade. In the event that fuels, oils, concrete washout or other material harmful to plant growth or germination have been spilled into the subgrade, excavate the subgrade sufficiently to remove all such harmful materials and fill with approved fill, compacted to the required subgrade compaction level.

3.3 FINE GRADING

A. Spread fertilizer and work lightly into the top 4-inches of site topsoil by harrowing or tilling prior sodding.

B. Grade planting areas to smooth, even surface with loose, uniformly fine texture. Remove all stones and extraneous material in excess of 1-inch diameter. Roll, rake and remove ridges and fill depressions, as required to meet finish grades.

C. Moisten prepared areas before sodding. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy loam condition.

3.4 SODDING LAWNS

A. Do not lay sod on ground that is frozen, dust dry or that has not been uniformly prepared, as specified. Do not lay dormant sod.
   1. Lay sod within 24 hours of harvesting.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod.
   1. Place sod strips in straight lines parallel to one another.
   2. Lay sod across angle of slopes exceeding one on three.
   3. Anchor sod with wooden pegs, or steel staples, on slopes exceeding one on six, spaced as recommended by sod supplier, but not less than two anchors for each sod strip to prevent slippage.

C. Immediately upon completion of a section of sodding, tamp, roll lightly and water, to ensure contact with subgrade and elimination of air pockets.

D. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.

E. Immediately after planting, water sod thoroughly with a fine spray. Water sufficiently to ensure penetration of moisture to bottom of prepared loam layer, not just to bottom of sod blanket.
3.5 RECONDITIONING EXISTING LAWNS AND MEADOWS

A. Recondition existing lawn and meadow damaged by CONTRACTOR'S operations, including areas used for storage of materials or equipment and areas damaged by movement of vehicles. Recondition existing lawns and meadow areas where minor regrading is required.

B. Provide fertilizer and sod as specified for new lawn and meadow, and as required to provide satisfactorily reconditioned lawns and meadows. Provide new loam as required to fill low spots and meet new finish grades.

C. Remove diseased or unsatisfactory lawn and meadow areas; do not bury into soil. Remove topsoil containing extraneous materials resulting from CONTRACTOR'S operations including oil drippings, stone, gravel and other construction materials.

D. In areas approved by ENGINEER, where substantial lawns and meadows remain (but are thin), mow, dethatch, core aerate and rake. Fill low spots, remove humps, cultivate soil, fertilize, and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers, as required. Apply a seedbed mulch, if required, to maintain moist condition.

E. Water newly planted areas and keep moist until new lawns and meadows are established, as specified.

3.6 ACCEPTANCE CRITERIA FOR LAWNS AND MEADOWS

A. Lawn and meadow Work will be considered acceptable when:
   1. Sodded Lawn: When a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.

3.7 CLEANUP AND PROTECTION

A. Promptly remove soil and debris, created by lawn and meadow Work, from paved areas. Clean wheels of vehicles before leaving Site to avoid tracking soil and loam onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout extended service period and remove when service period ends. Treat, repair or replace damaged lawns and meadows.
3.8 INSPECTION AND ACCEPTANCE

A. Where lawns and meadows do not comply with specified acceptance criteria, reestablish lawns and meadows and continue extended service period until lawns and meadows comply with criteria for acceptance.

+++ END OF SECTION +++
SECTION 33 05 05

BURIED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes the following:
      a. All types and sizes of buried piping, except where buried piping installations are specified under other Sections.
      b. Unless otherwise shown or specified, this Section includes all buried piping Work required, beginning at the outside face of structures or structure foundations, including piping beneath structures, and extending away from structures.
      c. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, cathodic protection, and other Work required for a complete, buried piping installation.
      d. Supports, restraints, and thrust blocks.
      e. Pipe encasements, with the exception of piping embedded in concrete within a structure or foundation specified under Section 40 05 05, Exposed Piping Installation.
      f. Field quality control, including testing.
      g. Cleaning and disinfecting.
      h. Incorporation of valves, meters, and special items shown or specified into piping systems in accordance with the Contract Documents and as required.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before buried piping Work.
   2. Coordinate with appropriate piping Sections of Division 40, Process Integration.

C. Related Sections:
   1. Section 31 20 00, Earth Moving.
   2. Section 03 00 05, Concrete.
   3. Section 09 91 00, Painting.
   4. Section 40 05 19, Ductile Iron Process Pipe
   5. Section 40 05 31, Thermoplastic Process Pipe
6. Section 40 24 33, Chlorine Piping, Valves, and Specials

1.2 REFERENCES

A. Standards referenced in this Section are:
1. ASME Boiler and Pressure Vessel Code.
6. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
11. ANSI/AWWA C206, Field Welding of Steel Water Pipe.
12. ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
15. ANSI/AWWA C651, Disinfecting Water Mains.
17. AWWA M23, PVC Pipe - Design and Installation.
18. AWWA M41, Ductile-Iron Pipe and Fittings.
19. AWWA M55, PE Pipe - Design and Installation.
20. ASCE 37, Design and Construction of Sanitary and Storm Sewers.
22. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with requirements and recommendations of authorities having
2. Obtain required permits for Work in roads, rights-of-way, railroads, and other areas of the Work.
1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Laying schedules for piping with restrained joints.
      b. Details of piping, specials, joints, harnessing and thrust blocks, and connections to piping, structures, equipment, and appurtenances.
   2. Product Data:
      a. Manufacturer’s literature and specifications, as applicable, for products specified in this Section.
   3. Testing Procedures:
      a. Submit proposed testing procedures, methods, apparatus, and sequencing. Obtain ENGINEER’s approval prior to commencing testing.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.
   2. Field Quality Control Submittals:
      a. Results of each specified field quality control test.

C. Closeout Submittals: Submit the following:
   1. Record Documentation:
      a. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work. Submittal shall show actual location of all piping Work and appurtenances at same scale as the Drawings.
      b. Show piping with elevations referenced to Project datum and dimensions from permanent structures. For each horizontal bend in piping, include dimensions to at least three permanent structures, when possible. For straight runs of piping provide offset dimensions as required to document piping location.
      c. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
   2. Upon delivery inspect pipe and appurtenances for cracking, gouging, chipping, denting, and other damage and immediately remove from Site and replace with acceptable material.
B. Storage:
   1. Store materials to allow convenient access for inspection and identification. Store material off ground using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.
   2. Pipe and fittings other than PVC and CPVC may be stored outdoors without cover. Cover PVC and CPVC pipe and fittings stored outdoors.

C. Handling:
   1. Handle pipe, fittings, specials, and accessories carefully in accordance with pipe manufacturer’s recommendations. Do not drop or roll material off trucks. Do not drop, roll or skid piping.
   2. Avoid unnecessary handling of pipe.
   4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Piping materials are specified in the Buried Piping Schedule at end of this Section. Piping materials shall conform to Specifications for each type of pipe and piping appurtenances in applicable Sections of Division 40, Process Integration.

B. General:
   1. Pipe Markings:
      a. Manufacturer shall cast or paint on each length of pipe and each fitting pipe material, diameter, and pressure or thickness class.

2.2 BURIED PIPING IDENTIFICATION

A. Polyethylene Underground Warning Tape for Metallic Pipelines:
   1. Tracer tape shall be of inert, acid- and alkali-resistant, polyethylene, four mils thick, six inches wide, suitable for direct burial. Tape shall be capable of stretching to twice its original length.
   2. Message shall read, “CAUTION [insert customized name of pipe service, i.e., “POTABLE WATER”, “SANITARY SEWER”, “CHLORINE GAS”, or other service as appropriate, as indicated in the Buried Pipe Schedule at the end of this Section] PIPE BURIED BELOW”, with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as pipeline colors specified for associated pipe service in Section 09 91 00, Painting.
3. Manufacturer: Provide products of one of the following:
   a. Brady Corporation
   b. Seton Identification Products
   c. Marking Services, Inc.
   d. Or equal.

B. Detectable Underground Warning Tape for Non-Metallic Pipelines:
   1. Tape shall be of inert, acid- and alkali-resistant, polyethylene, five mils thick,
      six inches wide, with aluminum backing, and have 15,000 psi tensile strength
      and 80 percent elongation capability. Tape shall be suitable for direct burial.
   2. Message shall read, “CAUTION [insert customized name of pipe service, i.e.,
      “POTABLE WATER”, “SANITARY SEWER”, “CHLORINE GAS”, or other
      appropriate service, as indicated in the Buried Pipe Schedule at the end of this
      Section] PIPE BURIED BELOW” with bold letters approximately two inches
      high. Messages shall be printed at maximum intervals of two feet. Tape shall
      be custom colored the same as the pipeline colors as specified for the
      associated pipe service in Section 09 91 00, Painting.
   3. Manufacturer: Provide products of one of the following:
      a. Brady Corporation
      b. Seton Identification Products
      c. Marking Services, Inc.
      d. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install piping as shown, specified, and as recommended by pipe and fittings
      manufacturer.
   2. In event of conflict between manufacturer’s recommendations and the Contract
      Documents, request interpretation from ENGINEER before proceeding.
   3. ENGINEER will observe excavations and bedding prior to laying pipe by
      CONTRACTOR. Notify ENGINEER in advance of excavating, bedding, pipe
      laying, and backfilling operations.
   4. Minimum cover over buried piping shall be 3 feet, unless otherwise shown or
      approved by ENGINEER.
   5. Earthwork is specified in Section 31 20 00, Earth Moving.
   6. Excavation in excess of that required or shown, and that is not authorized by
      ENGINEER shall be filled at CONTRACTOR’s expense with granular
      material furnished, placed, and compacted in accordance with Section
      31 20 00, Earth Moving.
   7. Comply with NFPA 24 for “Outside Protection”, where applicable to water
      piping systems used for fire protection.
B. Separation of Non Potable and Potable Water Piping:
   1. Horizontal Separation:
      a. Where possible, proposed potable water mains and service lines, and non potable water lines (drain and fire water lines) shall be separated horizontally by clear distance of at least five feet.
      b. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in separate trench or on undistributed earth shelf on one side of non potable water line and with bottom of potable water main at least 18 inches above top of non potable water line.
   2. Vertical Separation:
      a. Provide minimum vertical distance of 18 inches between outside of potable water main and outside of non potable water line when potable water main crosses over non potable water line.
      b. Center a section of potable water main pipe at least 17.5 feet long over non potable water line so that non potable water line joints are equidistant from potable water main joints.
      c. Provide adequate structural support where potable water main crosses under non potable water line. At minimum, provide compacted select backfill for ten feet on each side of crossing.
      d. Exceptions:
         1) Where it is not possible to provide minimum vertical separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe. Hydrostatically test water main and non potable water line as specified in this Section, prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.

C. Plugs:
   1. Temporarily plug installed pipe at end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
   2. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.
   3. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
   4. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to ENGINEER.

D. Bedding Pipe: Bed pipe as specified and in accordance with details on the Drawings.
   1. Trench excavation and backfill, and bedding materials shall conform to Section 31 20 00, Earth Moving, as applicable.
2. Where ENGINEER deems existing bedding material unsuitable, remove and replace existing bedding with approved granular material furnished, placed, and compacted in accordance with Section 31 20 00, Earth Moving. Payment for additional excavation and providing granular material will be made under the unit price payment items in the Contract.

3. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.

4. Carefully and thoroughly compact pipe bedding with hand held pneumatic compactors.

5. Do not lay pipe until ENGINEER approves bedding condition.

6. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

E. Laying Pipe:

1. Conform to manufacturer’s instructions and requirements of standards and manuals listed below, as applicable:
   c. Sanitary and Storm Sewers: ASCE 37.

2. Install pipe accurately to line and grade shown and indicated in the Contract Documents, unless otherwise approved by ENGINEER. Remove and reinstall pipes that are not installed correctly.

3. Slope piping uniformly between elevations shown.

4. Keep groundwater level in trench at least 24 inches below bottom of pipe before laying pipe. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.

5. Start laying pipe at lowest point and proceed towards higher elevations, unless otherwise approved by ENGINEER.

6. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by ENGINEER.

7. Excavate around joints in bedding and lay pipe so that pipe barrel bears uniformly on trench bottom.

8. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by ENGINEER.

9. For PVC and CPVC piping with solvent welded joints, 2.5-inch diameter and smaller, and copper tubing, snake piping in trench to compensate for thermal expansion and contraction.

10. Carefully examine pipe, fittings, valves, and specials for cracks, damage, and other defects while suspended above trench before installation. Immediately remove defective materials from the Site and replace with acceptable products.
11. Inspect interior of all pipe, fittings, valves, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be thoroughly wire brushed, and wiped clean and dry immediately before pipe is laid.

12. Field cut pipe, where required, with machine specially designed for cutting the type of pipe being installed. Make cuts carefully, without damage to pipe, coating or lining, and with smooth end at right angles to axis of pipe. Cut ends on push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.

13. Do not place blocking under pipe, unless specifically approved by ENGINEER for special conditions.

14. Touch up protective coatings in manner satisfactory to ENGINEER prior to backfilling.

15. Notify ENGINEER in advance of backfilling operations.

16. On steep slopes, take measures acceptable to ENGINEER to prevent movement of pipe during installation.

17. Thrust Restraint: Where required, provide thrust restraint conforming to Article 3.3 of this Section.

18. Exercise care to avoid flotation when installing pipe in cast-in-place concrete, and in locations with high groundwater.

F. Jointing Pipe:

1. Ductile Iron Mechanical Joint Pipe:
   a. Immediately before making joint, wipe clean the socket, plain end, and adjacent areas. Taper cut ends and file off sharp edges to provide smooth surface.
   b. Lubricate plain ends and gasket with soapy water or manufacturer’s recommended pipe lubricant, in accordance with ANSI/AWWA C111, just prior to slipping gasket onto plain end of the joint assembly.
   c. Place gland on plain end with lip extension toward the plain end, followed by gasket with narrow edge of gasket toward plain end.
   d. Insert plain end of pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
   e. Push gland toward socket and center gland around pipe with gland lip against gasket.
   f. Insert bolts and hand-tighten nuts.
   g. If deflection is required, make deflection after joint assembly and prior to tightening bolts. Alternately tighten bolts approximately 180 degrees apart to seat gasket evenly. Bolt torque shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Diameter (inches)</th>
<th>Bolt Diameter (inches)</th>
<th>Range of Torque (ft-lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>5/8</td>
<td>45 to 60</td>
</tr>
<tr>
<td>4 to 24</td>
<td>3/4</td>
<td>75 to 90</td>
</tr>
</tbody>
</table>
h. Bolts and nuts, except those of stainless steel, shall be coated with two coats, minimum dry film thickness of eight mils each, of high build solids epoxy or bituminous coating manufactured by Tnemec, or equal.

i. Restrained mechanical joints shall be in accordance with Section 40 05 19, Ductile Iron Process Pipe.

2. Ductile Iron Push-On Joint Pipe:
   a. Prior to assembling joints, thoroughly clean with wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.
   b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer’s instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
   c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.
   d. Immediately prior to joint assembly, apply thin film of pipe manufacturer’s recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
   e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
   f. Maintain an adequate supply of gaskets and joint lubricant at the Site when pipe jointing operations are in progress.

3. Ductile Iron Proprietary Joints:
   a. Install pipe that utilizes proprietary joints for restraint specified in Section 40 05 19, Ductile Iron Process Pipe, or other such joints, in accordance with manufacturer’s instructions.

4. Thermoplastic Pipe Joints:
   a. Solvent Cement Welded Joints:
      1) Bevel pipe ends and remove all burrs before making joints. Clean pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.
      2) Use solvent cement supplied or recommended by pipe manufacturer.
      3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.
4) Take appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.

b. Bell and Spigot Joints:
1) Bevel pipe ends, remove all burrs, and provide a reference mark at correct distance from pipe end before making joints.
2) Clean spigot end and bell thoroughly before making the joint. Insert O-ring gasket while ensuring that gasket is properly oriented. Lubricate spigot with manufacturer’s recommended lubricant. Do not lubricate bell and O-ring. Insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.

5. Mechanical Coupling Joints:

a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings, plasticized PVC couplings, and other mechanical couplings.

b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with wire brush to remove foreign matter.

c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.

d. For plasticized PVC couplings, loosen the stainless steel clamping bands and remove clamps from coupling. Slide coupling over plain ends of pipes to be joined without using lubricants. Place clamps over each end of coupling at grooved section and tighten with torque wrench to torque recommended by manufacturer.

G. Backfilling:
1. Conform to applicable requirements of Section 31 20 00, Earth Moving.
2. Place backfill as Work progresses. Backfill by hand and use power tampers until pipe is covered by at least one foot of backfill.

H. Connections to Valves and Hydrants:
1. Install valves and hydrants as shown and indicated in the Contract Documents.
2. Provide suitable adapters when valves or hydrants and piping have different joint types.
3. Provide thrust restraint at all hydrants and at valves located at pipeline terminations.
I. Transitions from One Type of Pipe to Another:
   1. Provide necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

J. Closures:
   1. Provide closure pieces shown or required to complete the Work.

3.2 TRACER TAPE INSTALLATION

A. Polyethylene Underground Warning Tape for Metallic Pipelines:
   1. Provide polyethylene tracer tape for buried metallic piping, which includes pipe that is steel, ductile iron, cast iron, and copper.
   2. Provide tracer tape 12 to 18 inches below finished grade, above and parallel to buried pipe.
   3. For pipelines buried eight feet or greater below finished grade, provide second line of magnetic tracer tape 2.5 feet above crown of buried pipe, aligned along pipe centerline.
   4. Tape shall be spread flat with message side up before backfilling.

B. Detectable Underground Warning Tape for Non-Metallic Pipelines:
   1. Provide polyethylene tracer tape with aluminum backing for buried, non-metallic piping, which includes pipe that is PVC, CPVC, and polyethylene.
   2. Provide magnetic tracer tape 12 to 18 inches below finished grade, above and parallel to buried pipe.
   3. For pipelines buried eight feet or greater below finished grade, provide second line of magnetic tracer tape 2.5 feet above crown of buried pipe, aligned along the pipe centerline.
   4. Tape shall be spread flat with message side up before backfilling.

3.3 THRUST RESTRAINT

A. Provide thrust restraint on pressure piping systems where shown or indicated in the Contract Documents.

B. Thrust restraint may be accomplished by using restrained pipe joints, concrete thrust blocks, or harnessing buried pipe. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Buried Piping Schedule at the end of this Section.

C. Place concrete thrust blocks against undisturbed soil. Where undisturbed soil does not exist, or for projects where the Site consists of backfill material, thrust restraint shall be provided by restrained pipe joints.
D. Restrained Pipe Joints:
   1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
      a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with proprietary restrained joint system as specified in Section 40 05 19, Ductile Iron Process Pipe; lugs and tie rods; or other joint restraint systems approved by ENGINEER.
      b. Thermoplastic Joints: Where bell and spigot-type or other non-restrained joints are utilized, provide tie rods across joint or other suitable joint restraint system, subject to the approval of ENGINEER.

E. Concrete Thrust Blocks:
   1. Provide concrete thrust blocks on pressure piping at changes in alignment of 15 degrees or more, at tees, plugs and caps, and where shown or indicated in the Contract Documents. Construct thrust blocks of Class B concrete, conforming to Section 03 00 05, Concrete.
   2. Install thrust blocks against undisturbed soil. Place concrete so that pipe and fitting joints are accessible for repair.
   3. Concrete thrust block size shall be as shown on the Drawings or as approved by ENGINEER.

F. Harnessed lengths of buried pipe shall be as shown on the Drawings.

3.4 FIELD QUALITY CONTROL

A. General:
   1. Test all piping, except as exempted in the Buried Piping Schedule in this Section.
   2. When authorities having jurisdiction are to witness tests, notify ENGINEER and authorities having jurisdiction in writing at least 48 hours in advance of testing.
   3. Conduct all tests in presence of ENGINEER.
   4. Remove or protect pipeline-mounted devices that could be damaged by testing.
   5. Provide all apparatus and services required for testing, including:
      a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain OWNER’s operations.
      b. Temporary bulkheads, bracing, blocking, and thrust restraints.
   6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
   7. Unless otherwise specified, OWNER will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into piping being tested. CONTRACTOR shall provide fluid for other types of testing required.
8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.

B. Test Schedule:
1. Refer to the Buried Piping Schedule in this Section for type of test required and required test pressure.
2. Unless otherwise specified, required test pressures are at lowest elevation of pipeline segment being tested.
3. For piping not listed in Buried Piping Schedule in this Section:
   a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum.
   b. Use exfiltration testing, low-pressure air testing, or vacuum testing for other piping.
   c. Disinfect for bacteriological testing piping that conveys potable water.
4. Test Pressure:
   a. Use test pressures listed in Buried Piping Schedule in this Section.
   b. If test pressure is not listed in Buried Piping Schedule, or if test is required for piping not listed in the Buried Piping Schedule, test pressure will be determined by ENGINEER based on maximum anticipated sustained operating pressure and methods described in applicable ANSI/AWWA manual or standard that applies to the piping system.

C. Hydrostatic Testing:
1. Preparation for Testing:
   a. For thermoplastic pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.
   b. For other piping follow procedures described in ANSI/AWWA Manual M9, except that minimum wetting period required immediately prior to testing for asbestos cement pipe shall be 24 hours rather than the 48 hours prescribed for concrete pipe. Wetting period is not required for pipe that is not cement mortar-lined.
   c. Prior to testing, ensure that adequate thrust protection is in place and joints are properly installed.
   d. Piping for Hydraulic Fluid, Lube Oil, and Diesel Fuel: Hydrostatically test system using the fluid with which system will function permanently. Allowable leakage is zero. For fluid power systems, pipe manufacturer shall supervise installation and testing of system components, including field piping.
2. Test Procedure:
   a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.
   b. Expel air from pipe as required. Obtain approval of ENGINEER prior to tapping pipe for expelling air.
c. Examine exposed joints and valves, and make repairs to eliminate visible leakage.
d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
e. Timed test period shall not begin until after pipe has been filled, exposed to required wetting period, air has been expelled, and pressure stabilized.
f. Timed Test Period: After stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure.
g. Pump from test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at 15 minute intervals for duration of test.

3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of test pressure during timed test period. Allowable leakage rates for piping are:
   a. No Leakage: Pipe with flanged, welded, fused, or threaded joints.
   b. Rates based on formula or table in ANSI/AWWA Manual M41:
      1) Metal pipe joined with rubber gaskets as sealing members, including the following joint types:
         a) Bell and spigot and push-on joints.
         b) Mechanical joints.
         c) Bolted sleeve type couplings.
         d) Grooved and shouldered couplings.
   c. Rates based on formula or table in ANSI/AWWA C605:
      1) Plastic pipe joined with O-ring gasket sealing members.

D. Drain Pipe Testing with Low Pressure Air:
   1. Plug and bulkhead ends and lateral connections of pipe segment to be tested.
   2. Required test pressure shall be increased by an amount equal to the elevation of groundwater above invert of lowest point of pipe segment being tested.
   3. Test in accordance with requirements of authority having jurisdiction.
   4. If there are no Laws and Regulations covering the test, use test procedures described in the following standards:

E. Vertical Deflection Test for Thermoplastic Pipe:
   1. Conduct vertical deflection test at least thirty days after backfill has been placed.
   2. Manually pull pin-type vertical gauge mounted on sled through pipe. Gauge shall be manufactured by Quality Test Products, or equal. Set gauge so that sled will stop if vertical deflection of pipe exceeds five percent. Excavate and re-install piping that fails deflection test, and retest.
   3. Use rigid ball or mandrel for deflection test, which shall have diameter of at least 95 percent of base inside diameter or average inside diameter of piping,
depending on which is specified in applicable ASTM standard, including appendix, to which pipe is manufactured. Perform test without mechanical pulling devices. Re-install and retest pipe segments that exceed deflection of five percent.

F. Examination of Welds for Stainless Steel Pipe:
   1. Personnel performing examination of welds shall be qualified to at least Level II in accordance with ASNT SNT-TC-1A.
   2. Conform to ASME Boiler and Pressure Vessel Code Section V and applicable articles for examination of welds.
   3. Visually examine all welds, Category D Fluid Service, in conformance with ASME B31.3.
   4. Examine at least ten percent of welds using liquid penetrant examination.
   5. If defect is detected, all welds shall be examined by liquid penetrant examination.
   6. At conclusion of liquid penetrant examination, remove penetrant test materials by flushing, washing, or wiping clean with applicable solvents.

G. Bacteriological Testing:
   1. Bacteriological testing for potable water lines, finished water lines, and other piping in accordance with the Buried Piping Schedule, is specified in Article 3.6 of this Section.

3.5 CLEANING AND DISINFECTION

A. Cleaning, General: Clean pipe systems as follows:
   1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in manner approved by ENGINEER, prior to placing in service. Flush chlorine solution and sodium hypochlorite piping with water.
   2. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with five percent sodium hypochlorite solution.

B. Disinfection:
   1. Disinfect all potable and finished water piping.
   2. Suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered for acceptance by ENGINEER.
      a. Prior to disinfection, clean piping as specified and flush thoroughly.
      b. Conform to procedures described in ANSI/AWWA C651. Use continuous feed method of disinfecting, unless alternative method is acceptable to ENGINEER.
   3. Water for initial flushing, testing, and disinfection will be furnished by OWNER. CONTRACTOR shall provide all temporary piping, hose, valves,
appurtenances, and services required. Cost of water required for redisinfection will be paid by CONTRACTOR to OWNER at water utility’s standard rates.

4. Chlorine shall be provided by CONTRACTOR.

5. Bacteriologic tests will be performed by OWNER. Certified test laboratory report will be provided to CONTRACTOR, if requested.

6. Chlorine concentration in water entering the piping shall be between 50 and 75 ppm, such that minimum residual concentration of 25 mg/L remains after 24-hour retention period. Disinfect piping and all related components. Repeat as necessary to provide complete disinfection.

7. After required retention period, flush chlorinated water to closed drain line, unless otherwise acceptable to ENGINEER. Properly dispose of chlorinated water in accordance with Laws and Regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland without adequate de-chlorination.

3.6 SCHEDULES

A. Schedules listed below, following the “End of Section” designation, are part of this Specification section.

1. Table 33 05 05-A, Buried Piping Schedule.

++ END OF SECTION ++
<table>
<thead>
<tr>
<th>Service</th>
<th>Diameter (inch)</th>
<th>Material</th>
<th>Interior Lining</th>
<th>Exterior Coating</th>
<th>Pressure Class/ Thickness</th>
<th>Joint</th>
<th>Test</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>RW</td>
<td>8, 12</td>
<td>C900 PVC</td>
<td>N/A</td>
<td>N/A</td>
<td>DR 18</td>
<td>RBS</td>
<td>HYD (100)</td>
<td>Restrained per AWWA Requirements</td>
</tr>
<tr>
<td>FW</td>
<td>12</td>
<td>C900 PVC</td>
<td>N/A</td>
<td>N/A</td>
<td>DR 18</td>
<td>RBS</td>
<td>HYD (150)</td>
<td>Fire Water System Piping, Restrained per AWWA Requirements</td>
</tr>
<tr>
<td>PW</td>
<td>8, 12</td>
<td>C900 PVC</td>
<td>N/A</td>
<td>N/A</td>
<td>DR 18</td>
<td>RBS</td>
<td>HYD (150), DBT</td>
<td>Potable Water Yard Piping, Restrained per AWWA Requirements</td>
</tr>
<tr>
<td>PW</td>
<td>6</td>
<td>C900 PVC</td>
<td>N/A</td>
<td>N/A</td>
<td>DR 18</td>
<td>RBS</td>
<td>HYD (150), DBT</td>
<td>Klausner Facility Service Line, Restrained per AWWA Requirements</td>
</tr>
<tr>
<td>SHP</td>
<td>1/2</td>
<td>PVC</td>
<td>N/A</td>
<td>N/A</td>
<td>Sch 80</td>
<td>SW</td>
<td>HYD (150)</td>
<td></td>
</tr>
<tr>
<td>DR</td>
<td>4</td>
<td>PVC</td>
<td>N/A</td>
<td>N/A</td>
<td>Sch 40</td>
<td>SW</td>
<td>AIR</td>
<td></td>
</tr>
<tr>
<td>PW</td>
<td>1-1/2</td>
<td>PVC</td>
<td>N/A</td>
<td>N/A</td>
<td>Sch 80</td>
<td>SW</td>
<td>HYD (150), DBT</td>
<td>Plant PW for Sink, Hose Bibs, and Emergency Showers</td>
</tr>
<tr>
<td>Sample</td>
<td>1/2</td>
<td>SS</td>
<td>N/A</td>
<td>N/A</td>
<td>Tubing</td>
<td>CF</td>
<td>NR</td>
<td>Sample Line to Chlorine Residual Analyzer</td>
</tr>
</tbody>
</table>
The following abbreviations are used in the Buried Piping Schedule.

A. Service Abbreviations

<table>
<thead>
<tr>
<th>Service</th>
<th>Abbrev</th>
<th>Service</th>
<th>Abbrev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Water</td>
<td>RW</td>
<td>Sodium Hypochlorite</td>
<td>SHP</td>
</tr>
<tr>
<td>Potable Water</td>
<td>PW</td>
<td>Drain</td>
<td>DR</td>
</tr>
<tr>
<td>Fire Flow Water</td>
<td>FW</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Material Abbreviations

<table>
<thead>
<tr>
<th>Material</th>
<th>Abbrev</th>
<th>Material</th>
<th>Abbrev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductile Iron</td>
<td>DI</td>
<td>Polyvinyl Chloride</td>
<td>PVC</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>SS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. Lining/Coating Abbreviations

<table>
<thead>
<tr>
<th>Lining</th>
<th>Abbrev</th>
<th>Coating</th>
<th>Abbrev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Mortar Lined</td>
<td>CL</td>
<td>Asphalitic Coated</td>
<td>AC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Polyethylene Wrapped</td>
<td>PEW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Painted</td>
<td>P</td>
</tr>
</tbody>
</table>

D. Joint Abbreviations

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Abbrev</th>
<th>Joint Type</th>
<th>Abbrev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bell and Spigot</td>
<td>BS</td>
<td>Solvent Weld</td>
<td>SW</td>
</tr>
<tr>
<td>Restrained Bell and Spigot</td>
<td>RBS</td>
<td>Split Flexible Coupling</td>
<td>SPFC</td>
</tr>
<tr>
<td>Push-on Joint</td>
<td>POJ</td>
<td>Plasticized PVC Coupling</td>
<td>PPVC</td>
</tr>
<tr>
<td>Restrained Push-on Joint</td>
<td>RPOJ</td>
<td>Flanged</td>
<td>Flg</td>
</tr>
<tr>
<td>Mechanical Joint</td>
<td>MJ</td>
<td>Sleeve-type Flexible Coupling</td>
<td>SLFC</td>
</tr>
<tr>
<td>Restrained Mech. Joint</td>
<td>RMJ</td>
<td>Threaded</td>
<td>Thd</td>
</tr>
<tr>
<td>Compression Flange Adapter</td>
<td>CFA</td>
<td>Grooved or Shouldered End Coupling</td>
<td>GSEC</td>
</tr>
<tr>
<td>Compression Sleeve Coupling</td>
<td>CSC</td>
<td>Compression Fitting</td>
<td>CF</td>
</tr>
</tbody>
</table>
### E. Test Abbreviations

<table>
<thead>
<tr>
<th>Test</th>
<th>Abbrev</th>
<th>Test</th>
<th>Abbrev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrostatic Test (test pressure in psig)</td>
<td>HYD ( )</td>
<td>Examination of Welds</td>
<td>EW</td>
</tr>
<tr>
<td>Low-pressure Air Sewer Test</td>
<td>AIR</td>
<td>Disinfection and Bacteriological Testing</td>
<td>DBT</td>
</tr>
<tr>
<td>Vertical Deflection</td>
<td>VD</td>
<td>No Test Required</td>
<td>NR</td>
</tr>
</tbody>
</table>
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install a pre-fabricated, pre-tested, skid-mounted, UL-listed pump station, complete and operational with end suction centrifugal pumps, motors, piping, fittings, valves, wiring, control panel and equipment, and accessories as shown and specified. Anchor bolts are included in this Section.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the packaged potable pump station Work.
   2. The manufacturer of the equipment specified herein shall be required to review and satisfy all relevant requirements of other sections of the Contract Documents and the requirements of the Contract Drawings. The CONTRACTOR, manufacturer, supplier, fabricator and/or subcontractors furnishing and/or installing equipment, services and specialties associated with this Section shall fully coordinate their efforts to avoid potential claims that are based on failure to review all relevant Contract Documents.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 05 05 33, Anchor Systems.
   3. Section 09 91 00, Painting.
   4. Section 26 00 05, Electrical Work.
   5. Section 40 05 05, Exposed Piping Installation.
   6. Section 40 05 53, Process Valves Four-inch Diameter and Larger.
   7. Section 40 60 05, Instrumentation and Control for Process Systems.
   8. Section 40 61 96, Process Control Descriptions.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
5. Institute of Electrical and Electronic Engineers, (IEEE).
8. Standards of the National Electrical Manufacturers Association, (NEMA).

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment, and shall be able to show evidence of at least ten installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. To ensure that the equipment is properly coordinated and will function in accordance with the requirements of the Contract Documents, the equipment specified herein shall be provided by a single supplier, whom shall have complete responsibility for the proper function of the potable pump station system. However, the CONTRACTOR shall retain ultimate responsibility under this Contract for equipment coordination, installation, operation and guarantee, and the CONTRACTOR shall furnish and install all labor, equipment, materials, appurtenances, specialty items and services not provided by the supplier but required for a complete and operable system.

   2. The packaged pump station manufacturer shall review and approve all Shop Drawings and other submittals for all components furnished under this Section prior to submittal to the ENGINEER.

   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the packaged pump station manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Manufacturer's literature, illustrations, specifications and engineering data for all components including: dimensions, materials, size, weight, and performance data. Provide pump curves showing overall pump efficiencies, required net positive suction head, flow rate, head, brake horsepower, motor horsepower, speed and shut-off head.
      b. Motor Tests and Data: Furnish an inspection report for the motor or for a previously manufactured electrically duplicate motor which was tested. Provide the following minimum data:
         1) Running light current.
         2) Locked rotor current.
3) Winding resistance measurement.
4) High potential test.
5) Bearing inspection.

2. Shop Drawings:
   a. Drawings including skid framing, connection location and dimensions, and equipment layout.
   b. Fabrication, assembly, installation and wiring diagrams.
   c. Control panel layouts and wiring diagrams.

B. Informational Submittals: Submit the following:
   1. Source Quality Control:
      a. Certified pump station shop tests.
   2. Warranty:
      a. Submit a copy of the Warranty.

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data:
      a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information for all components of the packaged pump station.
      b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
   2. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
   1. Unload, store, and handle equipment in accordance with manufacturer's recommendations and the requirements of the Contract Documents.
   2. Store all equipment in covered storage off the ground.
   3. Protect all threads and machined surfaces from corrosion.
   4. Store all electrical and electronic equipment, control panels, and like equipment and materials in air conditioned, fully enclosed buildings which have a concrete or wooden floor, a roof, and solid walls on all sides. Protect electrical and electronic equipment from contamination from dust, dirt and moisture. Maintain humidity at levels recommended by manufacturer for electric and electronic equipment.
   5. Conform to Section 01 66 00, Product Storage and Handling Requirements.
C. Acceptance at Site:
   1. Equipment shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer’s instructions.

1.6 WARRANTY AND GUARANTEE

A. The Manufacturer shall provide a warranty that the packaged pump station shall be free of defects in workmanship for a period of one year from date of authorized start-up. Packaged pump station manufacturer shall provide replacement parts or components during the warranty life at no additional cost to the OWNER.

B. In addition to the manufacturer's standard guarantee, CONTRACTOR shall include the services of a factory-trained serviceman to provide repair service for the equipment for the period of one year commencing with the time the equipment is placed in continuous permanent operation. This service shall include the cost of all replacement parts required during the interval.

PART 2 - PRODUCTS

2.1 GENERAL

A. General:
   1. All wetted surfaces of packaged pump station shall be suitable for continuous exposure to chlorinated water (up to 6 mg/L) and shall be NSF or food grade approved.
   2. Pump station system shall be listed by Underwriters Laboratories for packaged pumping systems.
   3. Piping, valves and appurtenances not specified herein shall meet the requirements of Sections 40 05 19, Ductile Iron Process Pipe, and Section 40 05 53, Process Valves, Four-Inch Diameter and Larger.

2.2 PUMPS

A. Description:
   1. Pumps shall be horizontal centrifugal end suction type.
   2. The pumps shall be manufactured and installed according to the standards of the Hydraulic Institute and to ANSI Specification No. B58.1.

B. Performance Criteria: Pumps shall comply with the minimum design conditions specified below and shall be specially designed, constructed, and installed for the service intended:
<table>
<thead>
<tr>
<th>Design Conditions&lt;sup&gt;(1)&lt;/sup&gt;</th>
<th>Pumps No. 1 and 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number required:</td>
<td>2</td>
</tr>
<tr>
<td>Design Flow, (gpm):</td>
<td>500</td>
</tr>
<tr>
<td>Design TH&lt;sup&gt;(1)&lt;/sup&gt;, (ft.):</td>
<td>175</td>
</tr>
<tr>
<td>Minimum Efficiency at Design, (%):</td>
<td>74</td>
</tr>
<tr>
<td>Minimum Shutoff Head, (ft):</td>
<td>210</td>
</tr>
<tr>
<td>Motor, (Hp):</td>
<td>40</td>
</tr>
<tr>
<td>Maximum Speed, (rpm):</td>
<td>3500</td>
</tr>
<tr>
<td>Pump Station Suction Size, (in.):</td>
<td>8</td>
</tr>
<tr>
<td>Pump Station Discharge Size, (in.):</td>
<td>8</td>
</tr>
<tr>
<td>Flow at 2nd Design Point, (gpm):</td>
<td>350</td>
</tr>
<tr>
<td>TH at 2nd Design Point&lt;sup&gt;(1)&lt;/sup&gt;, (ft.):</td>
<td>195</td>
</tr>
<tr>
<td>Liquid Pumped:</td>
<td>Potable Water</td>
</tr>
<tr>
<td>Temperature, (°F):</td>
<td>60-85</td>
</tr>
<tr>
<td>Drive Type:</td>
<td>Constant Speed</td>
</tr>
<tr>
<td>Motor: Volts/Phase/Hertz</td>
<td>460/3/60</td>
</tr>
</tbody>
</table>

<sup>(1)</sup> Does not include pump station losses.

C. Pump Materials and Construction: All materials in contact with process water shall be NSF-61 listed for use with potable water and shall be compatible with the liquid pumped.

1. Casing: Cast-iron with an NSF-approved internal coating.
2. Impeller Type: Enclosed, dynamically balanced.
4. Impeller Wear Ring: Chrome steel, hardened.
5. Suction Head Wear Ring: Chrome steel, hardened.
7. Shaft: Stainless steel.
9. Bearings: Anti-friction, oil lubricated with a minimum B-10 life of 100,000 hours.
10. Baseplate: Structural steel or cast-iron provided with means for collecting and draining oil and water.
11. Furnish with 125 pound ANSI connection flanges.
12. All bolts, nuts and cap screws shall have hexagon heads.
13. Brass or stainless steel nameplates giving the manufacturer's model and serial number, rated capacity, head, speed and all other pertinent data shall be attached to the pump.
14. Manufacturers: Pumps shall be manufactured by one of the following:
   a. Peerless Pump.
   b. Aurora Pump of Pentair, Inc.
   c. Or approved equal.
D. Motors:
1. Motors shall conform to the requirements of Section 26 00 05, Electrical Work.
2. TEFC, NEMA Premium Efficiency, inverter duty, 3 phase 60 hertz 480 V, solid shaft rotor with ball bearing type.
3. Motors shall be in accordance with all current applicable standards of NEMA, IEEE, AFBMA, NEC, and ANSI.
4. Motors shall be normal starting torque, normal slip, squirrel cage induction type.
5. Motors shall be capable of carrying full load current continuously without injurious temperature rise in an ambient temperature of 40°C.
6. Motors shall be provided with a service factor of 1.15.
7. Motors shall be of sufficient size so that there will be no overload on the motor above rated nameplate horsepower under any condition of operation from shut-off to zero head, unless otherwise specifically permitted in this Section.
8. Motor thrust bearings shall be adequate to carry continuous thrust loads under all conditions of pump operation from zero head to shut-off.
9. Locked rotor currents shall be as specified in NEMA standards.
10. Motor Winding Protection: Provide in each phase winding, normally closed thermostats that are; snap-action, bi-metallic, temperature actuated switches, installed in the end turns of the motor winding to shutdown motor in the event of high winding temperature. Thermostat temperature switch point is pre-calibrated by the manufacturer, is not adjustable and is based on motor temperature rating (insulation class). Reset is automatic after winding cools down.
11. Space Heaters:
   a. Motors shall be furnished with space heaters to provide sufficient wattage to maintain the internal temperature of the motor at a level approximately 10°C above the ambient temperature while the motor is not in operation.
   b. Space heaters shall be of the silicone rubber strip type attached directly to the stator end turns. The leads shall be brought out to an auxiliary terminal box.
   c. Space heaters shall be rated for operation on a single phase, 60-hertz, 120-volt system.
12. Manufacturers: Motors shall be manufactured by one of the following:
   a. Baldor.
   c. Or approved equal.

2.3 VALVES

A. Butterfly Valves:
1. Isolation valves shall be installed on the suction and discharge of the pumps to completely isolate individual pumps.
2. Valves shall be manufactured in accordance with the latest revision of AWWA C504, Class 150B and conform to NSF Standard 61.
3. Valves shall have one piece body cast from ASTM A126 Class B cast iron.
4. Stem shall be 304 stainless steel.
5. Disc shall be from ASTM A126 Class B cast iron with a 316 stainless steel edge, lens shaped design, retained by stainless steel pins extending through the stem.
6. Stem bushings shall be self lubricating non metallic material.
7. Seat shall be one piece elastomer, bonded into a recessed cavity in the valve body or retained on the disc with a removable seat ring.
8. Manual actuator shall be of the traveling nut, self locking type and shall be designed to hold the valve in any position intermediate between fully open and fully closed without creeping or fluttering.
9. Valve shall be rated at 150 PSI working pressure.
10. Pump isolation valves shall be as manufactured by Val-Matic, Pratt, DeZurik, or approved equal, and shall conform to the requirements of Section 40 05 53, Process Valves Four-inch Diameter and Larger.

B. Flexible Pipe Connectors:
1. Pump suction and discharge connections shall include a flanged flexible connector, single sphere type, rated at 150 psi working pressure.
2. Connector shall be installed between the pump and its isolation valve.
3. Control rod assembly shall be provided to absorb pressure thrust at the expansion joint.
4. Wetted and exposed elastomeric portions of flexible connector shall be constructed of EPDM.

C. Silent Check Valves:
1. Pump discharge check valves shall be of the silent operating type that begin to close as the forward flow diminishes and is fully closed at zero velocity, preventing flow reversal and resultant water hammer or shock.
2. The valves shall be designed, manufactured and tested in accordance with American Water Works Association.
3. Check valves shall be provided with flanges in accordance with AWWA C207, Class D.
4. All component parts shall be field replaceable without the need of special tools. A replaceable guide bushing shall be provided and held in position by the spring.
5. The spring shall be helical or conical in form and shall be designed to withstand 100,000 cycles without failure and provide a cracking pressure of 0.5 psi.
6. The valve disc shall be concave to the flow direction, and shall allow for zero leakage.
7. The valve body and cover shall be constructed of ASTM A126 Class B cast iron.
8. The seat and disc shall be ASTM B584 bronze with Buna-N seal.
9. The compression spring shall be constructed of Type 316 stainless steel with ground ends.

10. Valves shall be hydrostatically tested at 1.5 times their rated working pressure and seat tested at the valve rated working pressure.

11. The valve shall be coated with an NSF 61 approved fusion bonded epoxy coating for use with potable water and shall be compatible with the liquid pumped.

12. Check valves shall conform to the requirements of Section 40 05 53, Process Valves Four-inch Diameter and Larger.

13. Manufacturer:
   a. The manufacturer shall demonstrate a minimum of five (5) years experience in the manufacture of silent check valves.
   b. Provide valves manufactured by Val-Matic, Apco Valve, Pratt, or approved equal.

D. Pressure Relief Valve:
   1. Pressure relief valve shall be single-seated, diaphragm operated, pilot-controlled, globe or angle valve. It shall be spring loaded and hydraulically operated. Valve spring shall be of stainless steel. Seat ring shall be of stainless steel and readily replaceable with no special tools.

   2. Diaphragm assembly shall be fully guided, top and bottom. Diaphragm shall be constructed of nylon reinforced Buna-N synthetic rubber and shall be fully supported by the valve casting in both the full-open and full-closed positions to eliminate strain on the diaphragm. All necessary repairs shall be possible without removing valve from the line. Packing glands are not permitted. Disc shall be Buna-N and have a rectangular cross section. Valve disc and seat shall have an anti-cavitation design of intermeshing orifices to prevent cavitation from discharge pressure to atmosphere.

   3. The main valve shall be equipped with the following accessories to ensure proper operation:
      a. Control valve pilots shall have stainless steel seats, Buna-N sealing surface and a Buna-N diaphragm. Pilot valve bodies shall be from bronze.
      b. Pressure-sustaining pilot shall be sensitive to valve inlet pressure. Pilot shall be normally closed and spring-loaded with spring tension adjustment. Pilot shall open automatically against the spring-loading set when pilot inlet pressure exceeds the set value. This pilot shall function to maintain a minimum valve inlet pressure which shall prevent the pumps from operating under an unstable or overloaded condition.
      c. Isolation cocks shall be provided on control tubing at the valve inlet, outlet and bonnet ports on valves 4" and larger. These valves shall be situated such that the control valve may be manually closed & the valve trim isolated and serviced.

   4. Strainers shall be provided to remove any solids that may be of sufficient size to damage or plug the pilots and other control components. The inner mesh
shall be of MONEL and shall be designed to support the outer screen. The outer screen shall be of 0.008" MONEL wire, having a 40 x 40 mesh.

5. An isolation valve shall be provided at the inlet of the surge anticipator valve, conforming to the requirements of the high pressure butterfly pump isolation valves specification.

6. Valve shall exhaust to suction manifold.

7. Valve shall be manufactured by Cla-Val Company, or approved equal.

2.4 PIPING AND ACCESSORIES

A. Piping:
1. All piping, 10" and smaller, shall be constructed from ASTM A105 or ASTM A-53 schedule 40 steel pipe.
2. Piping smaller than 4" and greater than 36" shall be flame cut and beveled, having the cut surface ground to bare metal before welding.
3. Piping 4" to 36" size shall be plasma cut and beveled, including ends, and side penetrations.
4. Welders performing structural and pipe welds shall be certified to ASME section IX, and their certificates shall be on file with the manufacturer. Upon request by the engineer or owner, the certificates shall be made available for inspection.
5. After fabrication and before coating, piping shall be hydrostatically tested to 150% of maximum pump shutoff pressure plus stated suction pressure, or greater.
6. All steel piping shall be blasted inside to SSPC SP10, near white metal, and lined with an AWWA C213 and NSF 61-approved fusion bonded epoxy, tested and found to be without holidays.
7. Fusion bonded epoxy shall be applied to the manufacturer's recommendations regarding thickness, temperature, and duration. Manufacturer's certificate of application shall be retained on file, and shall be available for inspection when requested by the engineer or owner.

B. Skid Base:
1. All equipment including, but not limited to, pumps, motors, valves, panel, instrumentation and controls, shall be mounted on a common structural steel base to form a complete operating pumping system.
2. The pumping system base shall be designed and fabricated to provide proper structural support for all attached equipment if it is supported solely on the peripheral members. Internal members need not contact the floor. This design shall allow the pumping system to be mounted on a slab. The base shall supply sufficient rigidity to withstand the stresses of reasonable and competent transportation to site, off loading, installation, and operation.
3. Peripheral structural members shall be from channel or wide flange beam, ASTM A36.
4. Internal structural members shall be from ASTM A36 rectangular tubing or channel.
5. Base shall be of open framework construction, suitable for grouting.
6. All employees welding structural members shall have certificates on file exhibiting conformance to ASME AWS D1.1 structural welding.
7. Provisions shall be made in the station base for off-loading and handling the station at the site.

C. Pipe Supports:
1. Piping support shall be manufactured from structural rectangular tubing, sized according to the weight and size of the piping to be supported when filled with water.
2. Each tubing member shall be capped to prevent internal corrosion.
3. Vertical tubing members shall be solidly welded to the skid and shall support the weight of the piping when filled with water.
4. Horizontal tubing members shall be solidly welded to the vertical members, shall extend beyond the pipe OD, and shall support the weight of the piping when filled with water.
5. Piping shall be secured to the members through the use of piping U bolts designed for this purpose.

D. Sample Tap:
1. A sample tap shall be provided, installed with a vacuum breaker to prevent the possibility of cross contamination.

2.5 POTABLE WATER PUMP CONTROL PANEL (PWPCP)

A. Provide a skid mounted duplex control panel for control and monitoring of the potable water pumps, as required and shown. The potable water pump system control panel shall use relay logic with use of relays, timers, and other appurtenances to control and monitor the potable water pumps.

B. The PWPCP shall be a factory assembled, wired and tested unit. It shall require only one source power feed connection of 480V, 3ph, 60Hz with 30,000 ampere rms symmetrical fault interrupting capacity.

C. Provide control power transformer with fused secondary power. PWPCP shall provide power and control to all skid mounted equipment, instrumentation, and other appurtenances.

D. Motor starters shall be NEMA-rated and include magnetic contactor, with encapsulated magnet coils. Starters shall be full-voltage non-reversing.

E. Overload relays:
1. Provide an overload relay for each motor starter. Relays shall be electronic,
multi-function, adjustable, current sensing type and include overload, phase-unbalance, phase-loss, and equipment type ground fault in one package.

2. Each overload relay shall be manual reset type and shall include provisions for resetting by an insulating button on front of starter unit door.

3. Size each overload relay for full-load amperes and service factor of actual motors installed.

F. The control enclosure and back plate assembly shall be constructed of 14 gauge steel.

G. All indicating lights, reset buttons, and selector switches shall be mounted on the enclosure door and shall be NEMA 4 rated. Refer to 40 60 05, Instrumentation and Control for Process Systems for additional control panel requirements.

H. The PWPCP shall be of NEMA 4X stainless steel construction and shall include the following devices for each potable water pump:
   1. Pump “HAND/OFF/AUTO” selector switch.
   2. Pump “RUN” green indicating light.
   4. Pump “Discharge Pressure High” amber indicating light.
   6. ETM.

I. The PWPCP shall include the following additional devices on the panel:
   1. Alternate switch shall be provided for manual pump alternation. A three way switch shall be provided to select “LEAD-Pump No.1”, “LEAD-Pump No.2”, and “Disable Alternation”.
   2. “General Fail Alarm” contact closure output for autodailer connection:
      a. A dedicated terminal strip shall be provided near the bottom of the enclosure to which the remote signal for the autodailer system shall be connected.
   4. The PWPCP shall also include terminals and other devices, as required, to operate with the Potable water pumps.

2.6 INSTRUMENTATION AND CONTROLS

A. Refer to Section 40 60 05, Instrumentation and Control for Process Systems for panel and instrumentation equipment requirements.

B. Refer to section 40 61 96, Process Control Descriptions for monitoring and control requirements.
2.7 PACKAGED PUMP STATION MANUFACTURERS

A. Manufacturers: Packaged potable water pump station shall be manufactured by one of the following:
   a. SyncroFlo.
   b. Engineered Fluid, Inc.
   c. Or approved equal.

2.8 TOOLS AND SPARE PARTS

A. Each pump shall be furnished with the following:
   1. One mechanical seal.
   2. One set of gaskets.
   3. One shaft sleeve.
   4. Two sets of special tools required for normal maintenance or operation, if required.

B. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the OWNER at the conclusion of the project.

2.9 PAINTING

A. Structural steel and supports shall be deslagged and grit-blasted per SSPC-SP6 to commercial blast condition.

B. Pumps, motors, frames, skid base, piping, supports, appurtenances, etc., shall receive manufacturer's standard finish paint system prior to shipment.

C. Machined, polished, and non-ferrous surfaces shall be coated with corrosion prevention compound.

D. All interior surfaces of the packaged pump station which are not bronze or stainless steel shall be painted with a currently-listed NSF-61 coating.

E. Field painting shall conform to the requirements of Section 09 91 00, Painting.

2.10 SOURCE QUALITY CONTROL

A. Pump Station Shop Tests:
   1. The entire pumping system shall be flow tested across its entire range at the manufacturer’s facility prior to shipment.
2. Factory flow test rig shall include flowmeter and gauges and shall be able to supply power to the pumping system control panel to support the operation of all pumps.

3. System shall be supplied with the established minimum suction pressure, and adequate flow for test of the pumps.

4. All electrical controls and circuits shall be included in the system test.

5. System factory flow test results shall be provided in the form of an X-Y plot.

6. Any failure in the flow test, either for any pump, or for the system, shall be corrected by the manufacturer at his expense, and the test repeated until satisfactory results are obtained.

7. Flow test shall be witnessed by a Professional Engineer, registered in the state of Florida. Engineer can be an employee of the pump station manufacturer. Provide certified results of pump station shop test to the ENGINEER.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 UNLOADING AND SETTING

A. Pump station manufacturer shall inform the contractor, prior to system shipment, of the calculated weight of the pumping system.

B. Crane to off-load and set the pumping system onto the concrete slab shall be provided by the CONTRACTOR.

C. Setting of the pumping system and connection to suction, discharge and power, anchoring of the pumping system, and thrust blocking of the suction and discharge piping that is connected to the pumping system shall be the responsibility of the CONTRACTOR.

3.3 INSTALLATION

A. CONTRACTOR shall provide all materials, equipment, and labor necessary to install and connect the pumping system.

B. Package pump station skid shall be installed on a concrete pad and secured with anchor bolts in accordance with the manufacturer's recommendations and as shown. Concrete work and grout shall be in accordance with Section 03 00 05, Concrete.
The skid base shall be accurately shimmed to grade and the spaces between filled with an approved non-shrink grout. After the grout has reached its initial set, exposed edges shall be cut back 1/2-inch and the edges neatly finished with 1 to 2 cement mortar. Where channel skid bases are used, the void inside the channel shall be filled with non-shrink grout and the open ends plastered with 1 to 2 cement mortar.

C. Neatly placed 1-inch hard copper pipe shall be provided to convey leakage to nearest drainage inlet, as required.

D. Installation shall include furnishing and applying an initial supply of lubrication, as recommended by the manufacturer.

3.4 START-UP AND TEST

A. CONTRACTOR shall check and approve the installation of all anchoring, piping, control system components, and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.

B. CONTRACTOR shall conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. When there are future operational functions included in this work, they should be included in the system checkout. All problems encountered shall be promptly corrected to prevent any delays in start-up of the various unit processes.

C. Additionally, manufacturer's representative shall check and approve the installation before operation. The manufacturer's representative shall test the system in the presence of the ENGINEER, verify that the pumps conform to the specified requirements, and instruct plant personnel on care and maintenance of the equipment. Provide the manufacturer's representative to revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

D. Field Tests.
   1. The pump station shall be field-tested after installation to demonstrate satisfactory operation without excessive noise, cavitation, vibration, or overheating. All tests shall be documented at the two specified design points. Tests shall demonstrate that the pump capacity at each design point is not less than 95 percent of the capacity shown on the certified performance curve for a minimum of 10 minutes for each point.

   2. Testing procedures shall duplicate as nearly as possible the conditions of operation and shall be selected to demonstrate that the equipment is operational and free from damage. Each control device, item of mechanical, electrical and instrumentation equipment and control circuits shall be considered in the
testing procedures to demonstrate that the equipment has been properly serviced, aligned, dynamically balanced, connected, calibrated, and adjusted prior to operation.

3. Conduct all tests in the presence of the ENGINEER and/or OWNER. Test operation of all safety devices and interlocks.

4. Prior to acceptance of the pump installation, the CONTRACTOR shall provide the following test results in writing to the ENGINEER:
   a. Discharge pressure (psi).
   b. Capacity (gpm).
   c. Input to motor (KW, amps, and hp).
   d. Motor load (percent).
   e. Pump speed (rpm).
   f. Overall efficiency (pumps and motors).

5. Remediation:
   a. In the event that the initial performance test or subsequent retests fail to demonstrate compliance with the requirements stated above, the pump manufacturer’s representative shall review the test results, field test conditions (flow meter and other instruments and the installation). The representative shall provide a written report, satisfactory to the ENGINEER, detailing the reasons for non-compliance and suggestions for remediation.
   b. If non-compliance is attributed to faulty test equipment supplied by the CONTRACTOR, improper installation by the CONTRACTOR, or faulty pumping unit components the problem shall be corrected by the CONTRACTOR and the pumping unit retested at no cost to OWNER.

6. Noise Test:
   a. Provide a calibrated sound meter.
   b. Demonstrate that the sound pressure level when the pump is operating by itself does not exceed 85 dBA as measured at a distance of 3 feet from the motor.

7. Testing and start-up shall conform to the requirements of Sections 01 75 11, Checkout and Startup Procedures and 01 79 13, System and Facility Performance Testing Procedures.

E. After inspection and field testing services by the manufacturer, the CONTRACTOR shall submit to the ENGINEER a certification letter. Letter, provided on the manufacturer's letterhead and signed by the manufacturer, shall certify that the equipment was installed per the manufacturer's recommendations and requirements and all field test data shall also be furnished.

3.5 MANUFACTURER’S SERVICES

A. Manufacturer’s Field Services: The CONTRACTOR shall provide the following services in addition to any other services specified herein, and required by these Specifications.
1. A factory-trained manufacturer’s representative shall provide for a minimum of two (2) trips, minimum of six hour days each trip, to provide installation inspection, start-up and field testing services, and operations and maintenance training services. The installation inspection services shall be coordinated between the CONTRACTOR and the manufacturer. The start-up and field testing services, and the O&M services shall be coordinated with the ENGINEER.

2. The manufacturer shall provide training of plant operation and maintenance personnel in accordance with the requirements of Section 01 79 23, Instruction of Operations and Maintenance Personnel.

B. All costs, including travel, lodging, meals, and incidentals for manufacturer services shall be included in the CONTRACTOR’S bid.

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all professional services, labor, materials, tools, equipment and incidentals as shown, specified, and required to design, furnish, install, test, coat, and disinfect prestressed concrete tank of the specified type, diameter and capacity, capable of withstanding specified structural loads without excessive cracking or deflection.
   2. Included are:
      a. Site work, excavation and fill, foundation, roof, concrete work, reinforcing, coating, disinfection, testing, and appurtenances directly related to the prestressed concrete tanks unless otherwise specified.
      b. Providing openings in and attachments to prestressed concrete tanks to accommodate the Work under this and other Sections, and providing for prestressed concrete tanks all items required for which provision is not specifically included under other Sections.
   3.Extent of prestressed concrete tanks Work is specified and shown on the Drawings.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before prestressed concrete tanks Work.

C. Related Sections:
   1. Section 03 00 05, Concrete
   2. Section 05 05 33, Anchor Systems.
   3. Section 09 91 00, Painting.
   4. Section 26 00 05, Electrical Work.
   5. Section 31 20 00, Earth Moving.
   6. Section 33 05 05, Buried Pipe Installation.
   7. Section 40 05 05, Exposed Piping Installation.
   8. Section 40 05 19, Ductile Iron Process Pipe.

1.2 REFERENCES

A. Standards referenced in this Section are:
1. ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
2. ACI 301, Specifications for Structural Concrete.
3. ACI 302.1R, Guide for Concrete Floor and Slab Construction.
6. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
7. ACI 350, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
8. ACI 350.3, Seismic Design of Liquid-Containing Concrete Structures and Commentary.
11. ACI CP-60, Craftsman Workbook for ACI Certification of Shotcrete Nozzleman.
13. ASCE 7, Minimum design loads for buildings and other structures.
14. ASTM A185/A185M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
15. ASTM A416/A416M, Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
17. ASTM A586, Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand.
18. ASTM A603, Specification for Zinc-Coated Steel Structural Wire Rope.
19. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
21. ASTM A706/A706M, Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
23. ASTM A1008/A1008M, Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
24. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
25. ASTM C33/C33M, Specification for Concrete Aggregates.
30. ASTM C172/C172M, Practice for Sampling Freshly Mixed Concrete.
31. ASTM C231/C231M, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
33. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
34. ASTM C618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
36. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
40. ASTM C1140, Practice for Preparing and Testing Specimens from Shotcrete Test Panels.
42. ASTM C1218/C1218M, Test Method for Water-Soluble Chloride in Mortar and Concrete.
43. ASTM D395, Test Methods for Rubber Property—Compression Set.
44. ASTM D412, Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
47. ASTM D1752, Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
48. ASTM D2000, Classification System for Rubber Products in Automotive Applications.
49. ASTM D2240, Test Method for Rubber Property—Durometer Hardness.
52. ASTM E1745, Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
54. AWS D1.2/D1.2M, Structural Welding Code – Aluminum.
57. NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.3 TERMINOLOGY

A. Terminology used in this Section shall comply with ANSI/AWWA D110 for definitions of terms relating to prestressed concrete tanks construction.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer’s Qualifications:
      a. All tank work shall be performed by a manufacturer that specializes in the design and construction of wire- and strand- wound, circular prestressed ANSI/AWWA D110 Type II concrete water tanks, which is capable of meeting all the requirements of these specifications. No manufacturer will be considered qualified unless it has designed and built in its own name at least ten prestressed concrete tanks of equal or greater size as those specified herein, conforming to ANSI/AWWA D110 Type II, in the last fifteen years, and which have been in successful service for a minimum of five years.
      b. The steel shell design and epoxy injection procedure currently used shall have also been used in the tanks mentioned in paragraph 1.4.B.1.a, above.
   2. Professional Engineer:
      a. Tank manufacturer shall employ a registered professional engineer legally qualified to practice in the same state as the Site. Professional engineer shall have at least ten years experience in design and field construction of wire- and strand- wound, circular prestressed ANSI/AWWA D110 Type II concrete tanks.
      b. Responsibilities include:
         1) Reviewing prestressed concrete tanks system performance and design criteria stated in the Contract Documents.
         2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to ENGINEER by CONTRACTOR.
         3) Preparing or supervising preparation of design calculations, tank design drawings, and related Shop Drawings.
         4) Signing and sealing all calculations, tank design drawings, and Shop Drawings.
   3. Testing Laboratory:
a. Retain the services of independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete and shotcrete mixes.
b. Testing laboratory shall comply with the requirements of Section 01 45 29.13, Testing Laboratory Services Furnished by Contractor, and demonstrate to ENGINEER’s satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated, in accordance with ASTM E329.

4. Welding:
   a. Qualify procedures and personnel according to AWS D1.1/D1.1M, AWS D1.2/D1.2M or AWS D1.4/D1.4M, as required.
   b. Submit certification that each welder employed on or to be employed for the Work possesses current AWS certification in the welding process with which welder will be working. Certifications shall be current and valid throughout the Work.

5. Shotcrete Crew:
   a. Shotcrete crew foreman, nozzle operator, finisher and gun operator shall be qualified per ACI 506R and as specified herein.
   b. Nozzle and gun operators shall have no less than two years experience in the shotcreting work similar to the Project and be certified in accordance with ACI CP-60. Shotcrete pool and ditch construction shall not be considered as qualifying experience.

B. Component Supply and Compatibility:
   1. Obtain all prestressed concrete tanks components through a single source and from a single manufacturer.
   2. Prestressed concrete tanks manufacturer shall review and approve, or prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by prestressed concrete tanks manufacturer.

C. Regulatory Design Requirements: Conform to the following:
   1. Fabricate prestressed concrete tanks to comply with material verification and special inspection requirements of the governing Building Code and Authorities Having Jurisdiction at the Site.
   2. 29 CFR 1910, Occupational Health and Safety Standards, Sections 1910.24 and 1910.27, for stairs and ladders, respectively.
   3. All supplementary cementitious materials, admixtures, curing compounds, and other industrial-produced materials used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.
   4. All internal wetted materials and coating systems that can contact potable water
or water that will be treated to become potable shall be listed in NSF/ANSI 61.

5. Seismic Criteria: AWWA Standard D110, Seismic Zone 0.

6. Wind Loads: Shall be as required by the most recent official compilation of codes, rules, and regulations of the Florida Building Code, county and city having jurisdiction over the Work. The most stringent requirement shall apply.

D. Pre-installation Conference:

1. Prior to erection of prestressed concrete tanks and associated Work, CONTRACTOR shall schedule and meet at the Site with the prestressed concrete tank manufacturer and installer, the installers of substrate construction to receive the prestressed concrete tanks, the installers of other Work in and around the prestressed concrete tank that follows the prestressed concrete tank Work, ENGINEER, and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the prestressed concrete tank Work, including, but not necessarily limited to the following:
   a. Project requirements and the Contract Documents.
   b. Required submittals, both completed and yet to be completed.
   c. Status of foundation work, including approval of surface preparations, structural loading limitations and similar considerations.
   d. Detailed requirements of CONTRACTOR’s proposed concrete and shotcrete design mixes.
   e. Discuss procedures for producing proper concrete and shotcrete construction, and to clarify roles of the parties involved.
   f. Construction schedule and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
   g. Environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
   h. Regulations concerning code compliance, environmental protection, health, safety, fire and similar considerations.
   i. Required inspection, testing, and certifying procedures.

2. Record the discussions of the conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending.

3. Record all revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

4. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

1.5 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Shop Drawings for the construction of prestressed concrete tanks system, including plans, elevations, sections, and details of entire system showing full dimensions and identification marks, joints, reinforcing details,
anchorage, piping details, and roof, wall, and floor construction, including penetration locations and details. Indicate the locations of all appurtenances.

1) Shop Drawings shall be signed, sealed, and dated by CONTRACTOR’s professional engineer. State of professional engineer’s registration, registration number, and name on seal shall be clearly legible.

b. CONTRACTOR shall also note Work not supplied by tank manufacturer and who is to supply such Work.

2. Product Data:
   a. Manufacturer's complete product information, specifications and installation instructions for prestressed concrete tanks components and accessories. Include material descriptions, dimensions, and profiles of individual system components, such as pre-manufactured pipe supports, ladder and safety cage, railing, hatches, manways, vent, waterstops, and all other accessories.

b. Copies of coating manufacturer’s technical data sheets, including surface preparation, number of coats, dry film thickness, test performance data including paint analysis, NSF compliance documentation, and application instructions for each product proposed for use.

B. Delegated Design Submittals:
   1. Design Data: Submit the following:
      a. Laboratory Trial Batch Reports:
         1) Submit laboratory test reports for materials, and mix design tests, including list of concrete and shotcrete materials and proportions for the proposed concrete and shotcrete mix designs. Include data sheets, test results, certifications, and mill reports to qualify the materials proposed for use in the mix designs, including admixtures.

      b. Design Calculations:
         1) Complete calculations for the prestressed concrete tanks, as one package with the Shop Drawings. Structural calculations shall include all specified performance criteria, required load cases and load combinations used in the design and resulting forces. All calculations and assumptions shall be presented so that ENGINEER can easily follow the progress and logic of CONTRACTOR’S professional engineer. The design analysis shall include the name and office phone number of the designer to answer questions during the shop drawing review.

         2) Design calculations shall be signed, sealed, and dated by CONTRACTOR’s professional engineer. State of professional engineer’s registration, registration number, and name on seal shall be clearly legible.
C. Informational Submittals: Submit the following:
   1. Submittals pertaining to excavation plan, soil protection, and backfill materials and procedures, according to the requirements of Section 31 20 00, Earth Moving.
   2. Delivery Tickets: Copies of all delivery tickets for each load of concrete or shotcrete delivered to or mixed at the Site. Each delivery tickets shall contain information in accordance with ASTM C94/C94M along with project identification name and number (if any), date, mix type, mix time, quantity and amount of water introduced.
   3. Certificates.
      a. Welder’s certifications.
   4. Qualification Statements: Submit qualifications for the following:
      a. Manufacturer.
      b. Professional Engineer.
      c. Testing Laboratory.
      d. Shotcrete crew.
   5. Field Quality Control Submittals:
      a. Report of field testing results.
   6. Warranty:
      a. Submit a copy of the Manufacturer’s warranty.

D. Closeout Submittals: Submit the following:
   1. Warranty Documentation:
      a. Copies of warranties, as specified.
   2. Record Documentation:
      a. Immediately upon completion of the Work submit three copies of Record Drawings showing the actual in-place installation of all work specified in this Section.

1.6 DELIVERY, STORAGE AND HANDLING

A. Transportation, Delivery, and Handling:
   1. Deliver concrete reinforcing materials to the site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings approved Shop Drawings.
   2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
   3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
   4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.
   5. Comply with Section 01 65 00, Product Delivery Requirements.
B. Storage:
   1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.
   2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.
   3. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.
   4. Comply with 01 66 00, Product Storage and Handling Requirements.

1.7 SITE CONDITIONS

A. Site Information:
   1. Information on subsurface conditions is available in the reports listed in the Supplementary Conditions.
      a. Aggressive/acidic soil conditions have been encountered at the site, and concrete in contact with earth shall be chemical resistant. Refer to Section 03 00 05 Concrete for criteria.
   2. Refer to Section 31 20 00 Earth Moving for excavation and fill requirements.

1.8 WARRANTY

A. Workmanship and Material Guarantee: The TANK CONTRACTOR shall guarantee the structure against defective materials or workmanship for a period of five years from the date of Substantial Completion. In case leakage or other defects appear within the five year period, the TANK CONTRACTOR shall proceed to make repairs promptly, upon written notice by the OWNER, at no additional cost to the OWNER.

B. Design Warranty: The TANK CONTRACTOR shall warrant the design of the proposed facility to be structurally and functionally suitable to serve the intended use. Such intended use is exemplified by the criteria of design, workmanship, and material expressed by the requirements of the specifications and drawings prepared by the ENGINEER. The OWNER'S or ENGINEER'S review of the TANK CONTRACTOR’S design, or the OWNER’S acceptance and final payment for the work shall not relieve the TANK CONTRACTOR of design responsibility. The OWNER shall be the direct beneficiary of the warranty.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description
1. General:
   a. Provide one 0.5 million gallon (MG) prestressed concrete tank. Tank shall be designed and constructed in accordance with the provisions of ANSI/AWWA D110, Type II, and shall consist of a cast-in-place reinforced concrete floor, wire or strand wound prestressed shotcreted wall with an embedded steel shell diaphragm, concrete dome roof, piping, hatches, vents, and appurtenances as shown and specified.

2. Tank Wall:
   a. Shotcrete with full height vertically fluted steel diaphragm, prestressed circumferentially by wrapping either high strength steel wire or strand. Waterstop shall be as required per tank design requirements. Horizontal prestressing shall be continuous. Discontinuous prestressing tendons or strands will not be allowed.

3. Tank floor slab:
   a. Designed as a cast-in-place reinforced concrete membrane floor not less than 4 inches thick. The floor shall have adequately thickened regions to facilitate transitions from concrete pipe encasements into the floor, appurtenance loadings and temporary bracing requirements, but no less than 8 inches thick. The floor shall have adequate chemical resistance to protect against the aggressive/acidic soil condition encountered as the site.

   b. The floor shall be flat-bottomed.

   c. Floor shall be placed continuously in sections as large as practicable to limit the length of construction joints and the potential for leakage. Construction joints shall be allowed only where shown on the approved Shop Drawings.

   d. Minimum floor slab reinforcing shall be in accordance with ACI 350 and ACI 372R.

   e. Wall footings may be above or below floor elevation. Below floor elevation footings shall be placed monolithically with the floor.

   f. Circumferential steel shall be as calculated by rational analysis. In wall footings monolithic with the floor, the minimum ratio of circumferential reinforcement to concrete area shall be no less than 0.005, placed within a minimum width of thirty inches.

4. Tank dome roof:
   a. Roof shall be free-spanning and have a rise to span ratio within the range of 1:8 to 1:12. The roof shall be either precast or cast-in-place construction.

   b. The dome roof shall be fixed or pinned to the tank wall. If dome is separated from tank wall, a positive means shall be provided to prevent lateral displacement of the dome. Columns or interior supports will not be allowed.

   c. Dome design shall be based on elastic spherical shell analysis and shell thickness shall be governed by buckling or maximum stress considerations in accordance with ANSI/AWWA D110 but not less than
4 inches to provide a minimum concrete cover of 1.5 inches at each face in accordance with ACI 350.

d. Dome reinforcing shall consist of wire mesh or reinforcing bars as required by design, minimum reinforcing area shall be no less than 0.25 percent. Minimum thickness for buckling resistance shall be in accordance with ACI 350, ANSI AWWA D110 and ACI 372R.

e. A circular prestressed dome ring shall be provided to resist dome thrust. The dome ring shall be prestressed to counteract the dead load and live load thrusts, and shall be of sufficient cross section to resist applied prestressing force.

f. Design shall consider the bending, thrusts, and shears that result from prestressing of the dome ring and dome live load on the edge region of the dome.

B. Design Criteria:
   1. Materials, design, workmanship and all other aspects of prestressed concrete tanks design and construction shall be in accordance with ANSI/AWWA D110 and ACI 372R except as modified herein.
   2. Use the following loadings and requirements in the design calculations:
      a. Nominal capacity: 0.5 million gallons.
      b. Dimensions: 55-ft inside diameter.
      d. In general, loads and load combinations shall comply with the requirements of ANSI/AWWA D110, ASCE 7, and applicable Building Code.
      e. Dead Load shall be the estimated weight of all permanent imposed loads. Unit weight of concrete 150 pounds per cubic foot; steel 490 pounds per cubic foot.
      f. Live Loads: Internal pressures resulting from the water pressure at maximum overflow level. Unit weight of liquid 62.4 pounds per cubic foot.
      g. Roof Live Load: Roof live load shall be the more severe of earth, snow, ice and other live loads per the requirements of the provisions of ANSI/AWWA D110, ASCE 7, and applicable Building Code. Construction loads shall also be considered in the design of the roof.
      h. Backfill Pressure: The lateral pressure from earth backfill and surcharge, including those caused by unequal fill, shall be determined by rational methods of soil mechanics and shall be in line with the recommendations of geotechnical report.
         1) Backfill pressure shall not be used to reduce the amount of required pre-stressing.
         2) Minimum vertical surcharge load shall be 300 psf.
      i. Foundation Loads: Cast-in place reinforced concrete foundation shall be designed in accordance with the recommendations of the geotechnical report, and the soil bearing pressures shall not exceed the pressures
specified therein. Effects of differential and total settlement and radial forces from the base of the tank shall be considered in design. Consideration shall be given to the effects of shrinkage, temperature, moisture gradients, and creep.

j. Wind Loads: Shall be per the requirements of ANSI/AWWA D110, ASCE 7, and applicable Building Code requirements.

k. Seismic Criteria: AWWA Standard D110, Seismic Zone 0.

l. Vent Capacity Requirements:

1) Maximum fill rate: 1,000 gpm.
2) Maximum drawdown rate: 2,250 gpm.

m. Overflow Rate: 1,000 gpm.

2.2 MANUFACTURERS

A. Manufacturer: Provide product of one of the following:

1. The Crom Corporation.
2. Precon Corporation.
3. Or approved equal.

2.3 CONCRETE

A. Concrete shall conform to ACI 301, and as specified herein.

1. Minimum compressive strength:

a. Membrane tank floor slabs: 3,500 psi at 28 days.

b. All other concrete: 4,000 psi at 28 days.

2. Portland Cement: ASTM C150/C150M, Type I or II.

3. Aggregates: ASTM C33/C33M, except local aggregates of proven durability may be used when acceptable to ENGINEER.


5. Admixtures, other than air-entraining and water reducing admixtures, will not be allowed unless approved by ENGINEER. Water reducing admixtures shall conform to ASTM C494/C494M, Type A. Air-Entraining Admixture shall conform to ASTM C260/C260M. Do not use calcium chloride.

6. Use air-entraining admixture in all concrete. Provide not less than four percent, nor more than eight percent, entrained air for concrete exposed to freezing and thawing, and provide from three to five percent entrained air for other concrete.

7. Concrete in contact with prestressing steel shall have a maximum water-soluble chloride ion concentration of 0.06 percent by mass of cementitious material as determined by ASTM C1218/C1218M. Non-prestressed members shall meet the allowable chloride ions limit of ACI 350.

8. Concrete in contact with earth shall be in accordance with Section 03005 Concrete for chemical resistant concrete.
2.4 SHOTCRETE

A. Shotcrete shall conform to ACI 506R, and as modified herein.
   1. The wet-mix process shall be employed for shotcreting.
   2. Minimum compressive strength shall be 4,000 psi at 28 days.
   3. Portland Cement: ASTM C150/C150M, Type I or II.
   4. Fly ash mineral admixture: A maximum 25 percent cementitious material in the final tank overcoat may be replaced with fly ash, conforming to ASTM C618, Class F in accordance with ACI 350 and AWWA D110.
   5. Aggregates: ASTM C33/C33M, except local aggregates of proven durability may be used when acceptable to ENGINEER.
   7. Admixtures for shotcrete shall conform to C1141/C1141M. Do not use calcium chloride.
   8. Shotcrete used for covering prestressed wire or strand shall consist of not more than three parts sand to one part Portland cement by weight. Additional coats of shotcrete shall consist of no more than four parts sand to one part Portland cement by weight.
   9. Shotcrete in contact with prestressing steel shall have a maximum water-soluble chloride ion concentration of 0.06 percent by mass of cementitious material as determined by ASTM C1218/C1218M.
  10. All shotcrete shall be air entrained with 7.5 percent air plus or minus 1.5 percent.
  11. Polypropylene fibers shall be included in the shotcrete used for the finish covercoat. The amount of fibers used shall conform to the manufacturer’s recommendations.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type of concrete and shotcrete required.

B. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the Project for each type of concrete or shotcrete required, complying with ACI 211.1 and the requirements of Section 03 00 05, Concrete.

C. Adjustment to Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results or other circumstances warrant. Laboratory test data for revised mix designs and strength results shall be submitted to and accepted by ENGINEER before being incorporated into the Work.

2.6 STEEL DIAPHRAGM

A. Sheet steel diaphragm shall conform to ASTM A1008/A1008M and shall be a minimum thickness of 0.017 inches. It shall be vertically ribbed with reentrant
angles. The back of the channels shall be wider than the front, thus providing a mechanical keyway anchorage with the concrete and shotcrete encasement.

B. Diaphragm steel may be considered as contributing to the vertical reinforcing of the wall.

2.7 NON-PRESTRESSED REINFORCING

A. Reinforcing bars shall be deformed in accordance with ASTM A615/A615M, and as follows:
   1. Provide Grade 60 for all bars, unless indicated otherwise.
   2. Where welding of reinforcing bars is allowed or required by tank professional engineer, provide ASTM A706/A706M reinforcing bars.

B. Welded Smooth Wire Fabric: Shall be in accordance with ASTM A185/A185M.
   1. Furnish in flat sheets, not rolls.

C. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
   1. Use wire bar-type supports complying with CRSI MSP-1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
   2. Provide precast concrete supports over waterproof membranes.

2.8 PRESTRESSING REINFORCING

A. Circumferential prestressing reinforcing:
   1. Prestressing reinforcing shall be one of the following:
      a. Uncoated, cold drawn, high carbon wire meeting the requirements of ASTM A821/A821M, having a minimum ultimate tensile strength of 210,000 psi.
      b. Galvanized strand shall meet the requirements of ASTM A416 with zinc coating for galvanizing meeting the requirements of ASTM A641/641M or ASTM A475. Each wire shall be individually hot-dipped galvanized before being stranded if strand if being used. The minimum weight of zinc coating per unit area of uncoated wire surface shall be 0.85 ounces per square foot.
   2. Splices for horizontal prestressing reinforcing shall be ferrous material compatible with the reinforcing and shall develop full strength of the prestressing reinforcing. Wire splice and anchorage accessories shall not nick or otherwise damage the prestressing reinforcing.

2.9 MORTAR AND GROUT

A. Non-shrink Grout:
1. Non-shrink cement grout used for repair or honeycomb and other concrete repair and for patching form tie holes shall be a nonhydrogen-gas-liberating, nonmetallic grout meeting all the requirements of ASTM C1107, grade A or C, for non-shrink grout. This grout shall not be used for bonding of prestressed tendons and shall not come in contact with the wire or strand prestressed reinforcement.

B. Cement Mortar:
1. Mortar used for repair of concrete, encasement of waterstop, and for patching form tie holes shall consist of not more than three parts sand to one part Portland cement by weight and shall conform to the requirements of ACI 301. Mortar shall not contain water-soluble chloride ions in excess of 0.06 percent of the weight of the cement in the mortar.

C. Epoxy Mortar:
1. Epoxy mortar used for concrete repair shall be a non-corrosive and non-contaminating mixture of epoxy resin, catalyst, and fine aggregate proportioned in strict accordance with the manufacturer’s instructions for product and intended use.

2.10 ELASTOMERIC MATERIALS

A. Waterstops:
1. Waterstops shall be extruded from elastomeric PVC compound containing plasticizers, resins, stabilizers, and other materials necessary to meet requirements of the Contract Documents and requirements of CRD-C572. Do not use reclaimed or scrap material.
   a. Tensile strength: 2,000 psi, minimum, per ASTM D638.
   b. Ultimate elongation: 350 percent, minimum, per ASTM D638.
   c. Waterstop profile and size shall be suitable for the hydrostatic pressure and movements to which it is exposed, and shall be chosen by tank design professional engineer.

B. Bearing pads: Shall be neoprene or natural rubber:
1. Neoprene bearing pads shall have a hardness of 40 to 50 durometer (ASTM D2240, Type A Durometer), a minimum tensile strength of 1,500 psi, a minimum elongation of 500 percent (ASTM D412), and a maximum compressive set of 50 percent (ASTM D395, Method A). Pads shall meet the requirement of ASTM D2000, Line Call-Out M 2 BC 410 A1 4 B14 or M 2 BC 414 A1 4 C12 F17 for 40 durometer material.
2. Natural rubber bearing pads shall contain only virgin natural polyisoprene as the raw polymer and the physical properties shall comply with ASTM D2000, Line Call-Out M 4 AA 4 14 A1 3.
C. Sponge Filler:
   1. Sponge rubber filler shall be closed cell neoprene or rubber conforming to ASTM D1752, type 1, or ASTM D1056, Grade 2A1 with compression deflection limited to 25 percent at 2 to 5 psi.

D. Sealant:
   1. Epoxy sealant shall conform to the requirements of ASTM C881/C881M, Type III, Grade 1, and should be a 100 percent solids, moisture-insensitive, low modulus, two part epoxy system. Epoxy sealant shall have proven characteristics of bond to metal surface and resistance to extrusion by hydrostatic pressure.
   2. Polysulfide sealant shall be a two component elastomeric compound meeting the requirements of ASTM C920, Type M. Sealants must have permanent characteristics of bond to metal surfaces, flexibility, and resistance to extrusion due to hydrostatic pressure. Air cured sealants shall not be used.

E. Epoxy Bonding Agent:
   1. Provide a two-component, 100 percent solids, moisture-insensitive epoxy adhesive meeting the requirements of ASTM C881/C881M, type II, grade 2. Bonding agent shall produce a bonding strength, as determined by ASTM C882/C882M, greater than 1,500 psi, 14 days after the plastic concrete is placed. Epoxy in contact with water shall not impart taste, or odor, or leach toxic elements into the water.

2.11 APPURTENANCES

A. General:
   1. Provide and install all accessories as specified and as shown on the Drawings.

B. Anchor Systems:
   1. Conform to the requirements of Section 05 05 33, Anchor Systems.

C. Vapor Retarder:
   1. Vapor retarder membrane shall comply with the following.
      a. Water Vapor Transmission Rate, ASTM E96/E96M: 0.04 perms or lower.
      b. Water Vapor Retarder, ASTM E1745: Meets or exceeds Class C.
      c. Thickness of Retarder (plastic), ACI 302 1R: Not less than 10 mils.
   2. Products and Manufacturers: Provide one of the following:
      a. Stego Wrap 10-mil Vapor Retarder, by Stego Industries LLC.
      b. Griffolyn 10-mil, by Reef Industries.
      c. Moistop Ultra, by Fortifiber Industries.
      d. Or equal.
   3. Vapor Retarder Accessories: Provide accessories by same manufacturer as vapor retarder.
a. Seam Tape:
   1) Tape shall have water vapor transmission rate (ASTM E96/E96M) of 0.3 perms or lower.

b. Products and Manufacturers: Provide one of the following:
   1) Stego Tape by Stego Industries LLC.
   2) Griffolyn Fab Tape by Reef Industries.
   3) Moistop Tape by Fortifiber Industries.
   4) Or equal.

c. Vapor Proofing Mastic: Mastic shall have a water vapor transmission rate ASTM E96/E96M, 0.3 perms or lower.

D. Inlet and Outlet piping: Shall conform to Section 33 05 05, Buried Piping Installation, and 40 05 05, Exposed Piping Installation, 40 05 19, Ductile Iron Process Pipe, as applicable. Piping shall be constructed in accordance with the Drawings.

E. Precast Concrete Overflows:
   1. Provide precast reinforced concrete overflows located on the dome near the edge and positioned so that they start to function when the liquid level is three inches above the design high water level. The combined opening of all overflows shall be three times the area of the largest pipe.
   2. Number and location of concrete overflows shall be as shown on the Drawings.
   3. Insect screens shall be installed as shown on the Drawings.

F. Wall Manhole:
   1. Provide a rectangular manhole with a minimum opening size of 17”x52”. Manhole frame and cover fabricated from type 316 stainless steel. Number, location, and elevation of the wall manhole shall be as shown on the Drawings. Manhole covers shall be bolted to the frame using stainless steel bolts and neoprene gaskets and shall be designed to resist hydrostatic pressures without excessive deflection.
   2. Provide an aluminum, fiberglass or stainless steel interior ladder at each manway location.

G. Roof Hatch:
   1. Lockable, not less than 42 inches x 42 inches, gasketed, fiberglass roof hatch. All hardware shall be type 316 stainless steel. Number and location as shown on the Drawings.

H. Roof Ventilator:
   1. Fiberglass, with minimum 16-mesh stainless steel bird screen. The vent shall be mushroom type reinforced to withstand wind force without damage. Connection of vent to roof shall be gasketed and all fasteners shall be type 316 stainless steel. The vent shall be designed to provide fail-safe operation in the event the insect screen frosts over.
I. Interior Ladder:
1. An interior fiberglass ladder with OSHA approved fall prevention system consisting of a sliding, locking mechanism and safety belt, mounting brackets and stainless steel anchors shall be provided as shown on the Drawings.
2. The top support bracket shall be designed to bolt flush with the inside of the access hatch curb.

J. Exterior Ladder and Railing System:
1. An exterior aluminum ladder with safety cage and dome railing system of aluminum alloy 6061-T6, complete with mounting brackets and stainless steel anchors, shall be installed as shown on the Drawings. In lieu of safety cage, provide exterior ladder OSHA approved fall prevention system consisting of a sliding, locking mechanism and safety belt.

K. Liquid Level Indication:
1. Install a six inch diameter ductile iron, stainless steel, or epoxy coated flanged pipe in the tank roof for mounting an ultrasonic level sensor furnished under Division 40. Locate as shown on the Drawings.
2. Provide an exterior-mounted fiberglass liquid level indicator, consisting of a fiberglass float, nylon coated stainless steel cable guides, a white fiberglass board with 4-inch black numerals, 2-ft gradations, and a red fiberglass target.

L. Grounding:
1. Conductors: Refer to Section 26 00 05, Electrical Work, for tank grounding conductor requirements.
2. Connectors and Ground Rods: Refer to Section 26 00 05, Electrical Work, for tank grounding connectors and ground rod requirements.

2.12 COATINGS

A. General: Coatings, including surface preparation and application, shall conform to the requirements of Section 09 91 00, Painting.

B. Exterior paint system shall consist of one of the following systems:
1. Two-coat decorative finish consisting of one coat of cementitious based damp-proofing product such as “Tamoseal”, or equal, and one coat of a non-cementitious, high build, 100 percent acrylic resin polymer such as “Tammscoat Smooth” textured protective coating, or equal.
2. Two-coat decorative finish consisting of two coats of an acrylic coating such as high build, 100 percent acrylic resin polymer such as “Tammscoat Smooth” textured protective coating as manufactured by The Euclid Chemical Company, Inc. or equal.
3. Two-coat Tnemec Series 156 Enviro-Crete Modified Waterborne Acrylate, or equal.
C. Interior Paint System: New Cast-In-Place Concrete associated with Potable Water Storage Tanks, Reservoirs, and Channels at Ambient Temperature and of Greater Than 1,500 Gallon Capacity; Certified by NSF International in accordance with ANSI/NSF Standard 61; Moderate VOC Content; Intermittently Submerged and Submerged, Interior and Exterior:
1. Provide painting system components specified for all cast-in-place concrete surfaces on the interior of the ground storage tank (GST), including floor,
2. Surface Preparation: In accordance with Section 09 91 00, Painting, and with manufacturer’s approved instructions for surface and atmospheric condition.
3. Filler, Surfacer and Patching Compound:
   a. Generic Components:
      1) Minimum 100 percent solids, modified amine epoxy; 8 grams per liter VOC, maximum.
   b. Products and Manufacturers: Provide one of the following:
      1) Series 63-1500 Filler and Surfacer (Tnemec Company, Inc.); Carboguard 501/510 (The Carboline Company); Steel Seam FT 910 Patching/Surfacer (Sherwin-Williams Company): One coat, 1/16-inch thick.
4. Primer/Intermediate/Finish: Interior:
   a. Generic Components:
      1) Minimum 67 percent solids, polyamindo-amine epoxy or cycloaliphatic amine epoxy; 290 grams per liter VOC.
   b. Products and Manufacturers: Provide one of the following:
      1) Series N140 Pota-Pox Plus (Tnemec Company, Inc.); Carboguard 891 (The Carboline Company); Macropoxy 646 NSF (Sherwin-Williams Company): Two coats, 5.0 to 8.0 dry mils.

D. Aluminum in Contact with Dissimilar Materials:
1. Primer/Finish:
   a. Generic Components:
      1) Minimum 100 percent volume solids, high-build, two-component, polyamido-amine or polyamine epoxy; 49 grams per gallon VOC, maximum.
   b. Products and Manufacturers: Provide one of the following:
      1) Series 165 Epoxoline 100 (Tnemec Company, Inc.); Carboguard 954 HB (The Carboline Company); Dura-Plate UHS (Sherwin-Williams Company): Two coats, 8.0 to 15.0 dry mils, per coat.

PART 3 - EXECUTION

3.1 INSPECTION
A. CONTRACTOR shall examine the areas and conditions under which prestressed concrete tank is to be erected and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 GENERAL

A. Site Preparation:
   1. CONTRACTOR shall prepare prestressed concrete tanks foundation and final grading in accordance with the requirement of Section 31 20 00, Earth Moving, and as shown on the Drawings.

3.3 CONCRETE

A. Concrete placement, finishing, and curing shall in accordance with the requirements of ACI 301.

B. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
   1. In hot weather comply with ACI 305R.
   2. In cold weather comply with ACI 306R.

C. Finishes:
   1. Tank floor slab: Float or Fresno finish.
   2. Interior wall: Light broom finish.
   3. Exterior wall: Shotcrete nozzle or natural gun finish.
   4. Roof Soffit: Formed finish chipped of extrusions.

D. Curing shall be by membrane-forming curing compound, by covering exposed surfaces with polyethylene sheets, or by water curing.

3.4 SHOTCRETE

A. All materials, methods of preparation, mixing, field-testing, and curing shall conform to the requirements of ACI 506R, and shall be applied by experienced nozzlemen.
   1. In lieu of manually applied shotcrete, shotcrete may be applied by nozzles mounted on power-driven machinery located a uniform distance from the wall surface, traveling at a uniform speed around the wall circumference to provide the required coatings. Proposed machinery shall be submitted for approval.

B. The nozzle shall be held at such a distance and position that the stream of flowing material shall be as near as practical to the surface being covered. Shotcrete shall be applied in such a way that it flows into position. No air pockets shall form and good
bond shall develop between reinforcing and shotcrete. Any deposit of loose sand shall be removed prior to placing of any succeeding layers. No shotcrete shall be applied to reinforcing steel or diaphragm that is encrusted with overspray.

C. Shotcrete walls shall be built up of individual layers of shotcrete no more than 2 inches thick. No less than two coats to a minimum total thickness of 1 inch shall be provided over the diaphragm on the inside on the inside of the tank.

D. Coating over prestressing wire:
   1. Each prestress wire shall be individually encased in shotcrete. Wire coat thickness shall be sufficient to provide clear cover over the wire of at least 0.25 inch.
   2. Finish covercoat shotcrete shall be applied as soon as practical after the last application of wire coat. The total thickness of shotcrete shall not be less than one inch over the wire.

E. Shotcrete shall not be placed in freezing weather without provisions for protection of shotcrete against freezing. Shotcrete placement can start without special protection when the temperature is 35 degrees F and rising and must be suspended when the temperature is 40 degrees F and falling. The surface to which the shotcrete is applied shall be free from frost. Cold weather shotcreting shall be in accordance with ACI 301 and ACI 306R.

F. Hot weather shotcreting shall be in accordance with the requirements of ACI 301 and ACI 305R.

G. Shotcrete shall not be applied under strong wind conditions.

H. Shotcrete damaged by rain or frost prior to setting up shall be removed and replaced. CONTRACTOR shall obtain ENGINEER’s approval prior to placing additional shotcrete over layers with potential damage from rain or frost.

I. Interior and exterior shotcrete shall be moist by fog spraying or sprinkling for a minimum of seven days. Curing compounds will not be allowed. Curing shall be started at soon as possible without damaging the shotcrete. Curing may be interrupted for subsequent application of prestressing and shotcreting.

3.5 FLOOR

A. After installation of below grade piping the wall footings shall be constructed to the dimensions shown on approved Shop Drawings.

B. Place vapor retarder membrane over prepared subbase, prior to floor placement. Installation of vapor retarder shall be per the requirements of Section 03 00 05, Concrete.

Suwannee County WTP
Prestressed Concrete Tanks
40039002.0000 33 16 13-21
C. Prior to placement of floor, all piping that penetrates the floor shall be set and encased in concrete as required to provide watertight connections into the prestressed concrete tank.

D. Waterstops:
   1. A continuous waterstop shall be cast into the wall footing and be positioned to be constructed into the wall. Waterstops shall be positively held from displacement during concrete placing and shall be supported without puncturing any portion of the waterstop unless it is manufactured with grommets or hog rings. Continuously inspect waterstops during concrete placing to ensure proper positioning.
   2. Perform splicing in waterstops by heat sealing adjacent waterstop sections in accordance with manufacturer’s printed recommendations.
      a. Material shall not be damaged by heat sealing.
      b. Splices shall have tensile strength of not less than 60 percent of unspliced material’s tensile strength.
      c. Maintain the continuity of waterstop ribs and of its tubular center axis.

3.6 WALL

A. Core wall shall be constructed of shotcrete, encasing a continuous steel shell diaphragm.

B. A steel diaphragm shall be embedded in the prestressed wall to form a waterstop. Diaphragm may be located near the inner or outer face of the core wall. If near the inner face, it shall be covered with at least one inch of shotcrete.

C. Steel Diaphragm shall extend the full height of the wall with no horizontal joints. Horizontal construction joints will not be allowed.

D. Steel diaphragm shall be encased and protected with shotcrete no less than one inch thick at all locations.

E. Steel diaphragm shall be epoxy bonded to a waterstop at the floor/wall connection.

F. Vertical joints within a wall panel shall be roll seamed or otherwise fastened in a fashion that results in a firm mechanical lock. All vertical joints in the diaphragm shall be sealed.

G. No punctures will be allowed in the diaphragm except those required for pipe sleeves, temporary construction openings, or special appurtenances. Details of such openings, as necessary, shall be approved by ENGINEER. All such openings shall be completely edge sealed with sealant.
3.7 PRESTRESSING

A. Prestressing wire/strand shall be placed on the wall with a machine capable of consistently producing a stress in the wire within range of -7 percent to +7 percent of the stress required by the design. No circumferential movement of the wire along the tank wall will be allowed during or after stressing the wire. Stressing may be accomplished by drawing wire through a die or by another process that results in uninterrupted elongation, thus assuring uniform stress throughout its length and over the periphery of the tank.

B. Each coil of prestressing wire/steel shall be temporarily anchored at sufficient intervals to minimize the loss of prestress in case a wire breaks during wrapping.

C. Minimum clear space between prestressing wires shall be 5/16 inch or 1.5 wire diameters, whichever is greater. Minimum clear distance between prestressing strands shall be 3/8 inch or 1.5 stand diameters, whichever is greater. Any wires/strands not meeting the spacing requirements shall be respaced. Prestressing shall be placed no closer than two inches from the top of the wall, edges of openings, or inserts, nor closer than three inches from the base of walls or floors where radial movement may occur.

D. The band of prestressing normally required over the height of an opening shall be displaced into circumferential bands immediately above and below the opening to maintain the required prestress force. Bundling of prestressing steel shall not be allowed.

E. A stress plate shall be used at all permanent wall penetrations that result in a displacement of wire equal to or greater than 24” in height above grade. The stress plate shall accommodate a portion of the prestressing wraps normally required for the height of the opening. The remaining prestressing normally required shall be displaced into circumferential bands immediately above and below the penetration. The effect of banded prestressing shall be taken into account in the design.

F. Ends of individual coils shall be joined by suitable steel splicing devices capable of developing the full strength of the wire.

G. Each layer of circumferential prestressing shall be covered with a flash coat of shotcrete as soon as practical after prestressing. Flash coat mix shall consist of one part Portland cement and not more than 3 parts fine sand by weight. The mortar shall be wet, but not dripping, and shall provide a minimum clear cover over the wire of 1/8 inch except the outside layer that shall have a minimum cover of 3/8 inch. Flash coat shall be applied in such a way that voids are not formed beneath the prestressing wire.
H. Apply a body coat of shotcrete at least 3/8 inch thick as soon as practical after application of the last layer of the flash coat. The body coat shall consist of one part Portland cement and not more than 3 parts fine sand by weight.

I. Total coating thickness over the outside pre-stressing wire shall be not less than 1 inch. Positive means shall be provided to control the coating thickness. The horizontal pre-stress wire shall be fully bonded to the prestressed concrete tank wall by means of shotcrete. Coatings, wrappings or other materials that reduce or prevent full bonding shall not be used. Horizontal sections of the wall shall form true circles without flat areas, excessive bumps, or hollows. The complete shotcrete shall be moist cured for at least 7 days. Curing shall be started as soon as possible without damaging the finishing coat.

J. CONTRACTOR shall furnish a calibrated stress recording device, which can be recalibrated, to be used in determining wire or strand stress levels on the wall during and after the prestressing process. At least one stress reading per vertical foot or one stress reading for every roll of prestressing steel, whichever is greater, shall be taken immediately after the wire or strand has been applied on the wall. Readings shall be recorded and shall refer to the applicable height and layer of wire or strand for which the stress is being taken. A written record of stress readings shall be kept by CONTRACTOR. All stress readings shall be made on straight lengths of wire. If applied stress falls below the design stress in the steel, additional wire or strand will be provided to bring the force on the corewall up to the required design force. If the stress in the steel is more than 7 percent over the required design stress, the wrapping operation shall be discontinued, and satisfactory adjustment made to the stressing equipment before proceeding.

3.8 ROOF

A. Domes shall be constructed of cast-in-place concrete and shall be of thin shell design.

B. Cast-In-Place dome construction:
   1. Dome shall be constructed to the dimensions and curvature as shown in the approved Shop Drawings.
   2. Dome roof decking shall not vary from level to level, or the curvature shown, more than 0.25 inch in 10 feet or 0.5 inch maximum in 20 feet or more.
   3. Dome shall be reinforced in accordance with the approved Shop Drawings with the spacing not varying more than 1.0 inch.
   4. Dome shall be constructed to the thickness shown on the approved Shop Drawings. Screed rails shall be provided to ensure proper curvature and reinforcing cover.
   5. Dome forms shall be designed to resist all forces acting with respect to its sloped surface. No portion of formwork shall be removed until the concrete has attained sufficient strength, and until the full circumferential prestressing force has been applied to the dome ring.
6. The exterior dome surface shall receive a coat of membrane-forming curing compound immediately after the final finishing operation. Curing compound shall be compatible with the decorative coating system.

3.9 CONCRETE REPAIR

A. All defects in concrete shall be repaired. Prior to repairing, submit and obtain ENGINEER’s approval of proposed repair procedures. Submitted repair shall include approval from CONTRACTOR’s professional engineer and corresponding information or calculations required to substantiate the repair procedures.

B. All cracks of any thickness shall be repaired prior to disinfection and leakage testing.

3.10 DECORATIVE COATINGS

A. Apply in strict accordance with manufacturer’s recommendations, approved shop drawings, and as specified herein.

B. All coatings shall be applied a minimum of 28 days after final application of concrete or shotcrete. Successfully perform hydrostatic testing of prestressed concrete tank before applying decorative coatings. Apply and cure coatings before starting disinfection.

C. All exposed concrete surfaces shall be coated. Surfaces to be coated shall be clean, free from laitance, dirt, grease, and foreign material. All defective surfaces shall be repaired to the satisfaction of the ENGINEER prior to application of coating. Application shall be in full accordance with manufacturer’s instructions.

D. Color will be selected by OWNER.

E. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, with specified paint system.

3.11 FIELD QUALITY CONTROL

A. Furnish services of independent testing laboratory to perform field quality control sampling and testing during concrete and shotcrete placement as follows:
   1. Concrete: Perform sampling and testing for field quality control during placement of concrete, as follows:
      a. Sampling Fresh Concrete: ASTM C172/C172M.
      b. Slump: ASTM C143/C143M; one test for each concrete load at point of discharge.
      c. Concrete Temperature: ASTM C1064/C1064M; one for every two concrete loads at point of discharge, and when a change in the concrete is
observed. Test each load when time from batching to placement exceeds 75 minutes.

d. Air Content: ASTM C231/C231M; one for every two concrete load at point of discharge, and when a change in the concrete is observed.

e. Compression Test Specimens:
   1) In accordance with ASTM C31/C31M; make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
   2) Cast, store, and cure specimens in accordance with ASTM C31/C31M.
   3) Test and record the following when cylinders are cast: slump, concrete temperature, air content, and unit weight.

f. Compressive Strength Tests:
   1) In accordance with ASTM C39/C39M; one specimen tested at seven days, and three specimens tested at 28 days.
   2) Adjust mix design if test results are unsatisfactory and resubmit for approval.
   3) Concrete that does not comply with strength requirements will be considered as defective Work.

g. Submit test results, certified by testing laboratory, to ENGINEER within 24 hours of completion of test.

2. Shotcrete:
   a. Strength test specimens shall be initially cured onsite, in the same manner as the production shotcrete, then transported in an approved manner to testing laboratory.
   b. One test panel shall be made for every 50 cubic yards of shotcrete placed but no less than one per each shift during which shotcrete is placed. Panels shall be 18 inches x 4 inches minimum and shall be gunned in the same position as the work represented during the course of the work by the CONTRACTOR’s regular nozzleman. Three 3 inch diameter cores shall be drilled from each panel at least 40 hours prior to testing and shall be tested in accordance with ASTM C1140.
   c. In addition, panels with rebar shall be shot, cored and graded in accordance with ACI 506R for every fifth day of shotcreting operations. Minimum acceptable grade shall be 2.5.

B. Prestressing wire:
   1. Testing tension in pre-stressing wire as it is installed shall be completed according to ANSI/AWWA D110 section 5.6.1.7, with a calibrated stress-measuring device or a continuous stress-recording device. A written record of stress readings shall be maintained and delivered to ENGINEER following the completion of pre-stressing and installation of the cover coats.
3.12 HYDROSTATIC TESTING AND DISINFECTION

A. CONTRACTOR shall thoroughly clean and flush the interior of the tank and remove all dirt and contaminating materials at the completion of the tank and prior to filling for hydrostatic testing.

B. Hydrostatic Test:
   1. OWNER will only furnish water for initial filling of the prestressed concrete tanks and absorption make-up period. Additional water required for retesting shall be furnished at CONTRACTOR’s expense. The prestressed concrete tank filling operation will be subject to scheduling and approval by OWNER.
   2. Damp spots which glisten on the surface of the tank and spots where moisture can be picked up on a dry hand will not be allowed. The source of water movement through the wall shall be located and permanently sealed in a manner acceptable to ENGINEER. No leakage that includes visible flow through the wall-floor joint shall be allowed. Damp spots on the footing will be accepted.
   3. If prestressed concrete tank does not meet these criteria, the OWNER may require prestressed concrete tank to be repaired and retested. If such repairs and retesting are required, they shall be performed by CONTRACTOR at no additional cost to the OWNER.

C. Disinfection of prestressed concrete tanks shall comply with all applicable regulations and codes.
   1. OWNER will only furnish water for a single filling of the prestressed concrete tanks for hydrostatic test. Water from accepted hydrostatic testing may be used for disinfection. Additional water or chlorine required for retesting or re-disinfection shall be furnished at CONTRACTOR’s expense. The prestressed concrete tank filling operation will be subject to scheduling and approval by OWNER.

D. CONTRACTOR shall notify ENGINEER prior to chlorinating the tank. Proceed with disinfection and bacteriological testing.

E. Water used for disinfection shall remain the tank to be later utilized in the distribution system after the tank has been completely filled and the biological test has been conducted and passed.

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes the following:
   a. All types and sizes of exposed piping, except where exposed piping installations are specified under other Sections.
   b. Unless otherwise shown or specified, this Section includes all piping beginning at the outside face of structures or structure foundations and extending into the structure. Piping embedded in concrete within a structure or foundation shall be considered as exposed and is included herein. Piping that is permanently or intermittently submerged, or installed in sub-aqueous environments, is considered as exposed and is included in this Section.
   c. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all Work required for a complete exposed piping installation.
   d. Supports, restraints, and other anchors.
   e. Field quality control, including testing.
   f. Cleaning and disinfecting.
   g. Incorporation of valves, meters, and special items shown or specified into the piping systems per the Contract Documents and as required

B. Coordination:
1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before exposed piping Work.
2. Coordinate with appropriate piping Sections of Division 40, Mechanical.

C. Related Sections:
1. Section 09 91 00, Painting.
2. Section 40 05 19, Ductile Iron Process Pipe
3. Section 40 05 31, Thermoplastic Process Pipe
4. Section 40 05 07, Pipe Hangers and Supports.
5. Section 40 24 33, Chlorine Piping, Valves, and Specials.
1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings
   2. ASME Boiler and Pressure Vessel Code.
   5. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
   9. ANSI/AWWA C206, Field Welding of Steel Water Pipe.
  10. ANSI/AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
   11. ANSI/AWWA C606, Grooved and Shouldered Joints.
   12. ANSI/AWWA C651, Disinfecting Water Mains.
   15. AWWA M41, Ductile-Iron Pipe and Fittings.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements and recommendations of authorities having jurisdiction over the Work.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Detailed drawings in plan and, as applicable, section.
      b. Details of piping, valves, supports, accessories, specials, joints, harnessing, and main anchor supports, and connections to existing piping, structures, equipment, and appurtenances.
   2. Testing Plans, Procedures, and Testing Limitations
      a. Submit description of proposed testing methods, procedures, and apparatus, and obtain ENGINEER’s approval prior to testing.

B. Informational Submittals: Submit the following:
   1. Certificates:
a. Submit a certificate, signed by manufacturer of each product, certifying that product complies with applicable referenced standards.

2. Source Quality Control Submittals:
   a. Submit copies of testing report for each test.

3. Site Quality Control Reports:
   a. Submit copies of testing report for each test.

C. Closeout Submittals: Submit the following:
   1. Record Documentation:
      a. Maintain accurate and up-to-date record documents showing field and Shop Drawing modifications. Record documents for exposed piping Work shall show actual location of all piping and appurtenances on a copy of the Drawings, unless otherwise approved by ENGINEER.
      b. Record documents shall show piping with elevations referenced to the project datum and dimensions from permanent structures. For straight runs of pipe provide offset dimensions as required to document pipe location.
      c. Include section drawings with exposed piping record documents when the Contract Documents include section Drawings.
      d. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery:
   1. Deliver products to Site to ensure uninterrupted progress of the Work.
   2. Upon delivery, inspect pipe and appurtenances for cracked, gouged, chipped, dented, and other damage and immediately remove damaged products from Site.
   3. Conform to requirements of Section 01 65 00, Product Delivery Requirements.

B. Storage:
   1. Store products for convenient access for inspection and identification. Store products off the ground using pallets, platforms, or other supports. Protect packaged products from corrosion and deterioration.
   2. Pipe and fittings other than thermoplastic materials may be stored outdoors without cover. Thermoplastic pipe and fittings stored outdoors shall be covered.
   3. Conform to requirements of Section 01 66 00, Product Storage and Handling Requirements.

C. Handling:
   1. Handle pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material of delivery vehicles. Do not otherwise drop, roll, or skid piping.
   2. Avoid unnecessary handling of pipe.
4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage. Repair damaged coatings.
5. Conform to requirements of Section 01 65 00, Product Delivery Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Piping materials are specified in the Exposed Piping Schedule at the end of this Section. Piping materials shall conform to Specification for each type of pipe and piping appurtenances in applicable sections of Division 40, Process Integration.

B. Markings and Identification:
   1. Pipe Markings:
      a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the approved Shop Drawings.
      b. Manufacturer shall cast or paint on each length of pipe and each fitting the pipe material, diameter, and pressure or thickness class.

C. Appurtenances: Provide products that comply with:
   1. Section 40 05 07, Pipe Hangers and Supports.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Install piping as shown, specified and as recommended by the pipe and fittings manufacturer.
   2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request in writing instructions from ENGINEER before proceeding.
   3. Provide pipe manufacturer’s installation specialist at Site as specified on this Section.

Suwannee County WTP
Exposed Piping Installation
40039002.0000 40 05 05-4
B. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:
   1. Temporarily plug installed pipe at the end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
   2. Install standard plugs in all bells at dead ends, tees, and crosses. Cap all spigot and plain ends.
   3. Fully secure and block blind flanges, plugs, caps, and bulkheads installed for testing, designed to withstand specified test pressure.
   4. Where plugging is required for phasing of Work or subsequent connection of piping, install watertight, permanent type blind flanges, plugs, caps, or bulkhead acceptable to ENGINEER.

C. Piping Installation:
   1. Conform to manufacturer’s instructions and requirements of standards and manuals listed in this Section, as applicable:
      c. Thermoplastic Pipe: AWWA M23
   2. Install straight runs true to line and elevation.
   3. Install vertical pipe truly plumb in all directions.
   4. Install piping parallel or perpendicular to walls of structures. Piping at angles and 45 degree runs across corners of structures will not be accepted unless specifically shown on the Contract Documents or approved by the ENGINEER.
   5. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.
   6. Install piping to leave all corridors, walkways, work areas, and similar spaces unobstructed. Unless otherwise approved by ENGINEER provide a minimum headroom clearance under piping and pipe supports of 7.5 feet. Clearances beneath piping shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.
   7. Protect and keep clean interiors, fittings, and valves of pipe that will convey potable water, chemicals, and other pipe designated by ENGINEER.
   8. Cutting: Cut pipe from measurements verified at Site. Field cut pipe, where required, with a machine specially designed for cutting type of pipe being installed. Make cuts carefully without damage to pipe, coating, or lining, and with a smooth end at right angles to axis of pipe. Cut ends of push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.
   9. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by ENGINEER.
   10. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by the Engineer.
   11. Additional General Requirements for FRP and Thermoplastic Piping:
a. Utilize wide band supports as recommended by pipe manufacturer and approved by ENGINEER to minimize localized stresses.
b. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.
c. Provide anchored supports at elbows, valves, bends in piping, and at connections to equipment and tanks.
d. Spacing of supports shall be in accordance with the manufacturer's published recommendations at maximum design operating temperature of pipe.
e. Provide U-clamps with wide band circumferential contact.
f. Provide guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by pipe manufacturer.
g. Provide anchored supports to restrain joints that allow expansion. Minimize use of bellows style joints. Where required and approved by the ENGINEER provide bellows style joints with low axial force to take up pipe expansion. Flexible connectors may be used to absorb thermal movement when approved in writing by ENGINEER.
h. Provide devices that will reduce hydraulic pulsation in piping, together with shut-off and drain valve on all discharge lines of positive displacement pumps to reduce hydraulic hammer, and provide flexible connectors to absorb vibration. Submit details for ENGINEER to review.

D. Jointing Pipe:
1. General:
   a. Make joints in accordance with pipe manufacturer’s recommendations and Contract Documents.
   b. Cut piping accurately and squarely and install without forcing or springing.
   c. Ream out pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.
   d. Remove all cuttings and foreign matter from inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.

2. Ductile Iron Mechanical Joint Pipe:
   a. Wipe clean the socket, plain end and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
   b. Lubricate plain end and gasket with soapy water or pipe manufacturer’s recommended pipe lubricant, per ANSI/AWWA C111, just prior to slipping gasket onto plain end of joint assembly.
   c. Place gland on plain end with lip extension toward plain end, followed by gasket with narrow edge of gasket toward the plain end.
   d. Insert pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
e. Push gland toward socket and center it around pipe with the gland lip against the gasket.
f. Insert bolts and hand tighten nuts.
g. Deflect joint only after assembled when approved by ENGINEER.
h. Make deflection after joint assembly, if approved by ENGINEER, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. Bolt torque shall be:

<table>
<thead>
<tr>
<th>Pipe Diameter (inches)</th>
<th>Bolt Diameter (inches)</th>
<th>Range of Torque (ft-lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>5/8</td>
<td>45 to 60</td>
</tr>
<tr>
<td>4 to 24</td>
<td>3/4</td>
<td>75 to 90</td>
</tr>
</tbody>
</table>

3. Ductile Iron Push-On Joint Pipe:
   a. Prior to assembling joints, thoroughly clean with a wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.
   b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer’s instructions for procedures to ensure gasket resiliency when assembling joints in cold temperatures.
   c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.
   d. Immediately prior to joint assembly, apply a thin film of pipe manufacturer’s recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
   e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with the rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of pipe to verify proper positioning of gasket. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
   f. Maintain an adequate supply of gaskets and joint lubricant at Site when pipe jointing is in progress.

4. Ductile Iron and Steel Flanged Joints:
   a. Assemble flanged joints using ring-type gaskets, with thickness as recommended by pipe manufacturer but not less than 1/8-inch thick, for raised-face flanges. Use full-face gaskets for flat-face flanges, unless otherwise approved by ENGINEER or recommended by pipe manufacturer. Gaskets shall be suitable for the service intended in
accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.

b. Tighten bolts in a sequence that provides equal distribution of bolt loads.
c. Length of bolts shall be uniform. Bolts shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. Machine-cut ends of bolts to be neatly rounded. Do not use washers.
d. Prior to assembly of flanged joints, lubricate bolt threads and gasket faces.
e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.
f. After assembly, coat all bolts and nuts, except stainless steel bolts and nuts, with same coating specified in Section 09 91 00, Painting, for material of pipe and fittings being joined.

5. Steel Pipe Threaded Joints:
a. For threaded joints, use standard, right hand tapered full depth threads on steel piping and apply a manufacturer’s recommended joint compound to male threads only, before installation.
b. Remove cuttings and foreign matter from inside of pipe.
c. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.

6. Thermoplastic Pipe Joints:
a. Solvent Cement Welded Joints:
   1) Bevel pipe ends and remove all burrs before making joint. Clean pipe and fittings thoroughly. Do not make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.
   2) Use solvent cement supplied or recommended by pipe manufacturer.
   3) Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.
   4) Implement appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit fluid when flushing or filling pipelines to prevent compression of gases within pipes.
b. Threaded Joints:
   1) Cut pipe square and smooth and remove burrs or raised edges with a knife or file.
   2) Hold pipe firmly in a pipe vise. Protect pipe at the point of grip by inserting a rubber sheet or other material between pipe and vise.
   3) Thread pipe in accordance with pipe manufacturer's recommendations. Brush threads clean of chips and ribbons.
   4) After threading pipe, starting with second full thread, and continuing over thread length, wrap 100-percent virgin TFE (Teflon) thread tape in direction of threads. Overlap each wrap by one-half width of tape.
   5) After application of the TFE thread tape, screw fitting or coupling onto the pipe end to be joined and tighten by hand. Using a strap wrench.
only, further tighten connection an additional one to two threads past hand tightness.

7. Mechanical Coupling Joints:
   a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings, plasticized PVC couplings, and other mechanical couplings used.
   b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with a wire brush to remove foreign matter.
   c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.
   d. For plasticized PVC couplings, loosen the stainless steel clamping bands and remove the clamps from the coupling. Slide the coupling over the plain ends of the pipes to be joined without using lubricants. Place clamps over each end of coupling at grooved section and tighten with a torque wrench to torque recommended by manufacturer.

E. Installing Valves and Accessories:
   1. Provide supports for large valves, flow meters, and other heavy items as shown or required to prevent strain on adjoining piping.
   2. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the flow measuring device manufacturer, unless specific location dimensions are shown.
   3. Position swing check valves and butterfly valves so that they do not conflict with upstream and downstream elements of the piping system.

F. Unions:
   1. Provide a union downstream of each valve with screwed connections.
   2. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

G. Transitions from One Type of Pipe to Another:
   1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.
H. Closures:
   1. Provide closure pieces, such as blind flanges and caps, shown or required to complete the Work.

3.3 THRUST RESTRAINT

A. Provide thrust restraint on all pressure piping systems and where otherwise shown or specified.

B. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Exposed Piping Schedule at end of this Section.

C. Restrained Pipe Joints:
   1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
      a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with a proprietary restrained joint system approved by ENGINEER. Restrain ductile iron pipe connected by flexible couplings or flanged coupling adapters by harnessing across the coupling or adapter using tie rods or extended bolts connecting between flanges.
      b. Steel Pipe Joints: Provide butt-welded joints, lap welded joints, flanged joints, or mechanical coupling connections. Provide tie rods connected to lugs welded to the steel pipe for restraint at mechanical couplings.
      c. Thermoplastic Joints: Where bell and spigot-type or other non-restrained joints are utilized, provide tie rods across the joint or other suitable joint restraint system, subject to approval of ENGINEER.

3.4 PAINTING

A. Field painting shall conform to Section 09 91 00, Painting.

3.5 FIELD QUALITY CONTROL

A. Manufacturer’s Installation Specialist:
   1. Provide services of a competent installation specialist of the pipe manufacturer when pipe installation commences for:
      a. Thermoplastic pipe.
   2. Retain installation specialist at Site for a minimum of 2 days (eight hours per day at the Site) or until competency of the pipe installation crew has been satisfactorily demonstrated to ENGINEER.

B. Testing, General:
   1. Test all piping, except as exempted in the Exposed Piping Schedule.
   2. Notification:
a. Notify ENGINEER at least 48 hours prior to testing.
b. When authorities having jurisdiction are to witness tests, notify ENGINEER and authorities having jurisdiction in writing at least 48 hours in advance of testing.

3. Conduct all tests in presence of ENGINEER.

4. Remove or protect pipeline-mounted devices that could be damaged by testing.

5. Provide all apparatus and services required for testing, including:
   a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required.
   b. Temporary bulkheads, bracing, blocking, and thrust restraints.

6. Provide air if an air test is required, power if pumping is required, and gases if

7. Unless otherwise specified, OWNER will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into the pipe being tested. CONTRACTOR shall provide fluid for other types of testing required.

8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.

C. Test Schedule:
   1. Refer to the Exposed Piping Schedule for type of test required and required test pressure.
   2. Unless otherwise specified, the required test pressures are at lowest elevation of pipeline segment being tested.
   3. For piping not listed in Exposed Piping Schedule:
      a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires a separate test.
      b. Disinfect for bacteriological testing piping that conveys potable water.

4. Test Pressure:
   a. Use test pressures listed in Exposed Piping Schedule.
   b. If test pressure is not listed in Exposed Piping Schedule, or if a test is required for piping not listed in the Exposed Piping Schedule, test pressure will be determined by the ENGINEER based on the maximum anticipated sustained operating pressure and the methods described in the applicable ANSI/AWWA manual or standard that applies to the piping system.

D. Hydrostatic Testing:
   1. Preparation for Testing:
      a. For thermoplastic pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.
      b. For steel pipe, follow procedures described in AWWA Manual M11. Wetting period is not required for pipe that is not cement-lined.
For other piping follow procedures described in AWWA Manual M9. A wetting period is not required for pipe that is not cement mortar-lined. Prior to testing, ensure that adequate thrust protection is in place and all joints are properly installed.

2. Test Procedure:
   a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in the pipe being tested.
   b. Expel air from pipe as required. Obtain approval of ENGINEER prior to tapping pipe for expelling air.
   c. Examine joints and valves, and make repairs to eliminate visible leakage.
   d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
   e. Timed test period shall not begin until after the pipe has been filled, exposed to the required wetting period, air has been expelled, and pressure stabilized.
   f. Timed Test Period: After the stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure.
   g. Pump from a test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at fifteen minute intervals for duration of test.

3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of the test pressure during timed test period. Allowable leakage rates for piping are:
   a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
   b. Rates based on formula or table in AWWA Manual M41:
      1) Metal pipe joined with rubber gaskets as sealing members, including the following joint types:
         a) Bell and spigot and push-on joints.
         b) Mechanical joints.
         c) Bolted sleeve type couplings.
         d) Grooved and shouldered couplings.
   c. Rates based on formula or table in ANSI/AWWA C605:
      1) Plastic pipe joined with O-ring gasket sealing members.

E. Examination of Welds:
   1. Personnel performing examination of welds shall be qualified to at least Level II, in accordance with ASNT SNT-TC-1A.
   2. Conform to ASME Boiler and Pressure Vessel Code Section V and applicable articles for examination of welds.
   3. Visually examine all welds, Category D Fluid Service, in conformance with ASME B31.3.
4. Examine at least ten percent of welds using liquid penetrant examination.
5. If a defect is detected, all welds shall be examined by liquid penetrant examination.
6. At conclusion of liquid penetrant examination, remove penetrant test materials by flushing, washing, or wiping clean with applicable solvents.

F. Bacteriological Testing:
1. Bacteriological testing for potable water lines, finished water lines, and other piping per Exposed Piping Schedule, is specified in Article 3.6 of this Section.

3.6 CLEANING AND DISINFECTION

A. Cleaning, General: Clean pipe systems as follows:
1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in a manner approved by ENGINEER, prior to placing in service. Flush sodium hypochlorite piping with water.
2. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with a five percent hypochlorite solution.

B. Cleaning of Liquid Chlorine Systems:
1. General: All portions of system shall be cleaned free of oil and grease.
2. Clean chlorine piping per procedures in Chlorine Institute Pamphlet No. 6.
3. Plastic Pipe: Clean vacuum and liquid piping with a detergent and water and thoroughly rinse to remove all detergent, after which a cleaning ball or swab shall be drawn through the pipe.

C. Disinfection:
1. Disinfect all potable and finished water piping.
2. A suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered for acceptance by ENGINEER.
   a. Prior to disinfection, clean piping as specified and flush thoroughly.
   b. Conform to procedures described in ANSI/AWWA C651. Continuous feed method of disinfecting shall be used, unless alternative method is acceptable to ENGINEER.
3. Water for initial flushing, testing, and disinfection will be furnished by OWNER. CONTRACTOR shall provide all temporary piping, hose, valves, appurtenances, and services required. Cost of water required for re-disinfection will be paid by CONTRACTOR to OWNER at the water utility’s standard rates.
4. Chlorine shall be provided by CONTRACTOR.
5. Bacteriologic tests will be performed by OWNER. A certified test laboratory report will be provided to CONTRACTOR, if requested.
6. Chlorine concentration in the water entering the piping shall be between 50 and 75 ppm, such that a minimum residual concentration of 25 mg/l remains after a 24-hour retention period. Disinfect the piping and all related components. Repeat as necessary to provide complete disinfection.

7. After required retention period, the chlorinated water shall be flushed to a closed drain line, unless otherwise directed by ENGINEER. Properly dispose of chlorinated water in accordance with applicable regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland without adequate de-chlorination.

3.7 EXPOSED PIPING SCHEDULE

A. The schedules listed below, following the “End of Section” designation, are a part of this Specification section.
   1. Table 40 05 05-A, Exposed Piping Schedule.
## TABLE
### 40 05 05-A, EXPOSED PIPING SCHEDULE

<table>
<thead>
<tr>
<th>Service</th>
<th>Diameter (inch)</th>
<th>Material</th>
<th>Interior Lining</th>
<th>Exterior Coating</th>
<th>Pressure Class/Thickness</th>
<th>Joint</th>
<th>Test</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>RW</td>
<td>6</td>
<td>DI</td>
<td>CL</td>
<td>P</td>
<td>350</td>
<td>Flg</td>
<td>HYD (100)</td>
<td>Well Heads</td>
</tr>
<tr>
<td>PW</td>
<td>6</td>
<td>DI</td>
<td>CL</td>
<td>P</td>
<td>350</td>
<td>Flg</td>
<td>HYD (150), DBT</td>
<td>Distribution Flow Meter, Klausner Flow Meter</td>
</tr>
<tr>
<td>RW</td>
<td>8</td>
<td>DI</td>
<td>CL</td>
<td>P</td>
<td>350</td>
<td>Flg</td>
<td>HYD (100)</td>
<td>Well Head, RW Flow Meter Bypass</td>
</tr>
<tr>
<td>PW</td>
<td>8</td>
<td>DI</td>
<td>CL</td>
<td>P</td>
<td>350</td>
<td>Flg</td>
<td>HYD (150), DBT</td>
<td>Potable Pump Skid, Pressure Tank, Dist Flow Meter Bypass</td>
</tr>
<tr>
<td>RW</td>
<td>12</td>
<td>DI</td>
<td>CL</td>
<td>P</td>
<td>350</td>
<td>Flg</td>
<td>HYD (100)</td>
<td>RW Flow Meter</td>
</tr>
<tr>
<td>PW</td>
<td>12</td>
<td>DI</td>
<td>CL</td>
<td>P</td>
<td>350</td>
<td>Flg</td>
<td>HYD (150), DBT</td>
<td>Potable Pump Skid, Distribution Flow Meter</td>
</tr>
<tr>
<td>FW</td>
<td>10</td>
<td>DI</td>
<td>CL</td>
<td>P</td>
<td>350</td>
<td>Flg</td>
<td>HYD (150)</td>
<td>Fire Pump Skid</td>
</tr>
<tr>
<td>Sample</td>
<td>1/2</td>
<td>SS</td>
<td>N/A</td>
<td>N/A</td>
<td>Tubing</td>
<td>CF</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>SHP</td>
<td>1/2</td>
<td>PVC</td>
<td>N/A</td>
<td>P, N/A</td>
<td>Sch 80</td>
<td>SW</td>
<td>HYD (150)</td>
<td>Paint Outdoors Pipe Only</td>
</tr>
<tr>
<td>PW</td>
<td>1-1/2</td>
<td>PVC</td>
<td>N/A</td>
<td>P, N/A</td>
<td>Sch 80</td>
<td>SW</td>
<td>HYD (150), DBT</td>
<td>Paint Outdoors Pipe Only</td>
</tr>
</tbody>
</table>

Suwannee County WTP
Exposed Piping Installation
40039002.0000

40 05 05-15
The following abbreviations are used in the Exposed Piping Schedule.

A. Service Abbreviations

<table>
<thead>
<tr>
<th>Service</th>
<th>Abbrev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Water</td>
<td>RW</td>
</tr>
<tr>
<td>Potable Water</td>
<td>PW</td>
</tr>
<tr>
<td>Fire Water</td>
<td>FW</td>
</tr>
<tr>
<td>Sodium Hypochlorite</td>
<td>SHP</td>
</tr>
</tbody>
</table>

B. Material Abbreviations

<table>
<thead>
<tr>
<th>Material</th>
<th>Abbrev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductile Iron</td>
<td>DI</td>
</tr>
<tr>
<td>Polyvinyl Chloride</td>
<td>PVC</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>SS</td>
</tr>
</tbody>
</table>

C. Lining/Coating Abbreviations

<table>
<thead>
<tr>
<th>Lining</th>
<th>Abbrev</th>
<th>Coating</th>
<th>Abbrev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Mortar Lined</td>
<td>CL</td>
<td>Painted</td>
<td>P</td>
</tr>
</tbody>
</table>

D. Joint Abbreviations

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Abbrev</th>
<th>Joint Type</th>
<th>Abbrev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solvent Weld</td>
<td>SW</td>
<td>Flanged</td>
<td>Flg</td>
</tr>
<tr>
<td>Compression Fitting</td>
<td>CF</td>
<td>Threaded</td>
<td>Thd</td>
</tr>
</tbody>
</table>

E. Test Abbreviations

<table>
<thead>
<tr>
<th>Test</th>
<th>Abbrev</th>
<th>Test</th>
<th>Abbrev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrostatic Test (test pressure in psig)</td>
<td>HYD ( )</td>
<td>Disinfection and Bacteriological Testing</td>
<td>DBT</td>
</tr>
<tr>
<td>No Test Required</td>
<td>NR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required to design, furnish, and install all hangers, supports and appurtenances necessary to complete the Work.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the pipe hangers and supports Work.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 09 91 00, Painting.
   3. Section 40 05 05, Exposed Piping Installation.
   4. Section 40 05 19, Ductile Iron Process Pipe.
   5. Section 40 05 31, Thermoplastic Process Pipe.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
      a. MSS SP 58, Pipe Hangers and Supports-Materials, Design and Manufacture.
      b. MSS SP 69, Pipe Hangers and Supports - Selection and Application.
      a. UL 203, Pipe Hanger Equipment for Fire Protection Service.
1.3 QUALITY ASSURANCE

A. Each type of pipe hanger or support shall be the product of one manufacturer.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single pipe hangers and supports manufacturer.
   2. The pipe hangers and supports equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pipe hangers and supports equipment manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Detailed drawings showing all hangers and supports for each piping system specified. Shop Drawings shall show location, installation, material, loads or forces, and deflection of all hangers and supports.
      b. Submit and coordinate these with Shop Drawings required for all piping systems.
   2. Product Data:
      a. Submit manufacturers' catalogs, literature, and engineering data on all hangers and supports. Load ratings, materials and installation shall be consistent with the recommendations of the MSS SP 58, MSS SP 69 and Federal Specification A-A-1192.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   2. Store materials in covered storage off the ground and prevent condensation.
C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Hangers and supports shall meet with the following requirements:
   1. Standard and fabricated hangers and supports shall be furnished complete with necessary inserts, bolts, nuts, rods, washers, and other accessories.
   2. Generally, run piping in groups where practicable and parallel to building wall. Provide minimum clearance of 1-inch between pipe and other work.
   3. Install hangers or supports at all locations where pipe changes direction.
   4. All hangers and supports shall be capable of adjustment after placement of piping.
   5. Different types of hangers or supports shall be kept to a minimum.
   6. All suspended or supported ductile iron pipe shall have a hanger or support adjacent to each hub.
   7. Support vertical piping at each floor and between floors by stays or braces to prevent rattling and vibration.
   8. Hanger rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.
   9. Maximum support spacing unless otherwise shown or approved for standard weight steel pipe shall be as follows:
Table 40 05 07-A:  
Maximum Pipe Support Spacing

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Maximum Pipe Span 1 (feet)</th>
<th>Steel</th>
<th>Copper</th>
<th>Plastic 2</th>
<th>Cast/Ductile Iron 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 to 3/4</td>
<td></td>
<td>5</td>
<td>6</td>
<td>Cont. 3</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>1-1/4</td>
<td></td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>1-1/2</td>
<td></td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>2-1/2</td>
<td></td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>12</td>
<td>12</td>
<td>5</td>
<td>12 feet for pressure pipe</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>12</td>
<td>12</td>
<td>5</td>
<td>10 feet for soil pipe</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>12</td>
<td>12</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>12</td>
<td>-</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>12</td>
<td>-</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

1Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.
2Span shown is for Schedule 80 CPVC pipe at 100°F. Spans for other plastics, other CPVC pipe Schedules and pipes at higher temperatures shall be shortened in accordance with the pipe manufacturer's recommendations.
3Continuous means pipe shall be in unistrut or similar channel.
4Pipe hanger and support selection shall be as shown and in this Section.

10. Maximum support spacing, unless otherwise shown for plastic pipe at ambient temperature, shall be one-half of the values specified for steel pipe.
11. Where proper hanger or support spacing does not correspond with joist or rib spacing, structural steel channels may be attached to joists or ribs and pipes suspended there from.
12. Prevent contact between dissimilar metals when supporting copper tubing, by use of copper plated, rubber or vinyl coated, or stainless steel hangers or supports.
13. Isolate thin walled stainless steel piping from carbon steel by use of plastic coated hangers or supports or by taping at points of contact with PVC or vinyl.
14. Supports and hangers shall be of a material that is compatible with the fluid being conveyed in such pipe being supported.
15. Anchors for pipe support systems shall be compatible or protected by a coating system which is compatible with the fluid being conveyed in such pipe being supported.
B. Expansion compensation shall be designed for individual exposed piping systems with the following Design Criteria:

1. \[ \Delta L = L \times \Delta T \times \alpha \]
   a. Where \( \Delta L \) = pipe length change (inches).
   b. \( L \) = pipe length between anchors (inches).
   c. \( \Delta T = 100 \) (F).
   d. \( \alpha \) = coefficient of thermal expansion (inches/inches/F).

2. Expansion compensation shall be designed as an integral part of the piping hanger, support and anchorage system.

2.2 HANGERS AND SUPPORTS

A. Hangers and supports not shown shall be in accordance with drawing details and MSS SP 58.

B. Products and Manufacturers: Provide one of the following:
   1. Anvil International, Inc.
   2. Elcen.
   4. Unistrut Corporation.
   5. Or equal.

C. Chemical Piping Systems:
   1. All pipe supports and fasteners shall be glass fiber-reinforced plastic with a flame spread rating of 25, in accordance with ASTM E 84.
   2. Materials shall be manufactured by either the pultrusion or extrusion process.
   3. All pipe supports shall have a surface veil over 100 percent of the surface which, along with a filler system, shall protect against degradation from ultra-violet light.
   4. All fasteners shall be manufactured from long glass fiber-reinforced polyurethane to ensure strength and corrosion resistance.
   5. All-thread rods shall be made from vinylester resin.
   6. Manufacturers: Provide products of one of the following:
      a. Unistrut Company.
      b. Or equal.

2.3 ACCESSORIES

A. Hanger rods shall be made from ASTM A 575, with square head nut on top and running thread on bottom end.

B. Concrete Inserts:
   1. Concrete inserts shall be MSS SP 58 malleable Type 18.
2. Manufacturers: Provide products of one of the following:
   c. B-Line.
   d. Anvil International, Inc.
   e. Or equal.

C. Steel Beam Clamps:
   1. Steel beam clamps shall be of malleable iron and conform to MSS SP 58.

D. Brackets:
   1. Brackets for wall mounting shall conform to MSS SP 58 Type-32.

2.4 PAINTING

A. Clean and prime ferrous metal surfaces in the shop in accordance with the requirements of Section 09 91 00, Painting.

B. Field painting shall conform to the requirements of Section 09 91 00, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate hangers, supports, and accessories to support piping, valves, and at all concentrated loads.

B. Locate hangers, supports, and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.

C. Locate hanger, supports to prevent vibration or swaying and to provide for expansion and contraction.
   1. Temperature differential specified in this Section.
   2. Support piping independently so that equipment is not stressed by piping weight or expansion.
   3. For Uninsulated Copper Pipe or Tubing: Clamps and supports, electroplated copper finish. Instrumentation tubing shall be supported in steel or aluminum troughs with covers. All tubing layout and connections shall be as approved by the manufacturer of the equipment.
   5. Maximum spacing for horizontal piping:
      a. As shown in Table 40 05 07-A.
b. Additional supports at:
   1) Change in direction.
   2) Branch piping and runouts over five feet.
   3) Concentrated loads due to valves, strainers or other similar items.
c. Maximum support spacing for plastic pipe at ambient temperature shall be one-half the above values.

6. Hanger types for horizontal piping, except as noted and shown:
   a. Forged steel adjustable clevis type, rod support for all services.
   b. Slide Bases:
      1) Pipe stand, brackets, trapeze or other equivalent structural support.
      2) For piping 2-inches or larger.
   c. For pipe and covering provide:
      1) Saddles for rollers or slide bases.
      2) Protective shields or saddles for all other types of supports.
   d. Threaded Steel Rods:
      1) Two inch vertical adjustment with two nuts each end for positioning and locking.
      2) Size hanger rods according to the schedule below, unless otherwise noted:

<table>
<thead>
<tr>
<th>Nominal Pipe (Inches)</th>
<th>Rod Diameter (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 and less</td>
<td>3/8</td>
</tr>
<tr>
<td>2-1/2 to 3-1/2</td>
<td>1/2</td>
</tr>
<tr>
<td>4</td>
<td>5/8</td>
</tr>
<tr>
<td>6</td>
<td>3/4</td>
</tr>
<tr>
<td>8 through 12</td>
<td>7/8</td>
</tr>
</tbody>
</table>

3) For Double Rod Hangers: One size smaller than above.
4) Connection to Structure for Piping to 2-Inches: Concrete inserts, or expansion shields in shear into sides of beams.
5) Connection to Structure for Piping 2-1/2-Inch or Larger: Concrete inserts, beam clamps or suitable bridging.

7. Vertical Piping:
   a. Base Support: Base elbow or welded equivalent.
      1) Bearing plate on structural support.
   b. Guides not to exceed:
      1) 25 feet for piping to 2-inches.
      2) 36 feet for piping 2-1/2-inches or larger.
   c. Top Support:
      1) Special hanger or saddle in horizontal connection.
      2) Provisions for expansion.
   d. Intermediate Supports: Steel pipe clamp at floor.
      1) Bolted and welded to pipe.
      2) Extension ends bearing on structural steel or bearing plates.
e. For Multiple Pipes: Coordinate guides, bearing plates and accessory steel.

D. Install items to be embedded before concrete placement.

E. Fasten embedded items securely to prevent movement during concrete placement.

F. Install hangers and support units on piping systems in accordance with manufacturer's recommendations.

G. Adjust hangers and supports and place grout for concrete supports to bring pipelines to specified elevations.

H. Bring all pipe systems up to operating pressures and temperatures. Cycle systems to duplicate operating conditions. Correct all support malfunctions.

++ END OF SECTION ++
SECTION 40 05 19

DUCTILE IRON PROCESS PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish ductile iron pipe and fittings.
   2. Extent of piping is shown on the Drawings. Piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, specify pipe service, diameter, material, lining, coating, pressure rating, joint type, and testing required.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ductile iron pipe Work.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 31 20 00, Earth Moving.
   3. Section 33 05 05, Buried Piping Installation.
   4. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI B18.2.1, Square and Hex Bolts and Screws, Inch Series.
   2. ANSI B18.2.2, Square and Hex Nuts, Inch Series.
   3. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   5. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
   10. ASTM D5162, Discontinuity (Holiday) Testing of Non-Conductive Protective
Coating on Metallic Substrates.
20. ANSI/AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water.
21. ANSI/AWWA C153, Ductile Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch for Water Service.
22. ANSI/AWWA C606, Grooved and Shouldered Type Joints.
23. MSS-SP 60, Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.
25. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
27. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
28. SSPC Painting Manual, Volume 1, Para. XIV.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Manufacturer shall have a minimum of five years successful experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
      b. Lining and coating products shall be manufactured by a firm with a minimum of five years successful experience in protecting pipelines exposed to the specified service conditions, and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
c. When not applied by the manufacturer, lining and coating Subcontractor shall have a minimum of five years successful experience in the application of the specified linings and coatings for similar applications for the specified service, and shall be able to show evidence of at least five installations in satisfactory operation in the United States.

B. Supply and Compatibility:
1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single ductile iron pipe manufacturer.
2. Ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.
3. Pipe, fittings, and appurtenances shall be suitable for the specified service and shall be integrated into overall piping system by ductile iron pipe manufacturer.
4. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer’s facility or at manufacturer’s Supplier’s facility.

C. Regulatory Requirements:
1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at Site.

1.4 SUBMITTALS

A. Action Submittals: Submit the following with Shop Drawings required under Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation:
1. Shop Drawings:
   a. Detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings, and coatings.

B. Informational Submittals: Submit the following:
1. Certificates:
   a. Submit certificate signed by manufacturer of each product that product conforms to applicable referenced standards and the Contract Documents.
2. Source Quality Control Submittals:
   a. Submit results of specified shop tests for pipe, fittings, linings, and coatings.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General:
1. Piping systems shall be suitable for their intended use.
2. Joints shall be as specified in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Provide couplings on pipe with plain or grooved ends where shown or where approved by ENGINEER.

B. Ductile Iron Pipe, Joints, and Fittings:
1. Flanged Pipe: Fabricate in accordance with ANSI/AWWA C115.
   a. Pressure Rating: As specified in piping schedule in Section 40 05 05, Exposed Piping Installation. If not otherwise specified, use Special Thickness Class 53 for three-inch to 54-inch diameter pipe.
2. Non-Flanged Pipe: Conform to ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
   a. Pressure Class: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation.
   b. Special Thickness Class: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation.
3. Pipe Joints:
   a. Flanged Joints: Conform to ANSI/AWWA C110 and ANSI/AWWA C111 capable of meeting the pressure rating or special thickness class, and test pressure specified in piping schedule in Section 40 05 05, Exposed Piping Installation.
   1) Gaskets: Unless otherwise specified, gaskets shall be at least 1/8-inch thick, ring or full-face as required for the pipe, of synthetic rubber compound containing not less than 50 percent by volume nitrile or neoprene, and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall be suitable for the service conditions specified, specifically designed for use with ductile iron pipe and fittings.
2) Bolts: Comply with ANSI B18.2.1.
   a) Exposed: ASTM A307, Grade B.
   b) Buried or Submerged: ASTM A193, Grade B8M, Class 2, Heavy hex, Type 316 stainless steel.
3) Nuts: Comply with ANSI B18.2.2.
   a) Exposed: ASTM A563, Grade A, Heavy hex.
   b) Buried or Submerged: ASTM A194, Grade B8M, Heavy hex, Type 316 stainless steel.

b. Mechanical Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure rating or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   1) Glands: Ductile iron.
   2) Gaskets: Plain tip.
   3) Bolts and Nuts: High strength, low alloy steel.
   4) Manufacturers: Provide products of one of the following:
      a) Clow Water Systems Company
      b) Atlantic States Cast Iron Pipe Company
      c) Canada Pipe Company, Ltd.
      d) McWane Cast Iron Pipe Company
      e) Pacific States Cast Iron Pipe Company
      f) Griffin Pipe Products Co.
      g) American Cast Iron Pipe Co.
      h) U.S. Pipe and Foundry Co.
      i) Or equal.

c. Push-On Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure class or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   1) Gaskets: Vulcanized SBR, unless otherwise specified.
   2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.
   3) Products and Manufacturers: Provide one of the following:
      b) Fastite Joint by American Cast Iron Pipe Company.
      c) Tyton Joint by U.S. Pipe and Foundry Company.
      d) Or equal.

d. Grooved End Joints: Comply with ANSI/AWWA C606.
   1) Gaskets: Flush seal type designed for ductile iron that complies with or exceeds requirements of ASTM D2000
   2) Bolts and nuts: As specified for flanged joints.
3) Unless otherwise specified, grooved end couplings shall be rigid joint for exposed service and flexible joint for buried service.
4) Products and Manufacturers: Provide one of the following:
   a) Victaulic, Style 31.
   b) Or equal.
e. Restrained Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Field cuts of restrained pipe are not allowed without approval of ENGINEER.
1) Products and Manufacturers: Provide restrained joints for mechanical joint piping by one of the following:
   a) Megalug, Series 1100, by EBBA Iron Sales, Inc.
   b) MJ Coupled Joint, by American Cast Iron Pipe Co.
   c) MJ Field Lok, by U.S. Pipe and Foundry Co.
   d) Or equal.
2) Products and Manufacturers: Provide restrained joints for push-on joint piping by one of the following:
   a) Super-Lock Joint Pipe, by Clow Water Systems, a division of McWane, Inc.
   b) Lok-Ring Joint, or Flex-Ring Joint, by American Cast-Iron Pipe Company.
   c) TR Flex Joint, by U.S. Pipe and Foundry Company.
   d) Snap-Lok, by Griffin Pipe Products Company.
   e) Or equal.
   a. Material: Ductile iron.
   b. Pressure rating, gaskets, bolts, and nuts shall be as specified for flanged joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of the connected pipe.
   a. Material: Ductile iron.
   b. Glands: Ductile iron.
   c. Pressure rating, gaskets, bolts, and nuts shall be as specified for mechanical joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of connected pipe.
C. Lining, General:
   1. Surface Preparation:
      a. Surface Preparation: Prepare surface in accordance with recommended method.
      b. Finished Surface Inspection: Lining applicator shall inspect finished surface prior to application to determine acceptability. If surface is unacceptable, repeat surface preparation as necessary.
D. Cement-mortar Lining:
   1. Where specified in piping schedules included with Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation, pipe and fittings shall be lined with bituminous seal coated cement-mortar lining in accordance with ANSI/AWWA C104.

E. Specials:
   1. Taps:
      a. Provide taps where shown or required for small-diameter piping or instrumentation connections.
      b. Provide corporation stops where shown or required.
      c. Where pipe wall thickness or tap diameter will not allow engagement of four full threads, provide tapping saddle with outlet joints conforming to requirements of Paragraph 2.1.B.3.a of this Section for four-inch through 12-inch diameter pipe.
      d. For flanged connections on tapping saddle outlet branch, counterbore flange in accordance with MSS SP-60 dimensions. Inside diameter of outlet shall be 1/4-inch greater than nominal diameter.
   2. Tangential Outlets:
      a. Provide tangential outlet fittings where shown or indicated.
      b. Weld-on fittings are acceptable.
      c. Flanged and grooved end joints are not allowed.

2.2 MARKING FOR IDENTIFICATION

A. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify push-on joint and mechanical joint pipe with:
   1. Name or trademark of manufacturer.
   2. Weight, class or nominal thickness, and casting period.
   3. Country where cast.
   4. Year the pipe was produced.
   5. Letters “DI” or “Ductile” shall be cast or metal stamped

B. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify flanged pipe with:
   1. Flange manufacturer’s mark, size, and letters “DI” cast or stamped on the flanges.
   2. Fabricator’s mark if other than flange manufacturer.
   3. Length and weight.
C. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify fittings with:
1. Manufacturer’s identification.
2. Pressure rating.
3. Nominal diameters of openings.
5. Number of degrees or fraction of the circle on bends.
6. Letters “DI” or “Ductile” cast on them.

2.3 EXTERIOR SURFACE PREPARATION AND COATINGS

A. General Coating Requirements:
1. Coating types are specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

B. Exposed Pipe and Fittings:
1. Surface Preparation:
   a. Initial Surface Inspection: Pipe and fitting manufacturer and coating applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.
   b. Surface Preparation: Prepare surface in accordance with recommended NAPF 500-03 method.
   c. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable, repeat surface preparation and re-application as necessary.
2. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop in accordance with Section 09 91 00, Painting.
3. Field painting shall comply with Section 09 91 00, Painting.

C. Buried Pipe and Fittings:
1. Asphaltic Coating: Where specified in piping schedule in Section 33 05 05, Buried Piping Installation, coat pipe and fittings with an asphaltic coating approximately one-mil thick, in accordance with ANSI/AWWA C151, ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

PART 3 – EXECUTION

3.1 INSPECTION
A. Inspect piping to assure that piping is free from defects in material and workmanship. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.

3.2 INSTALLATION AND FIELD QUALITY CONTROL

A. For buried piping installation and testing, refer to Section 33 05 05, Buried Piping Installation.

B. For exposed piping installation and testing, refer to Section 40 05 05, Exposed Piping Installation.

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install thermoplastic piping and fittings.
2. Chlorine solution piping, fittings, and valves are specified under Section 40 24 33, Chlorine Piping, Valves, and Specials.
3. Extent of piping is shown and shall be in accordance with piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

B. Coordination:
1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before thermoplastic piping Work.

C. Related Sections:
1. Section 33 05 05, Buried Piping Installation.
2. Section 40 05 05, Exposed Piping Installation.
3. Section 40 05 19, Ductile Iron Process Pipe.
4. Section 40 24 33, Chlorine Piping, Valves, and Specials.

1.2 REFERENCES

A. Standards referenced in this Section are:
1. AASHTO, Standard Specifications for Highway Bridges.
3. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
9. ASTM D683, Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
10. ASTM D3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
20. ASTM F1055, Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
24. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In.-12 In. (100 mm-300 mm), for Water Transmission and Distribution
25. AWWA C907, Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm).
27. ANSI/NSF 61, Drinking Water System Components - Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer: Shall have a minimum of five years experience producing thermoplastic pipe and fittings substantively similar to the materials specified, and shall be able to submit documentation of satisfactory service in at least five completed installations in operation for at least five years each.

2. Installer:
   a. Engage a single pipe installer who shall be responsible for all thermoplastic pipe Work, and who shall employ only tradesmen with specific skills and experience in the type of Work required.
   b. Installer shall have a minimum of five years experience installing thermoplastic pipe and fittings substantively similar to the materials specified and substantively similar to or larger than the scope of thermoplastic piping Work on the Project, and shall be able to submit documentation of satisfactory experience in at least five completed installations in operation for at least five years each.

B. Component Supply and Compatibility:
   1. Obtain all materials included in this Section, regardless of component Supplier, from a single thermoplastic pipe Supplier. All pipe of each material type shall be furnished by the same manufacturer.
   2. Thermoplastic pipe Supplier shall review and approve to prepare all Shop Drawings and other submittals for all materials furnished under this Section.
   3. Materials shall be suitable for specified service conditions and shall be integrated into overall assembly by thermoplastic pipe Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit piping layout Shop Drawings in accordance with Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   2. Product Data:
      a. Submit product data on pipe, fittings, gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit manufacturer’s certificate of compliance standards referenced in this Section.
   2. Source Quality Control Submittals:
      a. When requested by ENGINEER, submit results of source quality control tests.
   3. Qualifications Statements:
      a. Submit qualifications of manufacturer when requested by ENGINEER.
      b. Submit qualifications of installer when requested by ENGINEER.
1.5 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 SERVICE CONDITIONS

A. General:
   1. Pipe materials shall be suitable for services intended. Refer to piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   2. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
   4. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated on the Drawings.
   5. Pipe, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in ANSI/NSF 61 as being suitable for contact with potable water, and shall comply with requirements of the authorities having jurisdiction at the Site.

2.2 POLYVINYL CHLORIDE (PVC) PIPING

A. PVC Pipe – General Applications: Unless otherwise shown or indicated, PVC pipe shall comply with the following:
   1. Manufacturers: Provide products of one of the following:
      a. Ipex, Inc.
      b. Spears Manufacturing Company.
      c. JM Eagle.
      d. Or approved equal.
   2. Material: Unless otherwise specified, comply with the following:
      a. Type and Grade: Type 1, Grade 1.
      b. Wall Thickness: Schedule 80 complying with ASTM D1784 and ASTM D1785, and US Product Service PS 21-70 as having same outside diameter dimension as cast-iron pipe.
      c. Temperature Rating: Rated for temperature to 140 degrees F.
      d. Color: Gray.
   3. Fittings: Type, grade, schedule, and color of fitting shall match the associated pipe.
a. Solvent Weld: Comply with ASTM D2467.
b. Threaded: Threaded fittings shall comply with ASTM D2464.
c. Flanged: Provide flanged fittings with Neoprene gaskets.

4. Joints:
   a. Solvent Weld: Use primer and solvent cement recommended by PVC pipe manufacturer for the application. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.
   b. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe shall not be threaded.
   c. Flanged: Provide with backup flange minimum 1/8-inch thick. Backup flanges and connecting bolts shall be Type 304 stainless steel.

B. Buried PVC Pressure Pipe:
   1. Manufacturers: Provide products of one of the following:
      a. Ipex, Inc.
      b. Diamond Plastics Corp.
      c. JM Eagle.
      d. Or approved equal.
   2. Material:
      a. Pipe shall comply with AWWA C900 or AWWA C905 (as applicable).
      b. Material shall comply with ASTM D1784.
      c. Wall Thickness: SDR 18.
      d. Fabricate pipe with cast-iron pipe equivalent outside diameter.
   3. Fittings:
      a. Comply with AWWA C900, AWWA C905, or AWWA C907, as applicable.
   4. Joints:
      a. Provide bell and spigot joints. Bell shall consist of an integral wall section to hold securely in place (and prevent displacement during assembly of joint) elastomeric O-ring gasket.
      b. Jointing lubricant shall be as recommended by pipe manufacturer.
      c. Provide elastomeric gaskets complying with ASTM F477 and ASTM D3139.
      d. Restrained Joints: Provide restrained joints where shown or indicated.
         1) Comply with Section 33 05 05, Buried Piping Installation.
         2) Proprietary Joint Systems: Comply with ASTM F1674. Provide restrained joint system by one of the following for bell and spigot joint PVC piping:
            a) Ebaa Iron Sales, Inc.: Series 1500 and Series 1600 Restraint Harness for C900 Pipe; Megalug Series 2500, 2800, and 1100HV Restraint Harness for C905 Pipe.
            b) PV-LOK Series, by Sigma Corp.
            c) Or equal.
   1. Manufacturers: Provide products of one of the following:
      a. Chemtrol, manufactured by Nibco, Inc.
      b. Spears Manufacturing Company.
      c. Or equal.
   2. Material: In accordance with ASTM D1784. Unless otherwise shown or indicated, PVC-DWV pipe shall be:
      a. Type and Grade: Type 1, Grade 1.
      b. Wall Thickness: Schedule 40.
   3. Fittings: Manufactured in accordance with ASTM D2665 and ASTM D3311.
      a. Solvent weld.
      b. Spigot.
   4. Joints:
      a. Solvent weld.
      b. Threaded.

2.3 IDENTIFICATION

A. Pipe material identification requirements are in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

2.4 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Pipe manufacturer shall maintain continuous quality control program.
   2. Where applicable and when requested by ENGINEER, submit results of source quality control tests specified in reference standards.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

A. For buried piping installation, refer to Section 33 05 05, Buried Piping Installation.
B. For exposed piping installation, refer to Section 40 05 05, Exposed Piping Installation.

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install process valves, four-inch diameter and larger, and appurtenances, complete and operational.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before process valves Work.

C. Related Sections:
   1. Section 05 05 33, Anchor Systems.
   2. Section 09 91 00, Painting.
   3. Section 33 05 05, Buried Piping Installation.
   4. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Bearing Manufacturers Association (ABMA).
   2. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
   5. API STD 594, Check Valves, Flanged Lug, Wafer and Butt-Welding.
   6. API STD 598, Valve Inspection and Testing.
   7. API STD 609, Butterfly Valves: Double Flanged, Lug-Type and Wafer-Type.
   10. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service, or Both.
13. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
14. ASTM A351/A351M, Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts.
15. ASTM A380, Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
17. ASTM A564/A564M, Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
19. ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
22. ASTM B265, Specification for Titanium and Titanium Alloy Strip, Sheet and Plate.
25. AWWA C500, Metal-Seated Gate Valves for Water Supply Service.
26. AWWA C502, Dry-Barrel Fire Hydrants.
27. AWWA C504, Rubber-Seated Butterfly Valves.
28. AWWA C507, Ball Valves, 6-inch through 48-inch.
29. AWWA C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
30. AWWA C509, Resilient-Seated Gate Valves for Water Supply Service.
31. AWWA C550, Protective Interior Coatings for Valves and Hydrants.
33. FS TT-C-494, Coating Compound, Bituminous, Solvent Type, Acid-Resistant.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:
   1. Manufacturer shall have minimum of five years of experience producing substantially similar materials and equipment to that required and be able to
provide evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain each type of equipment and appurtenances included in this Section, regardless of the component manufacturer, from a single manufacturer of the type of process valve. For each type of valve, do not furnish valves of more than one manufacturer.
   2. Supplier of each type of equipment specified shall prepare or review all Shop Drawings and other submittals for all components associated with the type of process valve Supplier is furnishing.
   3. Components shall be suitable for use in the specified service conditions. Components shall be integrated into the overall assembly by the process valve manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Installation drawings showing orientation of valve and handwheel in both plan and elevation view. Drawings shall clearly identify valve and its appurtenances, including controls, actuators, valve stems, and other components. Show dimensions of valves and appurtenances in relation to piping and structural and architectural components, where applicable.
   2. Product Data:
      a. Product data sheets.
      b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of all parts.
      c. Corrosion resistance information to confirm suitability of valve materials for the application. Furnish information on chemical resistance of elastomers from elastomer manufacturer.
      d. Cv values and hydraulic headloss curves.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Certificates of compliance with referenced standards, where applicable, including those of AWWA, NSF, and others required by ENGINEER.
   2. Manufacturer Instructions:
      a. Submit manufacturer’s instructions for handling, storing, and installing valves and appurtenances. Provide templates and setting drawings for valves and appurtenances that require anchor bolts or similar anchorages.
3. Field Quality Control Submittals:
   a. Submit results of field tests required.
4. Qualifications Statements:
   a. When requested by ENGINEER, submit manufacturer’s qualifications demonstrating compliance with the Specifications, including list of existing installations with contact names and telephone number(s) for each.

C. Closeout Submittals: Submit the following:
   1. Operations and Maintenance Data:
      a. Furnish operation and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
      b. Furnish in operations and maintenance manuals complete nameplate data for each valve and electric actuator.

D. Maintenance Material Submittals: Submit the following:
   1. Spare Parts, Extra Stock Materials, and Tools:
      a. Spare Parts and Extra Stock Materials: Furnish as specified for each valve type.
      b. Tools: Furnish two sets of special tools (excluding metric tools, if applicable) for each size and type of valve furnished.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
   2. Inspect boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer’s instructions.
   3. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
   1. Keep products off ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures. Store in accordance with manufacturer's recommendations. Protect steel, packaged materials, and electronics from corrosion and deterioration.
   2. Conform to Section 01 66 00, Product Storage and Handling Requirements.
1.6 WARRANTY

A. Valves and all components shall have a 3-year warranty from the date of authorized start-up.

PART 2 - PRODUCTS

2.1 GENERAL

A. Valves, General:
   1. Provide each valve with manufacturer’s name and rated pressure cast in raised letters on valve body.
   2. Provide valves with brass or Type 316 stainless steel nameplate attached with Type 316 stainless steel screws. Nameplates shall have engraved letters displaying the following minimum information:
      a. Valve size.
      b. Pressure and temperature ratings.
      c. Application (other than water and wastewater).
      d. Date of manufacture.
      e. Manufacturer’s name.
   3. Provide valves to turn clockwise to close, unless otherwise specified.
   4. Provide valves with permanent markings for direction to open.
   5. Manually operated valves, with or without extension stems, shall require not more than 40-pound pull on manual operator to open or close valve against specified criteria. Gear actuator and valve components shall be able to withstand minimum pull of 200 pounds on manual operator and input torque of 300-foot pounds to actuator nut. Manual operators include handwheel, chainwheel, crank, lever, and T-handle wrench.

B. Valve Materials:
   1. Valve materials shall be suitable for the associated valve’s service or application, as shown.
   2. Protect wetted parts from galvanic corrosion caused by contact of different metals.
   3. Wetted components and wetted surfaces of valves used with potable water or water that will be treated to become potable shall conform to ANSI/NSF 61.
   4. Clean and descale fabricated stainless steel items in accordance with ASTM A380 and the following:
      a. Passivate all stainless steel welded fabricated items after manufacture by immersing in pickling solution of six percent nitric acid and three percent hydrofluoric acid. Temperature and detention time shall be sufficient for removing oxidation and ferrous contamination without
etching surface. Perform complete neutralizing operation by immersing in trisodium phosphate rinse followed by clean water wash.

b. Scrub welds with same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.

C. Valve Joints:
1. Exposed Valves: Unless otherwise specified, provide with flanged ends conforming to ANSI B16.1. Pressure class of flanges shall be equal to or greater than specified pressure rating of the associated valve.
2. Buried Valves: Unless otherwise specified, provide with mechanical or push-on joints, restrained or unrestrained, as required by piping with which valve is installed.
3. For stainless steel bolting, except where nitrided nuts are required, use graphite-free anti-seize compound to prevent galling. Strength of joint shall not be affected by using anti-seize compound.

2.2 RESILIENT-SEATED GATE VALVES

A. Manufacturers: Provide products of one of the following:
   1. M&H Valve Company
   2. US Pipe and Foundry.
   3. Or equal.

B. General:
   1. Provide valves conforming to AWWA C509 and as specified in this Section.
   2. Sizes: Four-inch through 12-inch diameter.
   3. Type:
      a. Provide non-rising stem (NRS) valves for buried service.
      b. For interior and exposed service, provide outside screw and yoke (OS&Y) rising-stem valves, unless otherwise specified.
      c. Provide position indicators for NRS valves used in exposed service.
   4. Minimum Rated Working Pressure:
   5. Maximum Fluid Temperature: 150 degrees F.
   6. Provide valves with fully encapsulated resilient wedges, unless otherwise specified.

C. Materials of Construction: Shall conform to AWWA C509 and shall be as follows:
   1. Valve Body, Bonnet, and Stuffing Box: Cast-iron.
   2. Wedge: Cast-iron, symmetrically and fully encapsulated with molded rubber having minimum 1/8-inch thickness.
4. Rubber Items: Buna-N or other synthetic rubber suitable for the application.
5. Internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Interior Coating:
   1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.
   2. All wetted components shall conform to NSF 61, suitable for potable water service.

E. Testing:
   1. Test valves in valve manufacturer’s shop in accordance with AWWA C509.

F. Gear Actuators for Manually-operated Valves:
   1. Provide valves with gear actuators conforming to AWWA C500.
   2. Size gear actuators for the following maximum differential pressures:

2.3 BUTTERFLY VALVES

A. Manufacturers: Provide products of one of the following:
   1. DeZurik.
   2. Henry Pratt Company.
   3. Or equal.

B. General:
   1. Provide butterfly valves conforming to AWWA C504 and as specified herein.
   2. Rated Working Pressure: 150 psig, Class 150B.
   3. Maximum Fluid Temperature: 150 degrees F.
   4. Valves shall provide drip-tight bi-directional shutoff at rated pressures.
   5. Mount valve seats in valve body.
   6. Valves shall be capable of being maintained in open or partially open position for manual operation, and for automatic operation. When valve disc is maintained, there shall be no chatter or vibration of disc or operating mechanism.
   7. Valve packing shall be replaceable without dismantling valve.
   8. Disc shall be offset from shaft to provide uninterrupted 360-degree seat seal.

C. Materials of Construction: materials of construction shall conform to AWWA C504 and shall be as follows:
   1. Body: Cast-iron, ductile iron, or alloy cast-iron.
   2. Shaft: Type 316 stainless steel.
   3. Discs:
      a. Valves Smaller than 30-inch Diameter: Cast-iron.
4. Seats: Buna-N or other synthetic rubber suitable for the application.
5. Seating Surfaces: Type 316 stainless steel.
6. Bearings:
7. Shaft Seals: Externally adjustable, material same as for seats. For services that are either buried or submerged, self-adjusting V-type chevron, material same as for seats.
8. Tapered Pins for Attachment of Shaft to Disc: Type 316 stainless steel.
9. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Interior Coating:
1. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.
2. All wetted components shall conform to NSF 61, suitable for potable water service.

E. Testing:
1. Test each valve in the manufacturer’s shop in accordance with AWWA C504.

F. Gear Actuators for Manual Valves:
1. Provide gear actuators conforming to AWWA C540.
2. Gear actuators for valves 20-inch diameter and smaller shall be constructed for 150 psi differential pressure and 16 feet per second port velocity.

2.4 SWING CHECK VALVES

A. Manufacturers: Provide products of one of the following:
1. APCO Willamette Valve & Primer Corp.
2. Crispin Valve

B. General:
1. Provide valves conforming to AWWA C508 and as specified herein.
2. Sizes: Four-inch through 24-inch diameter.
3. Type: Resilient-seated.
4. Rated Working Pressure:
   a. Smaller than 12-inch Diameter: 175 psig.
5. Provide valves suitable for horizontal or vertical mounting.
6. Check valves shall have clear waterway with full-open area equal to nominal pipe size.
7. Provide check valves with outside adjustable weight and lever.
8. Provide valves larger than six-inch diameter with adjustable air cushion chambers.
9. Valve seats shall be mechanically attached and shall be field replaceable.

C. Materials of Construction: All materials of construction shall conform to AWWA C508 and shall be as follows:
1. Body, Disc, Cover and Gland: Cast-iron or ductile iron.
2. Disc Arm: Ductile iron.
3. Hinge Shaft: Type 316 stainless steel.
5. Shaft End Plate: Type 316 stainless steel.
7. Follower Ring for Rubber Seat on Disc: Type 316 stainless steel.
8. Disc Center Pin Assembly: Type 316 stainless steel.
9. Air Cushion Chamber:
   a. Chamber and Plunger: Bronze.
   b. Linkages and Pins: Type 316 stainless steel.
   c. Air Check Valve and Tubing: Brass or stainless steel.
10. Rubber Items:
    a. Applications Up to 180-degree F Fluid Temperature: Buna-N or other synthetic rubber suitable for the application.
11. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Interior Coating:
1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.
2. All wetted components shall conform to NSF 61, suitable for potable water service.

E. Testing:
1. Test each valve in manufacturer’s shop in accordance with AWWA C508.

2.5 FIRE HYDRANTS

A. Products and Manufacturers: Provide one of the following:
2. Kennedy, Model: Guardian K81D.
3. Or equal.
B. General:
1. Provide fire hydrants conforming to AWWA C502, Underwriters’ Laboratories-listed and Factory Mutual approved, and as specified herein.
3. Rated Hydrostatic Test Pressure: 400 psig, minimum.
4. Length of Bury: As shown.

C. Construction:
1. Type: Three-way fire hydrants with two hose nozzles and one pumper nozzle.
2. Nozzles:
   a. Provide one 4.5-inch diameter pumper nozzle and two 2.5-inch diameter hose nozzles with NFPA threads.
   b. Nozzles shall be O-ring sealed, threaded, and retained with stainless steel locks. Nozzles shall be field replaceable.
3. Main Valve and Drainage Assembly:
   a. Opening: 5.25-inch diameter.
   b. Main valve shall be compression type provided with upper and lower metal plates and lower valve plate nut.
   c. Barrel drainage shall be through dual drain valves. Opening and closing of main valve shall cause force-flush of dual drain ports.
   d. Main valve seat ring shall be easily replaceable from above-ground.
4. Provide an oil filled reservoir for lubrication of stem threads and bearing surfaces. Oil shall be U.S. Food and Drug Administration approved and ANSI/NSF 61-listed, and shall flow freely in temperature range of -60 to 158 degrees F.
5. Provide traffic flange in barrel and safety coupling in stem.
6. Inlet Connection: Six-inch diameter mechanical joint, restrained.

D. Materials of Construction: Materials of construction shall conform to the requirements of AWWA C502 and shall be as follows:
1. Upper and Lower Barrels, Shoe, and Bonnet: Cast-iron.
2. Stem and Accessories:
   a. Upper and Lower Stems: Steel.
   b. Operating Nut: Bronze.
3. Nozzles:
   a. Pumper and Hose Nozzles: Bronze.
   c. Cap Chains: Steel.
4. Main Valve Assembly:
   a. Main Valve: Rubber.
   b. Upper Valve Plate: Bronze.
   c. Lower Valve Plate and Nut: Cast-iron.
5. Drain Valves:
   a. Drain Ring Housing: Cast-iron.
   b. Drain Ring: Bronze.
7. External Assembly Bolts: Steel.
8. Internal Pins and Other Hardware: Stainless steel, ASTM A276.

E. Testing:
   1. Test each fire hydrant in manufacturer’s shop in conformance with AWWA C502.

F. Interior Coating:
   1. Hydrants shall be coated on the interior. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

G. Exterior Painting:
   1. Below- and above-ground painting shall be as specified under Article 2.9 of this Section and Article 2.10 of this Section.

2.6 APPURTENANCES FOR EXPOSED METALLIC VALVES

A. General:
   1. Provide handwheels on all exposed valves, unless otherwise shown or specified.
   2. For valves located five feet or more above operating floor, provide chain operators.

B. Handwheels:
   1. Conform to applicable AWWA standards.
   2. Material of Construction: Ductile iron, or cast aluminum.
   3. Arrow indicating direction of opening and word “OPEN” shall be cast on trim of handwheel.
   4. Maximum Handwheel Diameter: 2.5 feet.

C. Chain Operators:
   1. Chains shall extend to three feet above operating floor.
   2. Provide 1/2-inch stainless steel hook bolt to keep chain out of walking area.
   3. Materials of Construction:
      a. Chain: Type 316L stainless steel or galvanized steel.
      b. Chainwheel: Recessed groove type made out of Type 316 stainless steel.
      c. Guards and Guides: Type 316L stainless steel.
   4. Chain Construction:
a. Chain shall be of welded link type with smooth finish. Chain that is crimped or has links with exposed ends is unacceptable.

5. Provide geared operators where required to position chainwheels in vertical position.

2.7 APPURtenANCES FOR BURIED METALLIC VALVES

A. Wrench Nuts:
   1. Provide wrench nuts on buried valves of nominal two-inch size, in accordance with AWWA C500.
   2. Arrow indicating direction of opening the valve shall be cast on the nut along with the word “OPEN”.
   3. Material: Ductile iron or cast-iron.
   4. Secure nut to stem by mechanical means.

B. Extension Stems for Non-Rising Stem Gate Valves and Quarter-turn Buried Valves:
   1. Provide extension stems to bring operating nut to six inches below valve box cover.
   2. Materials of Stems and Stem Couplings: Type 316 stainless steel.
   3. Maximum Slenderness Ratio (L/R): 100
   4. Provide top nut and bottom coupling of ductile iron or cast-iron with pins and set screws of Type 316 stainless steel.

C. Valve Boxes:
   1. Valve boxes shall be as indicated and as required.
   2. Type: Heavy-duty, suitable for highway loading, two-piece telescopic, and adjustable. Lower section shall enclose valve operating nut and stuffing box and rest on valve bonnet.
   3. Material: Cast-iron or ductile iron.
   5. Marking: As required for service.

2.8 TOOLS, LUBRICANTS, AND SPARE PARTS

A. Provide three T-handle operating wrenches for buried valves.

B. Lubricants: For valves, actuators, and appurtenances requiring lubricants, provide suitable lubricants for initial operation and for first year of use following Substantial Completion. Lubricants for equipment associated with conveying potable water or water that will be treated to become potable shall be food-grade and ANSI/NSF 61-listed.

C. Tools, spare parts, and maintenance materials shall conform with Section 01 78 43, Spare Parts and Extra Materials.
2.9 Painting of Exposed Valves, Hydrants, and Appurtenances

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined surfaces of exposed valves and appurtenances, shall be finish painted in manufacturer’s shop. Surface preparation, priming, finish painting, and field touch-up painting shall conform to Section 09 91 00, Painting.

2.10 Painting of Buried Valves

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined or bearing surfaces of buried valves, shall be painted in valve manufacturer’s shop with two coats of asphalt varnish conforming to FS TT-C 494.

PART 3 - EXECUTION

3.1 Inspection

A. Examine conditions under which materials and equipment are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 Installation

A. General:
   1. Install valves and appurtenances in accordance with:
      a. Supplier’s instructions and the Contract Documents.
      b. Requirements of applicable AWWA standards.
      c. Applicable requirements of Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   2. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
   3. Position swing check valves and butterfly valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.

B. Exposed Valves:
   1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
   2. Operators:
      a. Install valves so that operating handwheels can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by ENGINEER.
b. Avoid placing operators at angles to floors or walls.
c. Orient chain operators out of way of walking areas.
d. Install valves so that indicator arrows are visible from floor level.

C. Buried Valves:
1. Install valve boxes plumb and centered, with soil carefully tamped to a lateral distance of four feet on all sides of box, or to undisturbed trench face if less than four feet.
2. Provide flexible coupling next to each buried valve.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
1. Adjust all parts and components as required to provide correct operation of valves.
2. Conduct functional field test on each valve in presence of ENGINEER to demonstrate that each valve operates correctly.
3. Demonstrate satisfactory opening and closing of valves at specified criteria requiring not more than 40 pounds effort on manual actuators.
4. Test ten percent of valves of each type by applying 200 pounds effort on manual operators. There shall be no damage to gear actuator or valve.

++ END OF SECTION ++
SECTION 40 24 33

CHLORINE PIPING, VALVES, AND SPECIALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install and test the chlorine piping, valves, specials, and accessories.
   2. The extent of the piping is shown and in the piping schedules included in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the chlorine piping, valves and specials Work.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 33 05 05, Buried Piping Installation.
   3. Section 40 05 05, Exposed Piping Installation.
   4. Section 40 05 07, Pipe Hangers and Supports.
   5. Section 40 05 31, Thermoplastic Process Pipe.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American National Standards Institute, (ANSI).
      a. ANSI B2.1, Pipe Threads (except Drysealed).
      b. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
      c. ANSI B16.5, Pipe Flanges and Flanged Fittings.
      a. ASTM A 53/A 53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
      b. ASTM A 105/A 105M, Specification for Carbon Steel Forgings for Piping Components.
      c. ASTM A 181/A 181M, Specification for Carbon Steel Forgings for General-Purpose Piping.
      d. ASTM B 88, Specification for Seamless Copper Water Tube.
e. ASTM D 638, Test Method for Tensile Properties of Plastics.
g. ASTM D 1599, Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing and Fittings.
i. ASTM D 2122, Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

3. Chlorine Institute, (CI).

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single chlorine piping, valves and specials manufacturer.
   2. The chlorine piping, valves, and specials equipment manufacturer to prepare or review all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the CONTRACTOR.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Fabrication, assembly, and installation diagrams.
   2. Product Data:
      a. Manufacturer's literature, illustrations, specifications, detailed drawings, data and descriptive literature on all valves and appurtenances.
      b. Engineering data; including dimensions, materials, size and weight.
1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Acceptance at Site:
   1. All boxes and crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to the components or equipment. Replace lost and repair damage to new condition in accordance with the manufacturer’s instructions.

1.6 JOB CONDITIONS

A. If CONTRACTOR is observed improperly solvent welding PVC pipe joints, not strictly adhering to manufacturer's recommendations or procedures outlined in PART 3 of this Section, ALL PVC already assembled shall be removed from the Site and new PVC pipe shall be installed, at no additional cost to the OWNER.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Polyvinyl Chloride (PVC) Piping:
   1. Pipe:
      b. Type: Type 1, Grade 1.
      c. Wall Thickness: Schedule 80.
      d. Service Conditions: Sodium hypochlorite solution (10%) at pressures of 0 to 50 psig at ambient temperatures.
   2. Joints:
      a. Connect pipe by solvent-welded socket couplings, except where flanges are required at valves, flow meters, flanged fittings or where otherwise shown or directed by the ENGINEER.
      b. Solvent weld in strict accordance with the manufacturer's printed instructions.
      c. Flanged Joints: Dimensions and drilling conforming to ANSI B16.1, Class
125 with 1/8-inch Viton full-face gaskets.

d. Joint Primer and Solvent Cements: All socket type connections shall be joined with R&G Sloane GSR Fueson #903 primer or equal, socket connections up to 2-1/2-inch size shall be made with R&G Sloane, GSR Fueson #940 cement or equal, socket connections 3-inch size and larger shall be made with R&G Sloane GSR Fueseon #942 extra-heavy cement for 3-inch and larger size or equal.

3. Fittings:
   b. Type: Type 1, Grade 1.
   c. Wall Thickness: Schedule 80.

4. Unions:
   a. Provide threaded unions where shown or as directed by the ENGINEER.

2.2 VALVES, SPECIALS AND ACCESSORIES

A. General: Provide valves, specials and accessories as shown and specified herein.

B. Vented Ball Valves:
   1. Size: ½-inch
   2. Connections: End entry design with dual union design, solvent-weld socket ends.
   3. Material: ASTM D1784, Type 1, Grade 1 polyvinyl chloride full port body, ball, and stem. Teflon seat, Viton O-ring stem, face and carrier seals.
   4. Rated: 250 psi at 73 degree F
   5. Manufacturer:
      a. Nibco (Chemtrol); True-Bloc.
      b. Asahi-America.
      c. Or equal.

C. Ball Check Valve 4 Inches and Smaller:
   1. Connections: single or dual union socket weld ends.
   2. Rated: 150 psi at 73 degrees F.
   3. Material: ASTM D1784, Type I, Grade 1 polyvinyl chloride body and Viton seat and seal.
   4. Manufacturer:
      a. R&G Sloane Manufacturing Co., Inc.
      b. Nibco Chemical.

D. Anti-siphon/Vacuum Breaker Valve:
   1. Extent: Sodium hypochlorite metering pumps discharge line.
   2. Floating disc type which breaks seal to atmosphere when line pressures reach atmospheric and below.
3. PVC body with Viton O-rings.
4. 125 PSI rating.
5. Manufacturer:
   a. R-K Industries Model RVB.
   b. Or equal.

E. Pressure-Relief Valve 2 Inches and Smaller:
1. Service: Liquid (chemical and water)
2. Size Range: ¼-inch to 2 inches
3. Valve Pressure Class/Rating: 150 psig
4. Relief settings: 5-75 psig
5. Valve End Connections: Threaded
6. Material:
   a. Valves on PVC piping shall be manufactured of PVC material with Viton seals.
   b. PVC shall be Type 1, Grade 1 in accordance with ASTM D 1784, and shall be dark gray in color.
7. Manufacturer:
   a. Hayward Industrial Products, Inc.
   b. Or approved equal.

F. Backpressure Valves:
1. Service: Liquid (chemical and water)
2. Size Range: ¼-inch to 2 inches
3. Valve Pressure Class/Rating: 150 psig
4. Relief Settings:
   a. ¼-inch to ¾-inch valves: 10-125 psig.
   b. 1-inch valves: 10-100 psig.
   c. 1-1/2-inch to 2-inch valves: 10-80 psig.
5. Valve End Connections: Threaded.
6. Material:
   a. Valves on PVC piping shall be manufactured of PVC with Viton seals.
   b. PVC shall be Type 1, Grade 1 in accordance with ASTM D 1784, and shall be dark gray in color.
7. Manufacturer:
   a. R-K Industries, Series BPR.
   b. Or equal.

2.3 FLEXIBLE TUBING

A. Flexible Tubing: Unless otherwise shown or indicated, flexible tubing shall be as follows:
1. Manufacturers: Provide products of one of the following:
   a. Nalgene 980.
b. Or approved equal.

2. Tubing shall be clear, extruded from material compatible with sodium hypochlorite (10%), and shall meet NSF Standard 61 requirements.

3. Fittings: Fitting shall be as recommended by tubing manufacturer.

2.4 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Piping manufacturer shall maintain a continuous Quality Control Program. All PVC plastic molding materials used to manufacture pipe and fittings under this Section shall be tested for conformance to the requirements of ASTM D 1784.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install piping, valves and specials in accordance with the manufacturer's instructions and the approved Shop Drawings.

B. Comply with Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

C. Mechanical seals:
   1. Furnish and install mechanical seals at each point where piping passes through the walls.
   2. Provide mechanically-expandable rubber link-type seals at both inside and outside faces.

D. Joint Assembly:
   1. General: The procedure below may be used as a guide, the approved pipe manufacturer's recommended procedures should be followed, unless the procedures listed below are more stringent.
   2. Cut pipe square with miter box or plastic tube cutter.
   3. Chamfer pipe and to a 10 to 15 degree angle (1/16-inch to 1/32-inch).
   4. Clean and dry socket of all dirt, moisture and grease.
   5. Check dry fit of pipe in fitting. Pipe should enter socket about 1/3 to 3/4 depth.
   6. Dissolve inside surface by brushing with primer. Use brush half the size of pipe diameter. Use a scrubbing motion to assure penetration. Repeat application as necessary.
   7. Dissolve surface of male end of pipe to be inserted into socket to depth of fitting socket by brushing on liberal coat of primer. Be sure entire surface is well dissolved.
   8. Brush inside socket with primary one more time, then immediately apply proper
cement liberally to male end of pipe. Refer to Paragraph 2.1.A.2.d., above, for cement recommendations. The amount of cement should be more than sufficient to fill any gap.

9. Apply proper cement lightly to inside of socket. Keep excess cement out of socket to prevent solvent damage to pipe. Apply a second coat of cement to the pipe end. Time is important at this stage; two men may be required when cementing larger size pipe and fittings.

10. While both inside socket and outside surface of male end of pipe are SOFT and WET with cement, forcefully bottom the male end of the pipe into socket, giving the male a one-quarter turn. The pipe must go to the bottom of the socket. Hold joint together until both surfaces are firmly gripped (approximately 30 seconds).

11. After assembly, wipe excess cement from the pipe at the end of the fitting socket. A properly made joint will normally show a bead around its entire perimeter. Any gaps at this point may indicate a defective assembly job, due to insufficient cement, or use of light-bodied cement on large diameters where heavy bodied cement should have been used.

12. Do not disturb joint until initial setup of the cement occurs, refer to manufacturer's solvent cement set time schedule for setup times at various ambient temperatures.

3.2 TESTING

A. All chlorine solution piping shall be hydrostatically tested at a pressure of 100 psig in accordance with the recommendations stated in Chlorine Institute Pamphlet 6, latest issue.

B. Notify ENGINEER 48 hours in advance of testing.

C. Conduct all tests in the presence of the ENGINEER, unless otherwise approved.

D. Inspect all valves, joints, and specialties for tightness and for proper operation while under test pressure.

E. Repair and retest all lines, which fail to pass the specified tests.

F. CONTRACTOR shall be responsible for all testing and shall pay all costs incurred during the specified testing.

3.3 PIPING SCHEDULE

A. Chlorine solution piping:
   2. Exposed: PVC, Schedule 80, painted.
B. Chlorine Vent Piping: PVC, Schedule 40.

C. Pipe Sizes: Comply with sizes as shown.

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, calibrate, test, start-up, and place in satisfactory operation a complete and operating instrumentation and control system.
   2. The Work includes, but is not limited to, the following:
      a. Auto Dialer panel.
      b. Field mounted instruments
      c. Field instruments hardwired to the autodialer.
   3. The specification includes instrumentation, control panels and other appurtenances information that shall be used by vendors for provision of packaged systems and CONTRACTOR provided equipment.

B. Coordination:
   1. Instrumentation and Controls:
      a. Instruments and controls (I&C) Work under this Contract by I&C Subcontractor shall, as part of the Work, be interfaced with the Auto Dialer System. Programming and configuration of the autodialer along with the instrument installation and configuration is part of the Work. Process control description of process system and its associated equipment is included in specification section 40 61 96, Process Control Descriptions.
      b. Some panels and equipment are furnished under other Specification Sections under this Contract. CONTRACTOR shall coordinate with Suppliers of panels and equipment to provide fully functional system complying with the Contract Documents and that interfaces with the Auto Dialer.
      c. Auto Dialer input/output list identifies inputs and outputs required, and is part of this Section. Use input/output list for coordinating signals between equipment provided under this contract. Include Work for CONTRACTOR-furnished control options not on the input/output list and provided by the vendors at no additional cost to OWNER.
   2. To centralize responsibility, materials and equipment provided under this Section shall be furnished by a single Supplier.
   3. With CONTRACTOR, Supplier shall assume the responsibility for adequacy and performance of materials and equipment provided under this Section.
4. To the greatest extent possible, provide materials and equipment from a single manufacturer.

5. Supplier’s Responsibilities:
   a. Preparing all instrumentation and control equipment submittals in accordance with the Contract Documents.
   b. Proper interfacing of instrumentation and control equipment with field equipment, instruments, devices, and panels, including required interfacing with packaged control systems furnished by other equipment Suppliers, and required interfacing with the Site’s electrical system.
   c. Review and coordination with manufacturers, Suppliers, and other contracts of Shop Drawings and other CONTRACTOR submittals for equipment, valves, piping, and appurtenances for ensuring proper interfacing of hardware, and locations and installation requirements of inline devices and instrument taps.
   d. Direct, detailed oversight of installation of instruments, panels, consoles, cabinets, wiring and other components, and related wiring and piping connections.
   e. Calibrating, source quality control, field quality control, and start-up of the system.
   f. Responsibility for correction period obligations for instrumentation and control system.
   g. Training of operations and maintenance personnel in operation and maintenance (including calibration and troubleshooting) of the instrumentation and control system.

C. Related Sections:
   1. Section 09 91 00, Painting.
   2. Section 21 30 00, Packaged Fire Pump System
   3. Section 26 24 19, Motor Control Center
   4. Section 26 32 13, Engine Generators
   5. Section 26 36 23, Automatic Transfer Switches
   6. Section 33 12 23, Packaged Potable Water Pump Station
   7. Section 33 16 13, Pre-Stressed Concrete Storage Tanks
   8. Section 40 05 05, Exposed Piping Installation.
   9. Section 40 05 31, Thermoplastic Process Pipe.
   10 Section 40 60 96, Process Control Descriptions for Process Systems
   11. Section 43 21 13, Vertical Lineshaft Well Pumps
   12. Section 46 33 44, Skid-Mounted Peristaltic Metering Pump System

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/ASQ Z1.4, Sampling Procedures and Tables For Inspection By Attributes.
   2. ASTM A269, Specification for Seamless and Welded Austenitic Stainless
Steel Tubing for General Service.
5. ASTM B88, Specification for Seamless Copper Water Tube.
6. IEEE 802.1 LAN/MAN Bridging & Management
7. IEEE 802.1X, Port Based Network Access Control.
8. IEEE 802.3, Standards Defining Physical Layer and Data Link Layer Media Access Control (MAC) Sublayer of Wired Ethernet
9. ISA 5.1, Instrumentation Symbols and Identification.
10. ISA 5.4, Instrument Loop Diagrams.
11. ISA 20, Specification Forms for Process Measurement & Control Instruments, Primary Elements & Control Valves.
13. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
14. NFPA 70 (NEC), Article 770, Optical Fiber Cables and Raceways.
16. UL 50, Safety Enclosures for Electrical Equipment, Non-Environmental Considerations.
17. UL 508A, Industrial Control Panels.
19. UL 2062, Enclosures for Use in Hazardous (Classified) Locations.

1.3 QUALITY ASSURANCE

A. Qualifications:
1. Supplier:
   a. Shall be financially sound with at least five years continuous experience in designing, implementing, supplying, and supporting instrumentation and control systems for municipal water treatment facilities comparable to the instrumentation and control systems required for the Project, relative to hardware, software, cost, and complexity.
   b. Shall have record of successful instrumentation and control system equipment installations. Upon ENGINEER’s request, submit record of experience listing for each project: project name, owner name and contact information, name and contact information for contractor, name and contact information for engineer or architect, approximate contract value of instrumentation and controls Work for which Supplier was responsible,
c. Shall have at time of Bid experienced engineering and technical staff capable of designing, supplying, implementing, and supporting the instrument and control system and complying with submittal and training requirements of the Contract Documents.
d. Shall be capable of training operations and maintenance personnel in instrumentation and control applications, and in operating, programming, and maintaining the control system and equipment.
e. Shall have UL-approved panel shop.

2. Manufacturer: Manufacturers of instrumentation and control equipment furnished under this Section shall be experienced producing similar equipment and shall have the following qualifications:
   a. Shall manufacture instrumentation and control system components that are fully-developed, field-proven, and of standardized designs.
   b. Shall have system of traceability of manufactured unit through production and testing in accordance with ANSI/ASQ Z1.4.
   c. Shall have guaranteed availability clause (99.99 percent, minimum for one year) for microprocessor-based components and appurtenances.
   d. Shall have documented product safety policy relevant to products proposed for the Work.

B. Pre-submittal Conference
   1. Pre-submittal conference will be informed if required. Refer to Section 01 31 19.13, for more information on Pre-construction conference.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Field Instruments:
         1) Manufacturer’s product name and complete model number of devices proposed for use, including manufacturer’s name and address.
         2) Instrument tag number in accordance with the Contract Documents.
         3) Data sheets and manufacturer’s catalog literature. Provide data sheets in accordance with ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets using a format similar to ISA 20.
         4) Description of construction features.
         5) Performance and operation data.
         6) Installation, mounting, and calibration details; instructions and recommendations.
         7) Service requirements.
         8) Dimensions of instruments and details of mating flanges and locations of closed tanks, pipe sizes for insertion instruments, and upstream/downstream straight run pipe lengths required.
9) Range of each device and calibration information.
10) Descriptions of materials of construction and listing of NEMA ratings for equipment.

b. Panels, Consoles, and Cabinets:
1) Layout drawings that include:
   a) Front, rear, and internal panel views to scale.
   b) Tag number and functional name of components mounted in and on panel, console, or cabinet, as applicable.
   c) Product information on panel components.
   d) Nameplate location and legend including text, letter size and colors to be used.
   e) Location of anchorage connections.
   f) Location of external wiring and piping connections.
   g) Mounting and installation details, coordinated with actual application.
   h) Proposed layouts and sizes of operator interface graphic display panels and alarm annunciator panels.
   i) Calculations for heating and cooling of panels
   j) Subpanel layouts and mounting details for items located inside control panels.

2) Product information on panel components including:
   a) Manufacturer’s product name and complete model number of devices being provided, including manufacturer’s name and address.
   b) Instrument tag number in accordance with the Contract Documents.
   c) Data sheets and catalog literature. Submit data sheets as shown in ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets with format similar to ISA 20.
   d) Description of construction features.
   e) Performance and operation data.
   f) Installation, mounting, and calibration details; instructions and recommendations.
   g) Service requirements

3) Wiring and piping diagrams, including the following:
   a) Name of each panel, console, or cabinet.
   b) Wire sizes and types.
   c) Pipe sizes and types.
   d) Terminal strip and terminal numbers.
   e) Wire color coding.
   f) Functional name and manufacturer’s designation for components to which wiring and piping are connected.
   g) Lightning and surge protection grounding.

4) Electrical control schematics in accordance with NFPA 79. Drawings shall be in accordance with convention indicated in
Annex D of the NFPA 79. Typical wiring diagrams that do not accurately reflect actual wiring to be furnished are unacceptable. Tables or charts for describing wire numbers are unacceptable.

5) Stock list or bill of materials for each panel including tag number, functional name, manufacturer’s name, model number and quantity for components mounted in or on the panel or enclosure.

6) Detail showing anchorage plan of wire bundles between subpanels and front panel mounted devices.

c. Field wiring and piping diagrams, include the following:
1) Wire and pipe sizes and types.
2) Terminal numbers at field devices and in panels.
3) Fiber optic termination designations in the field and in panels.
4) Color coding.
5) Conduit numbers in which wiring will be located.
6) Locations, functional names, and manufacturer’s designations of items to which wiring or piping are connected.

d. Auto Dialer System:
1) Submit the following general information:
   a) Detailed block diagram showing system wiring configuration showing other systems.
   b) Input/Output Information:
      i. Input/output (I/O) point listing with I/O module cross-reference identification.
      ii. I/O module cross-reference identification based on I/O address list developed by I&C Subcontractor.
   c) Suggested detailed format and configuration of alarm summaries.
2) Hardware:
   a) Layout drawings showing front, rear, end and plan views to scale of equipment, I/O components, power supplies, and peripheral devices.
   b) Equipment ventilation requirements.
   c) Interconnection diagrams, including termination details, cable identification list, and cable length.
   d) Drawings showing equipment layout.
   e) Installation requirements, instructions, and recommendations.
3) Auto Dialer I/O Loop Wiring Diagrams: Prepare Shop Drawings to include the following information;
   a) Location and identification of intermediate panel and field terminal blocks and terminal numbers to which I/O wiring and power supply wiring is connected. Identify power supply circuits with designation numbers and ratings.
   b) Wiring types, wire numbers, and color coding.
   c) Designation of conduits in which field I/O wiring will be installed.
d) Location, functional name, tag numbers and manufacturer’s module numbers of panel and field devices and instruments to which I/O wiring will be connected.

e. Complete point-to-point interconnection wiring diagrams of field wiring associated with the system. Diagrams shall include the following:
   1) Field wiring between each equipment item, panel, instruments, and other devices, and wiring to control stations, panelboards, and motor starters. Some of this equipment may be specified in other Divisions, CONTRACTOR is responsible for providing complete point-to-point interconnection wiring diagrams for control and monitoring of that equipment.
   2) Numbered terminal block and terminal identification for each wire termination.
   3) Identification of assigned wire numbers for interconnections. Assign each wire a unique number.
   4) Schedule showing the wiring numbers and the conduit number in which the numbered wire is installed.
   5) Junction and pull boxes through which wiring will be routed.
   6) Identification of equipment in accordance with the Contract Documents.

2. Product Data:
   a. Product data for field instruments in accordance with requirements for Shop Drawings in this Section.
   b. Product data for panels, consoles, and cabinets in accordance with requirements for Shop Drawings in this Section.
   c. Product data for field wiring and piping provided for instrumentation and control service and not included under other Sections or contracts.

3. Samples:
   a. Color charts for finish paint for panels. Provide full range of paint manufacturer’s standard and custom colors. Color selection will be by ENGINEER.
   b. Color charts for FRP panels. Provide full range of panel manufacturer’s standard and custom colors. Color selection will be by ENGINEER.

B. Informational Submittals: Submit the following:
   1. Documents to be submitted prior to pre-submittal conference, in accordance with Article 1.3 of this specification.
   2. Manufacturer’s Instructions:
      a. Shipping, handling, storage, installation, and start-up instructions.
   3. Source Quality Control Submittals:
      a. Factory test reports and results.
   4. Field Quality Control Submittals:
      a. Submit the following prior to commencing system checkout and start-up.
1) Completed calibration sheets for each installed instrument showing five-point calibration (0, 25, 50, 75, 100 percent of span), signed by factory-authorized serviceman.

b. Field calibration reports
c. Field testing reports.

5. Supplier’s Reports:
a. Installation inspection and check-out report.
b. Submit written report of results of each visit to Site by Supplier’s service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.

6. Qualifications Statements:
a. Supplier.
b. Manufacturer, when required by ENGINEER.

C. Closeout Submittals: Submit the following:

1. Operations and Maintenance Data:
a. Submit in accordance with Section 01 78 23, Operation and Maintenance Data.
b. Include complete up-to-date system software documentation. Provide hardcopy and electronic copies.
c. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

2. Record Documentation:
a. At a minimum provide documents for record per Section 1.4Af. In addition, prepare and submit record documents in accordance with Section 01 78 39, Project Record Documents.
b. Revise all system Shop Drawing submittals to reflect as-built conditions in accordance with the following.
   1) Two copies of each revised Shop Drawings and documentation to replace out-dated drawings and documentation contained in operation and maintenance manuals. Submit half-size black line drawings for each drawing larger than 11 inches by 17 inches. Include specific instructions for out-dated drawing removal and replacement with record documents submittal.
   2) Half-size black line prints of wiring diagrams applicable to each control panel shall be placed in clear plastic envelopes and stored in a suitable print pocket or container inside each control panel.
   3) Submit CADD drawings of the point-to-point interconnection wiring diagrams updated to reflect final as-built equipment information and as-installed field installation information.

D. Maintenance Materials Submittals: Submit the following:

1. Spare Parts and Test Equipment
   a. General
1) Furnish the spare parts and test equipment as indicated below, identical to and interchangeable with similar equipment provided under this Section.

2) Provide source quality control for spare parts as part of factory testing prior to shipment of instrumentation and control equipment.

3) For process sensors and other analog instruments, Supplier shall submit a separate quotation for recommended list of spare parts and test equipment. Separately list and price each item recommended. Spare parts quotation shall include a statement that prices quoted are valid for a period of one year from date of equipment installation and that Supplier understands that OWNER reserves the right to purchase none, any, or all parts quoted. Upon request, Supplier shall submit documentation that stock of spare parts and test equipment is obtainable within 48 hours of receipt of OWNER’s order.

b. Furnish the following spare parts:
   1) Five of each type of input/output relay for each quantity of forty or fraction thereof provided under the Contract.
   2) One replacement power supply for each type and size provided under the Contract.
   3) One-year supply of all expendable or consumable materials.
   4) One per quantity of five or fraction thereof of gauges, indicators, and switches provided, complete with diaphragm seals, filled and ready to use.
   5) One per quantity of ten of fraction thereof provided, per range of field instruments including insertion type instruments. No spares are required for inline instruments such as magnetic flow meters and flumes or venturis that include flow tubes through which flow is conveyed.
   6) Twelve of each type and size of fuse used in instruments.
   7) Twelve of each type and size of Surge suppressors used.

c. Furnish the following test equipment:
   1) Tooling required to insert, extract, and connect internal or external connectors, including edge connectors.

1.5 STORAGE AND HANDLING

A. Prior to packaging, each manufacturer or Supplier shall securely attach tag number and instructions for proper field handling and installation to each instrument.

B. Comply with Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements.
PART 2 – PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Power Supplies:
1. Electrically powered equipment and devices shall be suitable for operation on 115-volt plus-or-minus 10 percent, single-phase, 60 Hertz plus-or-minus two Hertz, power supply. If different voltage or closer regulation is required, provide suitable regulator or transformer at no additional cost to OWNER.
2. Provide appropriate power supplies for field instruments requiring power source less than 115 volts. Power supplies shall be mounted in control panels or enclosures installed near associated instrument or in field panels.
3. Power supplies shall be capable of minimum of 130 percent of maximum simultaneous current draw.
4. Provide power on-off switch or air circuit breaker for each item provided under this Section that requires electric power.

B. Signal Requirements:
1. Control system shall use four to 20 mA DC analog signals, unless otherwise shown or indicated.
2. Provide signal converters and repeaters where required. Adequately size power supplies for signal converters and repeater loads.
3. Isolate signals from ground.
4. Signals transient DC voltage shall not exceed 300 volts over one millisecond, and shall not have a DC component over 300 volts.
5. Discrete signals shall use 120 vac.

C. Surge Protection Requirements:
1. Provide surge protection to protect electronic instrumentation and control systems from surges propagating along signal and power supply cabling. Protection systems shall be such that the protection level shall not interfere with normal operation, but shall be lower than instrument surge withstand level, and be maintenance-free and self-restoring.
2. Provide instruments in suitable metallic cases, properly grounded. Ground wires for surge protectors shall be connected to good earth ground and, where practical, run each ground wire individually and insulated from other wires. Mount protectors within instrument enclosure or in separate junction box compatible with the area designation coupled to the enclosure.
3. The surge protection devices shall be manufactured by Phenoix Contact or MTL.

D. Miscellaneous:
1. General:
   a. Instrumentation components shall be heavy-duty types, constructed for continuous service.
   b. System shall consist of equipment models currently in production.
c. Materials and equipment, including cabling and interconnections, shall be in accordance with Division 16, Electrical, and manufacturer’s recommendations, unless indicated otherwise in the Contract Documents.

d. Materials and equipment shall, where applicable, be in accordance with UL standards and be so marked and labeled.

2. Logic and control loops shall be fail-safe. Instrumentation components shall return automatically to accurate measurement within 15 seconds upon restoration of power after power failure and when transferred to standby power supply.

3. Provide surge protection for instruments and other control system components that could be damaged by electrical surges. Provide lightning arresters on both ends of communication lines, except for fiber optic cabling, external to buildings or structures, including leased telephone lines and similar communication lines.

4. Field-mounted instruments and system components shall be constructed for use in humid and corrosive service conditions. Field-mounted instrument enclosures, junction boxes and appurtenances shall have NEMA rating appropriate for hazardous rating requirements shown or indicated on drawings and specifications. Drawings, instrument data sheets, and elsewhere in the Contract Documents.

5. Miscellaneous hardware such as fittings, fasteners, and screws, be Type 316 stainless steel or other appropriate material to prevent galvanic reactions, and shall be suitable for service intended. Piping stands shall be provided for fastening instruments as required. Provide threaded pipe stands with flange bolted to slab. Use carbon steel piping and flanges painted in accordance with Section 09 91 00, Painting.

6. Data processing equipment and relays with interconnections to field devices shall be wired through field wiring terminal blocks in the panel. Terminals as part of relay base are unacceptable.

7. Arrange panel-mounted instruments, switches, and other devices ergonomically for functional use and ease of maintenance. Similar types of panel-mounted devices shall be by one same manufacturer and of the same model line.

8. Equipment furnished shall be of modular construction and be capable of field expansion through installation of plug-in circuit cards and additional cabinets as necessary.

9. Field- and panel-mounted instruments shall be tagged with equipment number and nomenclature indicated in the Contract Documents; if not so indicated, tag in accordance with approved Shop Drawings.

10. Coordinate ranges and scales specified in the Contract Documents with manufacturer of the equipment actually furnished for operability over the intended range. Complete the coordination prior to submitting Shop Drawings to ENGINEER.

11. Treat field-mounted devices with anti-fungus spray.
12. Protect field-mounted devices from exposure to high and freezing temperatures to provide complete operability under the environmental conditions indicated in the Contract Documents.

E. Environmental Conditions:
1. Provide control system suitable for continuous operation under the following conditions:
   a. Indoor Instruments:
      1) Ambient Temperature: Zero degrees F to 120 degrees F.
      2) Relative Humidity: 100 percent, maximum.
   b. Outdoor Instruments
      1) Ambient Temperature: -15 degrees F to 120 degrees F.
      2) Relative Humidity: 100 percent, maximum.
2. Protect outdoor-mounted field instruments and panels from direct sunlight by providing 3-sided, with top, sunshield for instruments and control panels with displays. Construct sunshield out of heavy gauge aluminum for outdoor mounting or stainless steel in corrosive areas. The sunshields shall be coated with power coat white. Sunshade and mounting shall withstand wind velocity of 150 miles per hour. Direct instrument display and mounting in northern direction if possible. The sunshield shall be provided as shown on the drawings.

2.2 PROCESS TAPS, SENSING LINES, AND ACCESSORIES

A. Water Pressure Sensing Lines and Accessories for Flow and Pressure Transmitters:
   1. Material: Copper water tubing, ASTM B88, Type L, drawn temper or annealed.
   2. Pressure Rating: Same as connecting pipe.
   5. Shut-off Valves:
      a. Type: Ball.
      b. Pressure Rating: Same as connecting pipe.
      c. Body, Ball, and Stem: Brass.
      d. Packing: High-density Teflon.
      e. Handle: Nylon with metal travel stops.
      g. End Connections: Removable.
   6. Manifolds:
      a. Type: Five-valve and three-valve meter manifolds.
      b. Materials: Type 316 stainless steel body, bonnets, and stems; delrin seats; Teflon packing.
      c. Manufacturers: Provide products of one of the following:
         1) Anderson-Greenwood.
         2) Swagelok by Crawford.
3) Or equal.

B. Air Pressure Sensing Lines and Accessories for Air Flow/Pressure Transmitters:
   1. Material: Type 316 stainless steel tubing, ASTM A269, medium wall thickness.
   2. Pressure Rating: Same as connecting pipe.
   4. Connections: Type 316 stainless steel compression type.
   5. Shut-off Valves:
      a. Type: Ball.
      b. Pressure Rating: Same as connecting pipe.
      c. Body, Ball and Stem: Type 316 stainless steel.
      d. Packing: High density Teflon.
      e. Handle: Nylon with metal travel stops.
      f. Support Rings: Teflon coated Type 316 stainless steel.
      g. End Connections: Removable.
      h. Products and Manufacturers: Provide one of the following:
         1) Whitey Valves.
         2) Anderson Greenwood.
         3) Or equal.
   6. Manifolds:
      a. Type: Five-valve and three-valve meter manifolds.
      b. Materials: Type 316 stainless steel body, bonnets and stems; delrin seats; Teflon packing.
      c. Products and Manufacturers: Provide products of one of the following:
         1) Anderson-Greenwood.
         2) Swagelok.
         3) Or equal.

C. Pressure Tap Sensing Lines and Accessories for Pressure Gauges and Pressure Switches:
   1. For Process Sensing Taps in Ductile Iron, Steel and Stainless Steel Piping Systems:
      a. Material and Fittings: Type 304 stainless steel pipe, ASTM A312; and threaded fittings and adapters, ASTM A403.
      b. Sizes: 1/2-inch diameter minimum for main sensing piping and 1/4-inch diameter gauge and switch connections.
      c. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in the Contract Documents.
      d. Accessories:
         1) For applications not requiring diaphragm seals, provide separate 1/2-inch diameter Type 316 stainless steel threaded ball valve for each gauge and switch.
         2) For applications requiring diaphragm seals, provide separate 1/2-inch diameter threaded Type 316 stainless steel ball valve for seal process side shutoff.
2. For Process Sensing Taps in Copper and Thermoplastic Piping Systems:
   a. Pipe Material and Fittings: Use same type of pipe material and fittings as that used in the process piping system. Provide PVC and CPVC piping in accordance with Section 40 05 31, Thermoplastic Process Pipe.
   b. Sizes: 1/2-inch diameter minimum for main process sensing piping and 1/4-inch diameter for gauge and switch connections.
   c. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in the Contract Documents.
   d. Accessories:
      1) For copper piping system taps with or without seals, provide separate 1/2-inch diameter minimum threaded brass or bronze ball valve for each gauge and switch.
      2) For PVC and CPVC piping systems with or without diaphragm seals, provide separate 1/2-inch diameter threaded ball valve for process sensing line shutoff.

2.3 PANELS

A. General Provisions:
   1. Provide electrical components and devices, support hardware, fasteners, and interconnecting wiring and piping required to provide control panels complete and operational.
   2. Locate and provide hardware so that connections can be easily made and there is ample room for servicing each item.
   3. Prevent movement by adequately supporting and restraining devices and components mounted on or within panel.
   4. Provide panels with sub-panels for installation of all internally mounted hardware.
   5. Provide numbered terminal strips for terminating field wiring and wiring from other panels, unless otherwise shown or indicated.
   6. Provide copper grounding studs for hardware requiring grounding.
   7. Provide the following convenience accessories inside each panel:
      a. One 120 vac, 20-amp duplex, grounding type receptacle.
      b. One 120 vac fluorescent service light fixture with 20-watt lamp and protective plastic shield or appropriate wattage incandescent bulb for panels two feet by two feet and smaller.
      c. One 120 vac snap switch, to turn on service light, mounted in outlet box with cover and located so that switch is easily accessible from access door.
      d. Service light with switch and duplex receptacle shall have a dedicated circuit breaker.
   8. Control of Environment (Except NEMA 7 Panels):
      a. Unless required, provide 120 vac thermostatically-controlled fan-driven heater units to maintain stable temperature within enclosure to protect equipment from harmful effects of condensation, corrosion, and low temperatures inside panels.
b. Submit supporting calculations as part of panel Shop Drawing submittal if panel equipment to comply with specified environmental requirements is proposed to be deleted as unnecessary.

9. Panels to be located in non-hazardous (non-classified) environments shall comply with UL 50 and UL 508A.

10. Panels to be located in hazardous (classified) environments shall comply with UL 698A and UL 2062.

11. Provide panels under this Section with 25% percent additional space requirements for future use. Install nothing in space reserved for future use.

12. CONTRACTOR is responsible for detailed layout and design of panels, in accordance with the Contract Documents. Base cutouts and design on instrument manufacturers’ requirements.

13. Lower 12 inches of free standing panels shall be free of devices, including panduits and terminal strips, for ease of installation and maintenance.

14. For front-opening panels, install no device less than three feet above operating floor level, unless otherwise shown or indicated. For rear-opening panels, install no devices on the door.

15. Wire bundles between subpanels and front panel-mounted devices shall be anchored and protected from damage by opening and closing of panel door.

16. Do not locate front panel-mounted devices requiring manipulation by operating personnel, such as pushbuttons, hand switches, controllers, and similar devices, higher than 5.5 feet above finished floor.

17. Panduits located on either side of terminal strips shall have minimum clearance of 1.5 inches between panduit and terminal strip.

18. Provide three-inch high channel base assembly, drilled to mate panel to floor pad.

19. Provide easily-accessible pocket built into panel door to enclose “as built” panel wiring diagrams.

20. Panels shall be UL-listed.

B. Identification:

1. Provide laminated plastic nameplate for identification of panels. Use self-tapping stainless steel screws for fastening nameplates to panels. When self-tapping screws may degrade panel’s NEMA rating, retain NEMA rating intact by using gaskets on each side of panel surface and use retaining plate on the panel back that is same size as nameplate. When gaskets and retaining plate are used, use full-penetration screws with nuts.

2. Panel identification nameplates shall have 1/2-inch high engraved letters.

3. Identify front panel-mounted devices with nameplates engraved with functional description of the device. Nameplate engraving shall be in accordance with the identification provided in the Drawing.

4. Tag electric components and devices mounted within panels with high adhesive labels.

5. Identify terminal strips with nameplate engraved as “TB-XX” where “XX’ is the numerical identification of terminal strip.
6. Identify terminals within each terminal strip with sequential numbers and wire numbers.

7. Internal panel wiring shall be color-coded and numerically identified with unique wire numbers affixed at each end of each wire. Color coding shall be in accordance with panel wiring color code table, below:

<table>
<thead>
<tr>
<th>Panel Wiring Color Code Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>110 vac panel power before fuses or breakers</td>
</tr>
<tr>
<td>Controlled 110 vac power (e.g., after relay contacts, selector switch contacts, and similar equipment.)</td>
</tr>
<tr>
<td>110 vac power source from devices external to panel</td>
</tr>
<tr>
<td>110 vac neutral</td>
</tr>
<tr>
<td>24 vdc positive power from power supplies</td>
</tr>
<tr>
<td>24 vdc negative power from power supplies</td>
</tr>
<tr>
<td>Controlled 24 vdc power (e.g., after PLC output contacts, relay contacts, and similar)</td>
</tr>
<tr>
<td>24 vdc positive power from devices external to panel</td>
</tr>
<tr>
<td>24 vdc negative power from devices external to panel</td>
</tr>
<tr>
<td>24 vdc four to 20 mA DC signal cable</td>
</tr>
<tr>
<td>Grounding wire</td>
</tr>
</tbody>
</table>

C. Panel Construction Features:
1. Control panels located in non-environmentally controlled areas and outdoor areas shall be rated NEMA 4X and with the following features:
   a. Construct panels of fiberglass mat-reinforced polyester resin, with minimum thickness of 3/16-inch for all surfaces, except areas requiring reinforcement.
   b. Panels shall be precision-molded to form one-pieced unit with rounded corners.
   c. Exterior surfaces shall be gel-coated to provide corrosion-resistant, maintenance-free satin finish that does not required painting or other protective coating.
   d. Color pigments shall be molded into the resin.
   e. Color shall be selected by ENGINEER from complete selection of standard and custom color charts furnished by manufacturer.
   f. Panels shall have front access doors where rear access is not feasible.
   g. Provide clear-plastic and gasketed lockable hinged door to encompass non-NEMA 4X front-of-panel devices.
   h. Hardware, including hinge and means of locking shall be corrosion resistant.

2. Control panels located in non-environmentally controlled areas and outdoor areas shall be rated NEMA 4X and with the following features:
   a. Panels shall be Type 316L stainless steel construction with minimum thickness of 12-gage for all surfaces, except areas requiring reinforcing, with a smooth-brushed finish.
   b. Stainless steel screw clamp assemblies on three sides of each door.
c. Rolled lip around three sides of door and along top of enclosure opening.
d. Hasp and staple for padlocking.
e. Provide clear-plastic, gasketed lockable hinged door to encompass non-NEMA 4X front-of-panel devices.

3. Wall-Mounted Panels:
   a. General: Wall-mounted panels shall comply with applicable features and standards specified in this Section for the associated NEMA-rated panel.
   b. Unless otherwise indicated or approved by ENGINEER, depth of wall-mounted panels shall not exceed 18 inches.
   c. Panels may be all stainless steel, fiberglass, polycarbonate, or acrylonitrile butadiene and styrene (ABS).
   d. Provide appropriate size and number of external mounting feet.
   e. Drilled holes or knockouts in back of wall-mounted panels are not allowed.
   f. Provide corrosion-resistant polyester quick release latches (for non-stainless steel panels) or stainless steel screw clamp assemblies (for stainless steel panels).

D. Electrical Systems:
   1. Power Source and Internal Power Distribution:
      a. Provide in the panel, near where incoming power is terminated, nameplate with panel power supply source, type, voltage, and circuit number.
      b. Protect incoming 120 vac power feeds to power the panel by providing lightning and surge arrestors, properly connected to grounds. Surge Protection Device shall be as specified in Section 26 00 05 – Electrical Work.
      c. Provide panels with internal 120 vac power distribution system with properly-sized and -rated circuit breakers to distribute power. Power not more than six devices from a single breaker. When power supplies are included in the panel, not more than two power supplies shall be powered from a single breaker. Convenience receptacles and interior panel lights shall have their own breakers. When one or more field instruments require 120 vac power from the panel for instrument power, power not more than three instruments from a given breaker.
      d. Provide space for a minimum of two spare breakers in each panel.
   2. Electrical Systems:
      a. Internal wiring shall be Type MTW and THW stranded copper wire with thermoplastic insulation rated for 600 volts at 85 degrees C for single conductors, color-coded and labeled with wire identification.
      b. For DC signal wiring, use shielded cable with 18-gage conductors. DC field signal wiring terminal strips shall be capable of handling wires up and including No. 12 size.
c. For AC power wiring, use No. 12 minimum AWG. For AC signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 amps, use sizes required by the NEC (NFPA 70).

d. Inside of panels, route DC signal wiring separately from power wiring with minimum separation distance of six inches.

e. Use covered panduits to route internal panel cables and wiring. Panduits in each section of panel shall be appropriately sized to accommodate the quantity of wires to be routed with a spare capacity of 40 percent.

f. Install wire troughs inside panels along horizontal or vertical routes to present a neat appearance. Angled runs are unacceptable.

g. Wiring that is routed without panduits shall be adequately supported and restrained to prevent sagging or other movement. Use of adhesive anchors to support or restrain wiring is unacceptable.

h. Terminate internal panel wiring using forked, insulated, crimp-on connectors; soldered connectors are unacceptable. Provide panels with 600-volt rated barrier type terminal strips mounted on Din rails. Identify terminal strips as indicated in this Section. Identification devices shall be self-stick, plastic tape strips with permanent, machine-printed numbers.

i. Wiring in panels shall be installed such that, if wires are removed from any one device, power will not be disrupted to other devices.

j. Provide spare terminals equal in number to 20 percent of terminals used for each type of wiring (e.g., DC signal and AC power).

k. Provide ground terminals to terminate the shield wire of shielded cables. Termination of more than two shielded wires on a single ground terminal is unacceptable.

l. Provide a single copper bus bar with 5/16-inch diameter copper grounding stud to connect the panel to external ground. Panel’s internal grounds shall be terminated to the bus bar.

m. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.

n. When DC power or low voltage AC power is required, furnish and install in the panel required power supplies and transformers.

o. Provide complete wiring diagram of “as-built” circuitry enclosed in transparent plastic.

2.4 DATA SHEETS – PANEL INSTRUMENTS AND PRIMARY SENSORS AND FIELD INSTRUMENTS

A. General:

1. Panel-mounted devices and instruments and primary sensors and field instruments shall be in accordance with the “data sheets” included in Part 3 of this specification.

2. Do not fabricate, ship, or assemble instruments and devices in panels until require Shop Drawings and other submittals required for fabrication are approved or accepted as required.
2.5 IDENTIFICATION

A. Instrument Tagging
   1. Headings on the instrument index in the Contract Documents have the following meaning:
      a. “TAG” is divided into two sections. The first seven to nine alphanumeric characters represent the OWNER’s equipment number and the remaining characters comply with ISA Standard S5.1.
      b. “DESCRIPTION/LOCATION” is an explanation of instrument function and location.
      c. “RANGE/SET POINT” is the limit for the specified units of the instrument and set point is the precise value within the instrument’s range.
      d. “SPEC REF” is the paragraph reference in the Specifications where the instrument’s requirements are specified.
      e. “DRAWING NO.” indicates the Drawing where the device is shown or indicated.
      f. “REMARKS” contains specific notes relative to the instrument.

B. Auto Dialer Input/Output List Identification
   1. I/O point list contains information required to configure I/O interface hardware, and to indicate location of the signal origination.
   2. “POINT NUMBER” is an alphanumeric character string. For example, for the point “FI-806” the following apply:
      a. The first two character is the functional identifier and conforms with ANSI/ISA S5.1. In the example, “F” represents flow.
      b. The first three-digit number (806) identifies the P&ID number.
      c. Suffix, where required, is used for distinguishing between similar variables.
   3. “DESCRIPTION” is an alphanumeric character string up to 40 characters in length. Points described as “SPARE” indicate pre-wired I/O.
   4. “SIGNAL TYPE” is one of the following:
      a. AI indicates analog input.
      b. DI indicates discrete input.
      c. PI indicates pulse input.
      d. AO indicates analog output.
      e. DO indicates momentary, maintained or latched discrete output.

C. ISA Identification
   1. A = Analytical.
   3. C = Cooling (Cooling Condenser).
   4. D = Dissolved.
   5. E = Voltage.
   6. F = Flow.
7. G = Intrusion.
12. L = Level.
14. N = UNDEFINED.
15. O = Overload.
17. Q = Communication.
18. R = Reverse.
20. T = Temperature.
22. V = Vibration.
23. W = Torque (Weight or Force).
24. X = Critical (Emergency).
25. Y = Event, State or Presence.

D. Function Identifier:
1. A = Alarm
2. B = UNDEFINED.
3. C = Control.
5. E = Element.
6. F = Failure.
7. G = UNDEFINED.
8. H = High.
9. I = Indication.
10. J = UNDEFINED.
11. K = Factor.
12. L = Low.
15. O = Oxygen.
16. P = UNDEFINED.
17. Q = Quantity.
18. R = Rotation.
19. S = Switch.
20. T = Timer
21. U = UNDEFINED.
22. V = Slow (output)
23. W = Slow (input)
24. X = Selector Switch (input)
2.6 SOURCES QUALITY CONTROL

A. General:
   1. Factory Test for equipment provided by Vendors and I&C subcontractor:
      a. Neither OWNER or ENGINEER will witness factory test at the testing
         facility during operational test of equipment. Registered professional
         engineer retained by CONTRACTOR or Supplier shall witness factory
         test to verify that approved test procedures are followed. When factory
         tests have been successfully completed, submit to ENGINEER factory
         test report signed and sealed by professional engineer.
   2. Factory test results will be acceptable when all components within tested
      control panel or system being tested successfully operate and meet its
      intended function, and are so certified by the testing entity.
   3. Do not ship the equipment until obtaining ENGINEER’s acceptance of
      factory test results.

B. Factory Inspection:
   1. Inspect each panel, console, device, and cabinet before testing and before
      shipping. Inspection shall include, but not be limited to the following:
      a. Verify all “Approved as Corrected” comments on Shop Drawings were
         implemented.
      b. Verify presence of and accuracy of nameplates and tags.
      c. Verify that wire sizes and color-coding comply with the Contract
         Documents.
      d. Verify presence of terminal blocks, terminal block numbers, and
         required quantity of spares.
      e. Verify annunciator window engravings and quantity of spare windows
         comply with the Contract Documents.
      f. Verify proper wiring practices and grounding.
      g. Verify enclosure flatness, finish, and color.
      h. Verify anchoring of wire bundles between subpanels and front panel-
         mounted devices.
      i. Verify presence of applicable items specified in this Section.

C. Auto Dialer Operational Testing:
   1. Test all input/output components to verify that internal panel wiring is
      properly terminated at correct locations. Verify initial ranges and settings.
   2. Test all system hardware and software to verify proper operation as stand-
      alone units. Test shall include, but not be limited to, the following:
      a. Power distribution and breaker ratings to match approved Shop
         Drawings.
      b. Power fail/restart tests.
      c. Diagnostics checks.
      d. Demonstrate that all specified equipment functional capabilities are
         working properly.
3. Test components and devices requiring data transmission to verify that communication between such components is working properly. Verify communication by using the same media required for the completed system at the Site as indicated in the Contract Documents.
4. Perform integrated system test with all system equipment and simulated inputs/outputs connected to verify that equipment is performing properly as an integrated system.
5. Simulation devices shall be of suitable quality to not mask control panel defects.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Environmental Requirements:
   1. Do not install instruments in areas where construction may cause instrument to be damaged, without providing adequate protection for said instrument.

B. Installation of Instrumentation:
   1. Secure field-mounted instruments to stands or brackets in accordance with manufacturer’s recommendations, approved or accepted (as applicable) submittals, and the Contract Documents.
   2. Locate sensors where shown on the Drawings. Confirm exact locations in the field with ENGINEER.
   3. Install all devices so that devices are readily accessible for service and do not cause potential hazards.

C. Installation of Fiber Optic Cable
   1. Provide continuous inter- and intra-building installation, closet to closet, suitable for passing through inside conduit locations directly from outside conduit. Exempt from NFPS 70 (NEC) Article 770-50 (50-foot rule).
   2. Fiber optic cable installation shall include the following:
      a. Do not exceed cable minimum bend radius. Tight loops, kinks, knots, and tight bends during and after installation are unacceptable.
      b. Pull cables using an indirect attachment method such as Kellemes Grip to distribute the pulling forces over cable’s outer portion. Pulls directly on fiber core are not allowed.
c. Provide handholds and pull boxes as required by cable manufacturer. At minimum, provide handholds or pull boxes minimum of every two hundred feet, and at every third 90-degree conduit bend.

d. Upon receipt of the fiber optic cable reels, test each fiber separately with optical time domain reflectometer (OTDR) to verify fiber length, attenuation and continuity. Maximum total loss including connectors and cable attenuation for each fiber optic link shall not exceed 7.5 dB.

D. Services and Operator Instructions:
1. Provide repairs or replacement of defective materials, equipment or workmanship, including with respect to equipment, the services of factory-trained servicemen.
2. In addition to the calibration required for check-out, provide two additional calibrations on all instruments. The first re-calibration shall be approximately six months after acceptance of the system, and the second shall be approximately eleven months after acceptance. As part of each calibration, provide two copies of the calibration sheets, a detailed list of deficiencies (should any be found), and a statement that the entire system is in proper operation and condition (except for the deficiencies noted) and shall be turned over to the OWNER.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections: Field-verify calibration and performance of each instrument prior to start-up of the associated equipment, and document on a separate sheet for each.
   1. For each calibration certification sheet, include the following information:
      a. Project name.
      b. Tag number and description.
      c. Manufacturer.
      d. Model and serial number.
      e. Date, time and person who performed calibration.
      f. Calibration data to include.
         1) Input, output, and error at 0, 25, 75, and 100 percent of span for analog instruments.
         2) Switch setting, contact action and deadband, if applicable, for discrete elements.
      g. Space for comments.
      h. Signature and date.
   2. System Check-Out and Start-Up Responsibilities for packaged systems and I&C subcontractor systems:
      a. CONTRACTOR shall retain the services of the System Supplier to supervise and/or perform check-out and start-up of all system components. As part of these services, the System Supplier shall include for those equipment items not manufactured by him the services of an authorized manufacturer's representative to check the equipment.
installation and place the equipment in operation. The manufacturer's representative shall be thoroughly knowledgeable about the installation, operation and maintenance of the equipment.

b. Check and approve the installation of all instrumentation and control system components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.

c. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. When there are future operational functions included in the Work, they should be included in the system checkout. All problems encountered shall be promptly corrected to prevent any delays in start-up of the various unit processes.

d. CONTRACTOR shall provide all test equipment necessary to perform the testing during system checkout and start-up.

e. CONTRACTOR and System Supplier shall be responsible for initial operation of monitoring and control system and shall make any required changes, adjustments or replacements for operation, monitoring and control of the various processes and equipment necessary to perform the functions intended at no additional cost to the OWNER. These changes or adjustments shall be documented by the CONTRACTOR and submitted to the ENGINEER as part of the Installation Inspection Report described in Paragraph g. below.

f. CONTRACTOR shall furnish to the ENGINEER certified calibration reports for field instruments and panel mounted devices specified in this Section as soon as calibration is completed.

g. CONTRACTOR shall furnish ENGINEER an Installation Inspection Report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by authorized representatives of both CONTRACTOR and the System Supplier.

h. Instrumentation and Control System Field Test:

1) Following the instrumentation and control system checkout and initial operation, CONTRACTOR, under the supervision of the System Supplier, shall perform a complete system test to verify that all equipment and programmed software is operating properly as a fully integrated system, and that the intended instrumentation and control functions are fully implemented and operational. Any defects or problems found during the test shall be corrected by CONTRACTOR and then retested to demonstrate proper operation.

2) Following demonstration of all system functions, the instrumentation and control system, including field sensors/transducers and instruments, and telemetry system shall be running and fully operational for a continuous 48 hour period.
3.4 MANUFACTURER’S SERVICES

A. General:
1. CONTRACTOR shall retain the services of the System Supplier to provide operation and maintenance training for all instrumentation and control system equipment as specified herein.
2. For equipment items not manufactured by the System Supplier, he shall provide for on-Site training by an authorized representative of the equipment manufacturer as part of his services. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment.
3. CONTRACTOR shall be responsible for all costs associated with training and shall provide all required materials, texts and required supplies.
4. Training shall conform to the requirements of Section 01 79 23, Instruction of Operations and Maintenance Personnel.

B. On-Site Training:
1. General:
   a. Provide on-Site operation and maintenance training by System Supplier and the equipment manufacturer representatives prior to placing the equipment in continuous operation.
   b. Training courses shall include time for students to develop and demonstrate understanding of training concepts. Testing shall include hands on training with equipment.
   c. At the conclusion of each course students shall be tested on course material. Testing shall include exercises where students must demonstrate proper response to normal operational needs, emergencies and maintenance tasks. Every student shall be tested individually.
   d. Training shall accomplish the following:
      1) Provide instruction covering use and operation of the equipment to perform the intended functions.
      2) Provide instruction covering procedures for routine, preventive and troubleshooting maintenance, including equipment calibration.
      3) Explain procedures for placing the equipment in and out of operation and explain necessary actions and precautions to be taken regarding the overall plant monitoring and control system.
      4) Provide classes and field training as to how to change process control and alarm set points in all microprocessor based controllers and transmitters. Maintenance personnel shall be trained to enter passwords, programming or configuration data, etc.

2. Primary Sensors/Transducers and Field Instruments:
   a. The services of equipment manufacturer's representatives shall be provided for a minimum of 1 hour for each type of instrument.
   b. Training shall include:
      1) Basic repair and maintenance capabilities of installed equipment.
      2) Procedures for placing the equipment in and out of operation.
3) Use of any special repair equipment or software packages that are used for repair or maintenance.
4) Procedures for testing any repair before placing equipment back in service.

3. Auto Dialer Equipment:
   a. The supplier shall allow minimum 1 hour for training.
   b. The supplier shall provide training that covers Auto Dialer system as follows:
      1) Provide an overview of hardware and software (if any).
      2) It shall train people in configuration and operation of the system.
      3) The emphasis shall be placed on how to perform minor configuration changes, range changes, diagnostics and upkeep of documentation.
      4) Instruction for hardware maintenance, troubleshooting and maintenance planning.

3.5 SUPPLEMENTS

A. The supplements listed below, following the “End of Section” designation, are part of this Specification section.

B. Data Sheets – Panel Instruments and Devices

<table>
<thead>
<tr>
<th>Parag.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.B.2</td>
<td>Automatic Telephone Dialer</td>
<td>28</td>
</tr>
<tr>
<td>3.5.B.6</td>
<td>Current Isolater</td>
<td>29</td>
</tr>
<tr>
<td>3.5.B.16</td>
<td><strong>Deleted – Not Used</strong> - Industrial Ethernet Switch</td>
<td>30</td>
</tr>
<tr>
<td>3.5.B.17</td>
<td>Power Supply - Single Unit</td>
<td>31</td>
</tr>
<tr>
<td>3.5.B.20</td>
<td>Recorder - Electronic Pen Type</td>
<td>32</td>
</tr>
<tr>
<td>3.5.B.21</td>
<td>Relay - Control</td>
<td>33</td>
</tr>
<tr>
<td>3.5.B.23</td>
<td>Relay - Time Delay</td>
<td>34</td>
</tr>
<tr>
<td>3.5.B.24</td>
<td>Selector Switches, Pushbuttons and Indicating Lights</td>
<td>35</td>
</tr>
<tr>
<td>3.5.B.26</td>
<td>Timer - Elapsed Time Meter (Hour Meter)</td>
<td>36</td>
</tr>
</tbody>
</table>

C. Data Sheets – Primary Sensors and Field Instruments

<table>
<thead>
<tr>
<th>Parag.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5.C.16</td>
<td>Analyzer - Free Residual Chlorine</td>
<td>38</td>
</tr>
<tr>
<td>3.5.C.29</td>
<td>Flow Meter - Magnetic Flow Tube</td>
<td>39</td>
</tr>
<tr>
<td>3.5.C.30</td>
<td>Flow Meter – Propeller/Rotor Type</td>
<td>40</td>
</tr>
<tr>
<td>3.5.C.39</td>
<td>Flow Switch - In Line</td>
<td>41</td>
</tr>
<tr>
<td>3.5.C.54</td>
<td>Level Transmitter - Ultrasonic Type</td>
<td>43</td>
</tr>
<tr>
<td>3.5.C.73</td>
<td>Pressure Gauge - Bourdon Type</td>
<td>44</td>
</tr>
</tbody>
</table>
3.5.C.75  Pressure Switch - High/Low  45
          References  48

D.  Instrument Index  49

E.  Auto Dialer Input/Output List  50

++ END OF SECTION +
<table>
<thead>
<tr>
<th><strong>PRODUCT</strong></th>
<th><strong>Automatic Telephone Dialer</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROJECT</strong></td>
<td>SUWANEE COUNTY WTP</td>
</tr>
<tr>
<td><strong>DIALER</strong></td>
<td></td>
</tr>
<tr>
<td>Type:</td>
<td>1 Solid-State, Message Recording, Automatic Telephone Dialer.</td>
</tr>
<tr>
<td>Input:</td>
<td>2 4 Digital Inputs (up to 32 optional) with surge protection.</td>
</tr>
<tr>
<td>Power Supply:</td>
<td>3 120 VAC, 60 Hz; 20-hour automatically rechargeable battery back-up (Battery operation shall be automatic upon power failure).</td>
</tr>
<tr>
<td>Operating Temp.:</td>
<td>4 20 to 130 degrees F.</td>
</tr>
<tr>
<td>Operating Humidity:</td>
<td>5 0 to 95% non-condensing.</td>
</tr>
<tr>
<td>Relay:</td>
<td>6 SPST dry contact for fault detection transmission.</td>
</tr>
<tr>
<td>Alarm:</td>
<td>7 Power failure alarm.</td>
</tr>
<tr>
<td>Capacity:</td>
<td>8 Stores up to 16 telephone numbers; Data entry via keyboard and audio input.</td>
</tr>
<tr>
<td>Message:</td>
<td>9 Variable message length of each fault.</td>
</tr>
<tr>
<td>Indication/Display:</td>
<td>10 Status only indication.</td>
</tr>
<tr>
<td>Enclosure/Housing:</td>
<td>11 NEMA 4X.</td>
</tr>
<tr>
<td>Mounting:</td>
<td>12 Panel or Wall Mount, as required.</td>
</tr>
<tr>
<td>Additional Features:</td>
<td>13 4-Digit Security Code; Internal Clock.</td>
</tr>
</tbody>
</table>

**NOTES**

**Functions:**
- Dialer shall:
  - Respond to any change in a monitored condition by automatically executing a series of telephone calls and repeating a pre-programmed human voice message.
  - Use standard telephone lines, detect a busy signal and automatically proceed to the next telephone number programmed for the fault.
  - Detect a fault via normally open/closed contacts.

**Installation:**
Refer to Contract Drawings and manufacturer's recommendations for installation details.

**MANUFACTURE**

Manufacturer: 31 Provide products of one of the following, Or Equal:
- RACO - Verbatim
- Sensaphone - Express II
<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Current Isolater</th>
<th>SHEET 1 OF 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT</td>
<td>SUWANNEE COUNTY WTP</td>
<td></td>
</tr>
<tr>
<td>SPEC. NO.</td>
<td>40 60 05 - 35.6.6</td>
<td>ADDENDUM./C.O.</td>
</tr>
<tr>
<td>PERFORMANCE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>1 0.5%</td>
<td></td>
</tr>
<tr>
<td>Repeatability</td>
<td>2 ±1% of span.</td>
<td></td>
</tr>
<tr>
<td>Linearity</td>
<td>3 ±0.1% of full scale</td>
<td></td>
</tr>
<tr>
<td>Ambient Temp.</td>
<td>4 32 to 120 degrees F.</td>
<td></td>
</tr>
<tr>
<td>Ambient Humidity</td>
<td>5 0 to 95%, non-condensing</td>
<td></td>
</tr>
<tr>
<td>ISOLATOR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>6 Two-Wire, Loop-Powered Current Isolator.</td>
<td></td>
</tr>
<tr>
<td>Input</td>
<td>7 4 to 20 mADC.</td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>8 4 to 20 mADC.</td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>9 Panel mount</td>
<td></td>
</tr>
<tr>
<td>Additional Features</td>
<td>10 One spare isolator</td>
<td></td>
</tr>
<tr>
<td>NOTES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>11 Current Isolater located in control room panels, remote terminal units, and field panels as required.</td>
<td></td>
</tr>
<tr>
<td>Installation</td>
<td>12 Refer to Contract Drawings and manufacturer's recommendations for installation details.</td>
<td></td>
</tr>
<tr>
<td>MANUFACTURE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturer</td>
<td>34 Ronan, Action Instruments, Crompton Instruments</td>
<td></td>
</tr>
</tbody>
</table>

Provide products of one of the following, Or Equal:
## PERFORMANCE

<table>
<thead>
<tr>
<th>General:</th>
<th>Compact, Managed, Gigabit Industrial Ethernet Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission:</td>
<td>Base-T, 10/100/1000 Mbps with auto negotiation</td>
</tr>
<tr>
<td>Operating Temp.:</td>
<td>32° to 122° F (0° to 50° C)</td>
</tr>
<tr>
<td>Relative Humidity:</td>
<td>5% to 95%, no condensation</td>
</tr>
</tbody>
</table>

## SWITCH

| Interface Ports: | Minimum of twelve (12) RJ-45 ports. Minimum of two (2) single-mode, Gigabit, LC format fiber-optic ports for redundant fiber-optic channels A and B. Fiber optic ports shall be expanded as needed to interconnect all system components. |
| Power Supplys: | Redundant 120VAC or 24VDC supply voltage connection. Powered by separate circuits on Uninterruptible Power Supply. |
| Standards: | Conforms to IEEE 802.3/802.3u/802.3ab |
| Local Indicators: | LEDs indicating port activity, transmission rate, power supply status and error status. |
| Mounting: | Din Rail mounting kit. |
| Alarm Contact: | Dry Contact output to indicate error or unit malfunction. |
| Software: | Integrated web-based configuration and diagnostic management; SNMP (Simple Network Management Protocol) to monitor Ethernet communication via network management systems. |
| Network: | Support PROFINET and Ethernet/IP Protocols; Support Rapid Spanning Tree and Fast Ring Detection. |
| Warranty: | Minimum 1 year |

## Additional Features:

- Supports the use of IGMP for multicast traffic; Supports VLAN as defined in IEE802.1Q.

## NOTES

- Location: Treatment System Control Panel (TSCP) panels.
- Function: Connect VFD's through Ethernet Communication Protocol. Connect internet cable to the switch for remote access.
- Installation: Mount on Din rail; Refer to manufacturer's recommendations for installation details.
- Software: Provide management software as required for remote configuration, monitoring and diagnostics.
- Status Output: Wire Alarm Dry Contact to TSCP PLC discrete input.

## MANUFACTURE

- Manufacturer: Allen-Bradley Stratix 8000, Product No. 1783-MS10T
# Single Unit Power Supply

**Type:** Single Unit Power Supply with Solid-State Circuitry.

**Input:** 120 V AC ±10%, 60 Hz. Powered by circuit on Uninterruptible Power Supply.

**Output:** 24 V DC ±1%

**Line / Load:** ±0.005% line to load regulation.

**Response Time:** < 1 s

**Polarity:** Floating output.

**Ambient Temp.:** -25 °C ... 70 °C (> 60 °C derating)

**Indication:** "DC OK" Status LED

**Protection:** Transient surge protection Varistor.

**Connections:** Twist-lock AC power connector plug; DC power terminal strip screw terminals for connecting a minimum of two No.14 AWG wires.

**Mounting:** DIN rail or surface mounted.

**Status Contact:** DC Status Relay Contact.

### Notes

- **Location:** Treatment System Control Panel (TSCP) panels.
- **Installation:** Refer to Contract Drawings and manufacturer’s recommendations for installation details.
- **Status Output:** Wire DC Status Relay Contact to TSCP PLC discrete input.
- **Spare Parts:** Provide fuses as required. Provide one spare power supply for the project.

### Manufacturer

- **Manufacturer:** Phoenix Contact, Inc.
**Data Sheets - Panel Instruments and Devices**

**Product:** Recorder - Electronic Pen Type  
**Sheet:** 1 Of 1

<table>
<thead>
<tr>
<th>Tag No.</th>
<th>Ref. Dwg. No.</th>
<th>Location/Panel</th>
<th>Performance</th>
<th>Recorder</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I-02</td>
<td>Location/Panel</td>
<td>2</td>
<td>Refer to Electrical Drawings for location</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Accuracy:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Operating Temp.:</td>
<td>4</td>
<td>0.05%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Relative Humidity:</td>
<td>5</td>
<td>32 to 120 degrees F.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pen Response:</td>
<td>6</td>
<td>10 to 90% non-condensing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Update Rate:</td>
<td>7</td>
<td>1 second of full scale.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500 ms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type:</td>
<td>8</td>
<td>Paper Trend Chart Recorder.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No. of Channels:</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Input:</td>
<td>10</td>
<td>Up to 6 inputs; Thermocouple, millivolt, voltage (configurable for each input).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Output:</td>
<td>11</td>
<td>Two - 4 to 20 mA.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Power Supply:</td>
<td>12</td>
<td>120 VAC, 60 Hz.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Display/Indication:</td>
<td>13</td>
<td>Circular Paper Chart Display; Analog Display for channel values in Engineering Units.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Enclosure/Housing:</td>
<td>14</td>
<td>Electronic Recorder shall match in appearance other panel mounted instruments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mounting:</td>
<td>15</td>
<td>Flush Panel Mount.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Area Classification:</td>
<td>16</td>
<td>NEMA 4X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Additional Features:</td>
<td>17</td>
<td>Adjustable Chart Speed; EEPROM Memory Protection; Overload Protection.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Functions:</td>
<td>18</td>
<td>Recorder shall be capable of performing the following:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Addition</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Subtraction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Multiplication</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Division</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Totalization</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Alarms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Installation:</td>
<td>19</td>
<td>Refer to Contract Drawings and manufacturer’s recommendations for installation details.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pen Type:</td>
<td>20</td>
<td>Replaceable and Disposable, fiber-tipped pens or printing cartridge. Provide unique color per channel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Provide spare pens and charts for 1 year supply.</td>
</tr>
</tbody>
</table>

**Manufacture**

| Manufacturer | Chessel | Hach |

**Manufacturer:**

Provide products of one of the following, Or Equal:
### DATA SHEETS - PANEL INSTRUMENTS AND DEVICES

#### RELAY

<table>
<thead>
<tr>
<th>Type</th>
<th>General Purpose, Plug-in Control Relay.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coil Voltage</td>
<td>24 VDC OR 120 VAC, as required.</td>
</tr>
<tr>
<td>Rating</td>
<td>Continuous Duty.</td>
</tr>
<tr>
<td>Contacts</td>
<td>Silver cadmium oxide rated not less than 5A resistive at 120 VAC or 24 VDC; For switching low energy circuits (less than 200mA) use: fine silver, gold flashed contacts rated not less than 3A resistive at 120 VAC or 24 VDC.</td>
</tr>
<tr>
<td>Indication/Display</td>
<td>Pilot light to show energized coil.</td>
</tr>
<tr>
<td>Enclosure/Housing</td>
<td>Clear plastic dust cover.</td>
</tr>
<tr>
<td>Mounting</td>
<td>As required.</td>
</tr>
</tbody>
</table>

#### NOTES

<table>
<thead>
<tr>
<th>Location</th>
<th>Control Relays located in TSCP panels and field panels as required.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation</td>
<td>Refer to Contract Drawings and manufacturer's recommendations for installation details.</td>
</tr>
<tr>
<td>Approvals</td>
<td>Relays shall be UL recognized.</td>
</tr>
</tbody>
</table>

#### MANUFACTURE

| Manufacturer | IDEC, Inc. | Schneider Electric, Inc. |

**PROJECT**

SUWANNEE COUNTY WTP

**PRODUCT**

Relay - Control

**MANUFACTURE**

Provide products of one of the following, Or Equal:

| Manufacturer | IDEC, Inc. | Schneider Electric, Inc. |

**SPEC. NO.**

40 60 05 - 3.5.8.21
### DATA SHEETS - PANEL INSTRUMENTS AND DEVICES

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Relay - Time Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHEET</td>
<td>1 OF 1</td>
</tr>
<tr>
<td>PROJECT</td>
<td>SUWANNEE COUNTY WTP</td>
</tr>
<tr>
<td>SPEC. NO.</td>
<td>40 60 05 - 3.5.8.23</td>
</tr>
<tr>
<td>ADDENDUM/C.O.</td>
<td></td>
</tr>
</tbody>
</table>

#### PERFORMANCE
- **Accuracy:** 10%
- **Operating Temp.:** 32 to 130 degrees F.

#### RELAY
- **Type:** Plug-in Type Time Delay Relay
- **Power Supply:** 120 VAC or 24 VDC, as required.
- **Contacts:** DPDT
- **Rating:** 5A at 120 VAC, 5A at 24 VDC.
- **Indication/Display:** Timing status LED
- **Range:** Switch selectable ranges as follows: 1 seconds, 10 seconds, 1 minute, 10 minutes, 1 hour, 10 hours.
- **Enclosure/Housing:** Dust and moisture resistant molded plastic case.
- **Mounting:** Panel Mount
- **Additional Features:** MOS digital circuit with transformer coupled power.

#### NOTES
- **Function:** Dial adjustable, plug-in type time delay relay providing delay-on-make, delay-on-break or interval operation.
- **Installation:** Refer to Contract Drawings and manufacturer’s recommendations for installation details.
- **Approvals:** Relay shall be UL recognized.

#### MANUFACTURE
- **Manufacturer:** Automatic Timing and Controls Company
- **Id:** IDEC
## Data Sheets - Panel Instruments and Devices

### Product
Selector Switches, Pushbuttons and Indicating Lights

### Project
Sewanee County WTP

### Switch

<table>
<thead>
<tr>
<th>Type</th>
<th>Position / Pole</th>
<th>Contacts</th>
<th>Rating</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>AC or DC compatible - 10A resistive at 120 VAC or DC continuous minimum.</td>
<td>Standard black knob.</td>
</tr>
</tbody>
</table>

### Pushbutton

<table>
<thead>
<tr>
<th>Type</th>
<th>Contacts</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Double break, silver contacts with movable contact blade providing scrubbing action; No. and arrangement of contacts as required to perform intended functions specified, but not less than one single pole, double throw contact.</td>
<td>Standard black knob unless otherwise noted (See Notes for Color Chart). Provide mushroom head pushbuttons for all emergency stop functions.</td>
</tr>
</tbody>
</table>

### Light

<table>
<thead>
<tr>
<th>Type</th>
<th>Lamps</th>
<th>Additional Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>LED; 6 Volts, Long Life (20,000 hours minimum); Lens Color (See Notes for Color Chart).</td>
<td></td>
</tr>
</tbody>
</table>

### Unit

<table>
<thead>
<tr>
<th>Type</th>
<th>Enclosure/Housing</th>
<th>Indication</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Oil-tight, heavy duty; Black bezel and knob.</td>
<td>Maximum 4 quadrant displays with individual lamp; 6 Volt Lamps.</td>
<td></td>
</tr>
</tbody>
</table>

### Component Table

<table>
<thead>
<tr>
<th>Component</th>
<th>Type</th>
<th>Use</th>
<th>Color Coding and Legends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator Light</td>
<td>LED</td>
<td>Equipment Status (e.g., &quot;ON/OFF&quot;, &quot;OPEN/CLOSED&quot;)</td>
<td>A: Red**; B: Green; C &amp; D: White</td>
</tr>
<tr>
<td>Acknowledge Pushbutton*</td>
<td>Momentary Pushbutton Action</td>
<td>To silence audible device associated with annunciator</td>
<td>A &amp; B: Amber; C &amp; D: Amber</td>
</tr>
<tr>
<td>Annunciator Test Pushbutton*</td>
<td>Momentary Pushbutton Action</td>
<td>To functionally test annunciator lights and audible device</td>
<td>A &amp; B: Amber; C &amp; D: Amber</td>
</tr>
<tr>
<td>Two Position Selector Switch</td>
<td>2-Position Maintained Contact</td>
<td>To select equipment mode (e.g., winter / summer; pumps 1/2)</td>
<td>A: Blue**; B: Green**; C &amp; D: White**</td>
</tr>
<tr>
<td>Three Position Selector Switch</td>
<td>3-Position Maintained Contact</td>
<td>For manual or automatic operation of equipment (e.g., pumps, gates)</td>
<td>A: Red**; B: Green**; C: Red**; D: White**</td>
</tr>
</tbody>
</table>

* Pushbuttons shall not have lights.
** Red, Blue, or Green quadrant lights shall be energized depending on selected position of the switch. White quadrant light shall be energized continuously.

### Notes

Location: Located on TSCP control room panels and field panels as required.
Attributes: Switches, pushbuttons, and lights shall be:

- Supplied by one manufacturer and be of the same series or model type.
- Heavy duty, oil tight, full size, and with modular contacts.
- NEMA rated to match panel in which mounted.

Mounting: Flush mount switches, pushbuttons and indicating lights on control panel front, unless otherwise noted.
Installation: Refer to Contract Drawings and manufacturer's recommendations for installation details.
Color Chart: Use Green: Open; On; Running
Red: Closed; Off (Ready); Stopped
Amber: Equipment Malfunction; Process Trouble; Alarms (e.g., "HIGH LEVEL")
Blue: Electrical Control Power ON

Legend Plate: Provide legend plate for indication of switch, pushbutton, or light function (e.g. "OPEN-CLOSED", "HAND-OFF-AUTO").

Manufacturer: Provide products of one of the following, Or Equal:
Cutler-Hammer
Allen Bradley
Micro Switch
## DATA SHEETS - PANEL INSTRUMENTS AND DEVICES

### PRODUCT
**Timer - Elapsed Time Meter (Hour Meter)**

### PROJECT
**SUWANNEE COUNTY WTP**

### SHEET 1 OF 1

#### PERFORMANCE
- **Accuracy:** 1%  
- **Operating Temp.:** -40 to 150 degrees F

#### METER
- **Type:** Elapsed Time Indicator.  
- **Input:** Contact Closure OR Open Collector, as required.  
- **Output:** 4 to 20 mA DC.  
- **Power Supply:** 120 VAC.  
- **Runtime Capacity:** Up to 99,999.9 hours; Automatic recycle to zero; One-tenth hour resolution.  
- **Indication/Display:** LCD for continuous time readouts; 6 Digits minimum; Easy to read analog figures; Engineering Units; Non-resetable time indicator.  
- **Enclosure/Housing:** Sealed against dirt and moisture; Tamperproof; Shock Resistant.  
- **Mounting:** Front Panel Mount.  
- **Additional Features:** Nameplate mounted below display engraved with "TOTAL HOURS".

#### NOTES
- Elapsed Time Meter shall be located in control room panels, remote terminal units, and field panels as required.  
- Refer to Contract Drawings and manufacturer's recommendations for installation details.

#### MANUFACTURE
- **Manufacturer:** Veeda-Root, Cutler-Hammer

---

40039002  40 60 05-36  100%
# DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Analyzer - Chlorine</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHEET</td>
<td>1 OF 1</td>
</tr>
<tr>
<td>PROJECT</td>
<td>SUWANNEE COUNTY WTP</td>
</tr>
<tr>
<td>SPEC. NO.</td>
<td>40 60 05 - 3.5.C.4</td>
</tr>
<tr>
<td>ADDENDUM/C.O.</td>
<td>AE / AIT - 201</td>
</tr>
</tbody>
</table>

## TAG NO.
- Ref. Dwg. No.: 1
- Location: 2
- Service: 3
- Vessel / Line No.: 4
- Fluid: 5
- Temp. Min/Max: 6
- Level Min/Max: 7

## SENSOR
- Type: 8
- Element: 9
- Range: 10
- Enclosure/Housing: 11
- Mounting: 12
- Commun. Cable: 13
- Area Classification: 14
- Additional Features: 15

## TRANSMITTER
- Type: 16
- Output: 17
- Power Supply: 18
- Relays: 19
- Switch Action: 20
- Setpoints: 21
- Rating: 22
- Indication / Display: 23
- Enclosure/Housing: 24
- Mounting: 25
- Area Classification: 26
- Additional Features: 27

## NOTES
- General: 28
- Materials: 29
- Installation: 30
- Replaceable Cap: 31
- Consumables: 32
- Setpoints: 33
- Equipment: 34
- Additional Features: 35
- MANUFACTURE: 36
- Manufacturer: 37

## MANUFACTURE
- Provide products of one of the following, Or Equal:
  - Capital Controls
  - Rosemount - Division of Emerson
  - Hach

---

40039002 4 0 6 0 0 5 - 3 8 100%
### DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

#### Flow Meter - Magnetic Flow Tube

**PRODUCT**

<table>
<thead>
<tr>
<th>Tag No.</th>
<th>Reference Dwg. No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I-02</td>
<td></td>
</tr>
</tbody>
</table>

**TAG NO.**

<table>
<thead>
<tr>
<th>Ref. Dwg. No.:</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Location: 2 Refer to Electrical Drawings</td>
</tr>
<tr>
<td></td>
<td>Service: 3 Raw Water</td>
</tr>
<tr>
<td></td>
<td>Vessel / Line No.: 4 8&quot; Well Discharge header</td>
</tr>
<tr>
<td></td>
<td>Fluid: 5 Ground Water</td>
</tr>
<tr>
<td></td>
<td>Temp. Min/Max: 6 60-80F</td>
</tr>
<tr>
<td></td>
<td>Flow Min/Max: 7 0-2500 GPM</td>
</tr>
</tbody>
</table>

**PERFORMANCE**

<table>
<thead>
<tr>
<th>Range:</th>
<th>±5% of full scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy:</td>
<td>±0.2%/±0.005 fps for flows below 1 fps</td>
</tr>
<tr>
<td>Temperature:</td>
<td>21-158 °F</td>
</tr>
<tr>
<td>Repeatability:</td>
<td>±0.2% of range</td>
</tr>
<tr>
<td>Fluid Conductivity:</td>
<td>Minimum Limit: 5 μS/cm</td>
</tr>
<tr>
<td>Impedance:</td>
<td>Minimum Pre-amp Input: 1012 ohms</td>
</tr>
</tbody>
</table>

**FLOW TUBE**

| Type: | Lined Metal Flow Tube |
| Element: | Conical or Elliptical Shaped Electrode |
| Electrode/Liner: | 316 SS/Teflon |
| Line Size: | 8" |
| Enclosure/Housing: | Polycarbonate or aluminium, fully-potted terminal box, NEMA6 to 10m (33ft) depth |
| Mounting: | Flange End Connections |
| AWWA/ANSI Class: | Class: 350psi; C104 / A21.4 |
| Additional Features: | 316 S.S. Grounding Rings |

**TRANSMITTER**

| Type: | Pulsed DC Magnetic Flow Transmitter |
| Output: | 4-20mA with HART |
| Power Supply: | 120 VAC, 60 Hz @ <7VA |
| Indication / Display: | Local LCD; Display Flow in Engineering Units; Provide Totalizer |
| Enclosure/Housing: | NEMA 4X; Powder-coated aluminum |
| Mounting: | Remote Stanchion mount NEMA 4X |
| Connections: | Electrical Conn.: 1/2 inch NPT |
| Commun. Cable: | Vendor Cable: 30m length minimum |
| Area Classification: | Not required |
| Additional Features: | Self Calibrating |

**NOTES**

| Function: | System shall monitor liquid flows, display monitored flow value, and output a signal proportional to monitored flow |
| Installation: | Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation. Provide Sunshield |
| Calibration: | Provide ISO Factory Calibration Certificate. Provide one calibrator suitable to calibrate all flow tubes provided |
| Accuracy: | Accuracy shall be: |
| Span Adjustment: | Unit shall have pre-calibrated continuous span adjustment over entire range. Provide direct reading thumbwheel switch or potentiometer for 1-31 ft/sec |
| Signal Conditioning: | Adjustable signal conditioning damping circuit with response times of 1-25 seconds minimum. Provide surge protection |
| Low Flow Cutoff: | Automatic low flow cutoff circuitry shall stop pulse output and local totalization when flow drops below 0.5% ±0.2% of calibrated upper range value |
| Totalizer: | 7-digit or 8-digit electronic LCD unit, with reset and lithium battery backup |
| Spool Piece: | Refer to Contract Documents for spool piece requirements |
| MANUFACTURE: | Rosemount Krohne ABB |

**PROJECT**

| Project: | SUWANNEE COUNTY WTP |
| SPEC. NO. ADDENDUM/C.O.: | FE / FIT - 100 |
DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT  Flow Meter - Propeller Type  SHEET 1 OF 1

PROJECT  SUWANNEE COUNTY WTP

FLOW METER

Type: 1 Flow Tube with Propeller or rotor
Range: 2 As specified below; Provide Flow Over-range Protection of 25% above rated capacity to 15% operating time.
Accuracy: 3 ±2% of Flow within specified range.
Temperature: 4 100°F maximum; Ambient Temp. Range: 0 to 165°F ±0.005% per °F over maximum operating temperature range.
Flow Tube: 5 Fabricated steel body; Nominal diameter throughout length; Designed for 150 pounds working pressure.
Materials: 6 Ductile iron meter head; Ceramic rotor bearings; Factory sealed, oil-filled, one piece cast bronze gear housing; Brass gears; S.S. Shafts and bolts; Permanent ceramic sleeve type magnets.
Finish: 7 For Tube Size 4 to 12 inch; Fusion bonded epoxy finish; For Tube Size 14 to 36 inch; Enamel paint finish.
Propeller: 8 Molded polypropylene conical shaped 3 bladed propeller, polypropylene nut and ceramic-coated S.S. propeller spindle; Propeller mounted on radial sleeve type ceramic bearings; S.S. support shaft; Magnetically coupled to register drive.
Straightening Vanes: 9 Four fabricated steel Straightening Vanes radially spaced 90° apart in flow tube.
Indication / Display: 10 Integral register consisting of rate indicator and totalizer; 4-inch diameter dial indicator and 6 digit totalizer with test hand to check accuracy of indicator.
Mounting: 11 Flange mounted; For Tube Size 4 to 12 inch: AWWA class D (125) Steel Flange; For Tube Size 14 to 36 inch: ANSI class 150 steel raised face flange suitable for mating with AWWA Class 125 ductile iron pipe flange; Meter head flange mounted to flow tube.
Additional Features: 12 Register unit protected by o-ring sealed bronze housing register box complete with locking lid. Register Drive shall be completely isolated from water pressure by o-ring sealed bronze housing.

PULSE TRANS.

Type: 13 Electronic Pulse Rate Transmitter.
Function: 14 Develops and transmits a high resolution pulse rate signal, proportional to flow rate, over a three wire cable to the external pulse rate Frequency to DC Current Flow Transmitter.
Output: 15 112 VDC square wave pulse; 50/50 ±20% Duty Cycle; 50mADC maximum Load Current; 50 Hz Pulse Rate at maximum meter indicator scale reading.
Power Supply: 16 12 VDC, ±5%, 50 mA max. supplied by external Frequency to DC Current Flow Transmitter.
Enclosure/Housing: 17 Submersible; Aluminum housing with rubber o-ring seal.
Mounting: 18 Integral mount to flow meter between meter head and direct reading register.
Commun. Cable: 19 Interconnecting cable to external frequency to DC current flow transmitter; Length as required (10 feet minimum).
Additional Features: 20 Watertight, corrosion resistant electrical fittings.

FLOW TRANS.

Type: 21 External Frequency to DC Current Flow Transmitter of quartz crystal time-base design.
Function: 22 Provides power to and receives pulse signal from the Electronic Pulse Rate Transmitter, and transmits 4-20 mA DC output signal proportional to flow rate to the plant instrumentation and control system.
Input: 23 3-wire floating transformer coupled with 12V excitation for propeller magnetic pickup/pre-amp. Input attenuation for higher input voltages as required.
Output: 24 4-20 mA DC into 0-1200 ohm load at 24 VDC; Load Effect: ±0.01% span from 0 to max load resistance.
Power Supply: 25 120 VAC, 60 Hz ±10% with 5 watts nominal power consumption.
Calibration: 26 Front panel adjustments via potentiometers for Span and Zero; Span: fully adjustable over preselected input range to 100% of selected output span; Zero: Adjustable to ±10% of selected output span at min.
Enclosure/Housing: 27 General purpose housing with angle bracket mounting for installation in larger, NEMA 4X field mounted enclosure.
Mounting: 28 Remote Stanchion mount; Support frame or pipe stand mount; SS hardware, brackets, and fasteners.
Connections: 29 Electrical Conn.: Screw-type barrier terminal strips on front of housing.
Additional Features: 30 Filters for RFI/EMI protection; Transformer isolated output and power input with common mode rejection exceeding 120 dB at 60 Hz with a limit of 500 volts rms.

NOTES

General: 31 The flanged tube type propeller flow meter shall include a magnetic drive, electronic pulse transmitter, frequency to DC current transmitter, and integral rate indicator and totalizer register. Coordinate to ensure compatibility of external Frequency to DC Current Transmitter and Electronic Pulse Rate Transmitter.
Installation: 32 Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation. Provide Sunshield.
33 Provide grounding per manufacturers recommendations.
34 Provide surge protection.

MANUFACTURER

Manufacturer: 35 Sensus, Model-Omni T2 with ACT PAK

INSTRUMENT

Requirements specified above shall apply to all instrument tag numbers listed below.

<table>
<thead>
<tr>
<th>Tag No.</th>
<th>Line Size</th>
<th>Process Fluid</th>
<th>Area Class.</th>
<th>Location / Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FE / FIT - 200</td>
<td>300 - 700 GPM</td>
<td>Potable Water</td>
<td>N/A Refer Elect. Dwgs/Distribution Supply</td>
</tr>
<tr>
<td>2</td>
<td>6 - inch</td>
<td>NEMA 4X</td>
<td>I-02</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Flow Switch - In Line</th>
<th>SHEET</th>
<th>1 OF 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT</td>
<td>SUWANNEE COUNTY WTP</td>
<td>SPEC. NO.</td>
<td>40 60 05 - 3.5.C.39</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TAG NO.</th>
<th>Ref. Dwg. No.</th>
<th>PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSL - 013</td>
<td>I-02</td>
<td>Location:</td>
</tr>
<tr>
<td>FSL - 023</td>
<td>I-02</td>
<td>Service:</td>
</tr>
</tbody>
</table>

| Manufacturer: | Magnetrol Model - TD1 |

### TAG NO.

<table>
<thead>
<tr>
<th>Ref. Dwg. No.</th>
<th>PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-02</td>
<td>Location: Refer to Electrical Drawings</td>
</tr>
<tr>
<td>I-02</td>
<td>Service: Refer to Electrical Drawings</td>
</tr>
</tbody>
</table>

### PERFORMANCE

<table>
<thead>
<tr>
<th>Range:</th>
<th>Accuracy:</th>
<th>Repeatability:</th>
<th>Opert. Temperature:</th>
<th>Deadband:</th>
</tr>
</thead>
<tbody>
<tr>
<td>±5% of range.</td>
<td>±5% of range.</td>
<td>±0.5% of range.</td>
<td>-20 to 140 °F.</td>
<td>±5% of range.</td>
</tr>
<tr>
<td>400 - 1000 gpm</td>
<td>400 - 1000 gpm</td>
<td>±5% of range.</td>
<td>-20 to 140 °F.</td>
<td>±5% of range.</td>
</tr>
</tbody>
</table>

### SWITCH

<table>
<thead>
<tr>
<th>Type:</th>
<th>Power Supply:</th>
<th>Line Size:</th>
<th>Relays:</th>
<th>Rating:</th>
<th>Switch Action:</th>
<th>Setpoints:</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Line Flow Switch.</td>
<td>120 VAC.</td>
<td>8 inch</td>
<td>SPDT Dual Switch.</td>
<td>5 A at 120 VAC.</td>
<td>Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.</td>
<td>400 gpm; Field Adjustable.</td>
</tr>
<tr>
<td>In Line Flow Switch.</td>
<td>120 VAC.</td>
<td>8 inch</td>
<td>SPDT Dual Switch.</td>
<td>5 A at 120 VAC.</td>
<td>Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.</td>
<td>400 gpm; Field Adjustable.</td>
</tr>
</tbody>
</table>

### NOTES

- All wetted parts shall be compatible with the process fluid. Refer to Materials Compatibility Chart. For seal water service, coordinate with requirements of equipment being furnished.
- Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.
- Provide ISO Factory Calibration Certificate.
## DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

### Flow Switch - In Line

#### PROJECT
- **SUWANNEE COUNTY WTP**
- **SPEC. NO.**
- **ADDENDUM/C.O.**

#### TAG NO.
- **Ref. Dwg. No.**
- **FSL - 303**
- **FSL - 313**
- **1-02**
- **1-02**

#### PROCESS
- **Location:** Refer to Electrical Drawings
- **Service:** Refer to Electrical Drawings
- **Vessel / Line No.:** 8" PW 8" PW
- **Fluid:** Potable Water Potable Water
- **Temp. Min/Max:** 50/ 100 deg F 50/ 100 deg F
- **Press. Min/Max:** 0/ 25 PSI 0/ 25 PSI
- **Flow Min/Max:** 0-3500 gpm 0-3500 gpm

#### PERFORMANCE
- **Range:** 300 - 700 gpm 300 - 700 gpm
- **Accuracy:** ±5% of range. ±5% of range.
- **Repeatability:** ±0.5% of range. ±0.5% of range.
- **Opert. Temperature:** -20 to 140 °F. -20 to 140 °F.
- **Deadband:** ±5% of range. ±5% of range.

#### SWITCH
- **Type:** In Line Flow Switch. In Line Flow Switch.
- **Power Supply:** 120 VAC. 120 VAC.
- **Line Size:** 8 inch 8 inch
- **Relays:** SPDT Dual Switch. SPDT Dual Switch.
- **Rating:** 5 A at 120 VAC. 5 A at 120 VAC.
- **Switch Action:** Switch Opens/Closes at predefined setpoint(s); Normally Closed contact. Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.
- **Setpoints:** 300 gpm; Field Adjustable. 300 gpm; Field Adjustable.
- **Indication / Display:** Integral LCD; Engineering Units. Integral LCD; Engineering Units.
- **Enclosure/Housing:** NEMA 4X NEMA 4X
- **Mounting:** Pipe mount Pipe mount
- **Connections:** Process Conn.: 1/2 inch NPT. Process Conn.: 1/2 inch NPT.
- **Area Classification:** N/A N/A
- **Additional Features:** 316 S.S. internal moving parts. 316 S.S. internal moving parts.

#### NOTES
- **General:** All wetted parts shall be compatible with the process fluid. Refer to Materials Compatibility Chart. For seal water service, coordinate with requirements of equipment being furnished.
- **Installation:** Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.
- **Calibration:** Provide ISO Factory Calibration Certificate.

#### MANUFACTURE
- **Manufacturer:** Magnetrol Model - TD1
<table>
<thead>
<tr>
<th>TAG NO.</th>
<th>LE / LIT - 111</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ref. Dwg. No.</td>
<td>I-2</td>
</tr>
</tbody>
</table>

**PROCESS**
- **Location:** Refer to Electrical Drawings
- **Service:** Ground Storage Tank
- **Fluid:** Ground Water
- **Vessel / Line No.:** GST
- **Temp. Min/Max:** 50/100 Deg F
- **Level Min/Max:** 0 - 50 Ft

**PERFORMANCE**
- **Range:** 0 - 30 Ft
- **Accuracy:** ±0.25% of Max. Range with Temperature Compensation.
- **Temperature:** Electronics: -5 to 120 degrees F; Transducer: -40 to 140 degrees F.
- **Resolution:** ±0.1% of Range or 2mm, greater of 2.
- **Damping:** Adjustable.

**SENSOR**
- **Type:** Ultrasonic, Non-Contacting Transducer.
- **Element:** Piezoelectric Barium Titanite Crystal.
- **Blanking:** Adjustable Blanking Distance.
- **Beam Angle:** 5 degree beam angle
- **Enclosure/Housing:** Hermetically Sealed in Kynar.
- **Mounting:** Flange Mount; Provide 316 S.S. Hardware/Brackets.
- **Commun. Cable:** Communications Cable to transmitter, Length as required.
- **Area Classification:** N/A
- **Additional Features:** Built-In Temperature Compensation Sensor.

**TRANSMITTER**
- **Type:** Microprocessor Based Control Circuitry Transmitter.
- **Output:** Two 4-20 mA DC isolated, into 0-750 ohms.
- **Power Supply:** 120 VAC, 60 Hz.
- **Relays:** 6 SPDT Level Alarm contacts with LED relay status indication.
- **Rating:** 5A at 250 VAC.
- **Indication / Display:** Multifield Back-lit LCD; Engineering Units; Loss of Echo Indication.
- **Software:** As Required by Manufacturer.
- **Enclosure/Housing:** NEMA 4X; Polycarbonate Enclosure.
- **Mounting:** Stanchion; 316 S.S. Hardware.
- **Area Classification:** N/A
- **Additional Features:** Electronic Filter to smooth signal variations.

**NOTES**
- **Function:** Ultrasonic Level Transmitter shall be a continuous liquid level measuring system which produces an output signal linear with level.
- **Installation:** Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation. Provide Sunshield.
- **Calibration:** Provide ISO Factory Calibration Certificate.
- **Beam Angle:** A 12 degree beam angle shall be used for ranges less than 33 feet, and a 5 degree beam angle shall be used for ranges greater than 33 feet.
- **Keypad:** Provide keypad for system programming and configuration. Programming and configuration values shall be stored in EEPROM memory that does not require battery back-up.

**MANUFACTURE**
- **Manufacturer:** Milltronics - Division of Siemens, Endress + Hauser, Grey line
DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Pressure Gauge - Bourdon Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT</td>
<td>SUWANNEE COUNTY WTP</td>
</tr>
<tr>
<td>SHEET</td>
<td>1</td>
</tr>
<tr>
<td>OF</td>
<td>1</td>
</tr>
<tr>
<td>SPEC. NO.</td>
<td>40 60 05 - 3.5.C.73</td>
</tr>
<tr>
<td>ADDENDUM/C.O.</td>
<td></td>
</tr>
</tbody>
</table>

**GAUGE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Element</th>
<th>Accuracy</th>
<th>Diaphragm Seal</th>
<th>Pressure Snubber</th>
<th>Indication / Display</th>
<th>Enclosure/Housing</th>
<th>Mounting</th>
<th>Additional Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

- Type: Liquid Filled Gauge for pressure ranges >15 psi and vacuum ranges <30 inches-Hg.
- Element: 316 S.S. Bourdon Tube and Socket; Heliarc Welded, unless otherwise specified.
- Accuracy: ±0.5% of span.
- Diaphragm Seal: A diaphragm seal is required for all mediums except air or potable water. Diaphragm material shall be compatible with the process fluid. Refer to Diaphragm Seal Data Sheet for requirements.
- Pressure Snubber: Provide sintered stainless steel or brass (for copper pipe) pressure snubber threaded into gauge socket or in external steel housing with 1/4 inch NPT male and female connections.
- Indication / Display: Glass window; White and Black markings on Dial; 300 series S.S. movement; Built-in overload/underload stops; Rotary geared with Teflon S coating, or cam and roller type.
- Enclosure/Housing: 4-1/2 inch Black Case; Solid front design constructed of glass filled polyester; Full blowout back for overpressure protection.
- Mounting: Stem Mounting; 1/4 inch male NPT connection on bottom.
- Additional Features: Threaded, glass filled polyester ring.

**NOTES**

- General: All wetted parts shall be compatible with the process fluid. Refer to Materials Compatibility Chart.
- Installation: Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.
- Calibration: Adjustable pointer and externally accessible zero adjustment; Provide ISO Factory Calibration Certificate.
- Process Isolation: Provide all valves for process isolation in accordance with specifications in this Section.
- Fill Fluid: Use silicone except for process fluids containing chlorine. When the process fluid contains chlorine, the filling liquid shall be Halocarbon 63 or Fluorolube 63.

**MANUFACTURE**

- Manufacturer: Ashcroft
- Manufacturer: Helicoid
- Manufacturer: WIKA Instrument Corporation

**INSTRUMENT**

Requirements specified above shall apply to all instrument tag numbers listed below.

<table>
<thead>
<tr>
<th>Tag No.</th>
<th>Process Fluid</th>
<th>Area Classification</th>
<th>Performance Range</th>
<th>Location / Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Process Press.</td>
<td>Min/Max (PSI)</td>
<td>Reference Drawing No.</td>
</tr>
<tr>
<td>1</td>
<td>PI - 011</td>
<td>Ground Water</td>
<td>Not Applicable</td>
<td>8&quot; Supply Well F1 Discharge</td>
</tr>
<tr>
<td>2</td>
<td>PI - 021</td>
<td>Ground Water</td>
<td>Not Applicable</td>
<td>8&quot; Supply Well F2 Discharge</td>
</tr>
<tr>
<td>3</td>
<td>PI - 301</td>
<td>Ground Water</td>
<td>Not Applicable</td>
<td>8&quot; PWP-1 Discharge</td>
</tr>
<tr>
<td>4</td>
<td>PI - 311</td>
<td>Ground Water</td>
<td>Not Applicable</td>
<td>8&quot; PWP-2 Discharge</td>
</tr>
<tr>
<td>5</td>
<td>PI - 321</td>
<td>Ground Water</td>
<td>Not Applicable</td>
<td>8&quot; Distribution Header</td>
</tr>
</tbody>
</table>
DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>High Pressure Switch</th>
<th>SHEET 1 OF 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT</td>
<td>SUWANNEE COUNTY WTP</td>
<td></td>
</tr>
<tr>
<td>TAG NO. Ref. Dwg. No.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSH - 012</td>
<td>PSH - 022</td>
<td><strong>PSL - 300</strong>* Pressure Switch Low</td>
</tr>
<tr>
<td>PROCESS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location:</td>
<td>Wellhead, Refer Elect. Dwggs</td>
<td>Suction Pressure, Refer to Elect. Dwggs</td>
</tr>
<tr>
<td>Service:</td>
<td>Wellhead, Refer Elect. Dwggs</td>
<td>Suction pressure</td>
</tr>
<tr>
<td>Vessel / Line No.:</td>
<td>8&quot; Well Discharge</td>
<td>8&quot; PWP Common Suction Header</td>
</tr>
<tr>
<td>Fluid:</td>
<td>80-80F</td>
<td></td>
</tr>
<tr>
<td>Temp. Min/Max:</td>
<td>0-100 psig</td>
<td>0-25 psig</td>
</tr>
<tr>
<td>Press. Min/Max:</td>
<td>0-2000GPM</td>
<td>0-2000GPM</td>
</tr>
<tr>
<td>PERFORMANCE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range:</td>
<td>0 - 60 PSI</td>
<td>0 - 60 PSI</td>
</tr>
<tr>
<td>Temperature:</td>
<td>-4 to 140 degrees F.</td>
<td>-4 to 140 degrees F.</td>
</tr>
<tr>
<td>Repeatability:</td>
<td>±1% of range.</td>
<td>±1% of range.</td>
</tr>
<tr>
<td>Deadband:</td>
<td>Adjustable;</td>
<td>Adjustable;</td>
</tr>
<tr>
<td>SENSOR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type:</td>
<td>Diaphragm/Piston Pressure Sensor.</td>
<td>Diaphragm/Piston Pressure Sensor.</td>
</tr>
<tr>
<td>Element:</td>
<td>Transducer.</td>
<td>Transducer.</td>
</tr>
<tr>
<td>Diaphragm Seal:</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Capillary Tubing:</td>
<td>316 S.S. Capillary to extend from process connection to switch.</td>
<td>316 S.S. Capillary to extend from process connection to switch.</td>
</tr>
<tr>
<td>Mounting:</td>
<td>Integral Mount to Switch.</td>
<td>Integral Mount to Switch.</td>
</tr>
<tr>
<td>Area Classification:</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Additional Features:</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>SWITCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type:</td>
<td>Snap Action Switch.</td>
<td>Snap Action Switch.</td>
</tr>
<tr>
<td>Power Supply:</td>
<td>Not less than 10A at 120 VAC; 0.5A at 125 VDC.</td>
<td>Not less than 10A at 120 VAC; 0.5A at 125 VDC.</td>
</tr>
<tr>
<td>Relays:</td>
<td>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</td>
<td>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</td>
</tr>
<tr>
<td>Rating:</td>
<td>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</td>
<td>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</td>
</tr>
<tr>
<td>Switch Action:</td>
<td>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</td>
<td>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</td>
</tr>
<tr>
<td>Setpoints:</td>
<td>PSH=TBD in Field</td>
<td>PSH=TBD in Field</td>
</tr>
<tr>
<td>Enclosure/Housing:</td>
<td>NEMA 4X; Epoxy painted; Die-cast low copper aluminum alloy housing.</td>
<td>NEMA 4X; Epoxy painted; Die-cast low copper aluminum alloy housing.</td>
</tr>
<tr>
<td>Mounting:</td>
<td>Pipe Stand Mount; External Mounting Lugs; 316 S.S. Hardware.</td>
<td>Pipe Stand Mount; External Mounting Lugs; 316 S.S. Hardware.</td>
</tr>
<tr>
<td>Connections:</td>
<td>Process Conn.: 1/4 inch NPT; Electrical Conn.: 3/4 inch NPT.</td>
<td>Process Conn.: 1/4 inch NPT; Electrical Conn.: 3/4 inch NPT.</td>
</tr>
<tr>
<td>Area Classification:</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Additional Features:</td>
<td>Set/Reset Point Adjustment (See Notes, Line 34).</td>
<td>Set/Reset Point Adjustment (See Notes, Line 34).</td>
</tr>
<tr>
<td>NOTES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General:</td>
<td>All wetted parts shall be compatible with the process fluid. Refer to Materials Compatibility Chart.</td>
<td></td>
</tr>
<tr>
<td>Function:</td>
<td>Pressure Switch shall sense gauge or absolute pressure and open or close a contact when the pressure reaches the specified trip point.</td>
<td></td>
</tr>
<tr>
<td>Installation:</td>
<td>Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.</td>
<td></td>
</tr>
<tr>
<td>Set/Reset Point:</td>
<td>Provide Set and Reset Point adjustable external adjusting nuts and pressure setting scales in psi. Provide metal cover with gasket for adjusting nuts.</td>
<td></td>
</tr>
<tr>
<td>Diaphragm Seal:</td>
<td>A diaphragm seal is required for all mediums except air or potable water. Diaphragm material shall be compatible with the process fluid. Refer to Diaphragm Seal Data Sheet for requirements.</td>
<td></td>
</tr>
<tr>
<td>MANUFACTURE</td>
<td>Ashcroft</td>
<td></td>
</tr>
<tr>
<td>Manufacturer:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

40039002  40 60 05-45  100%
<table>
<thead>
<tr>
<th><strong>PRODUCT</strong></th>
<th>High Pressure Switch</th>
<th><strong>SHEET 2 OF 3</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROJECT</strong></td>
<td>SWANNEE COUNTY WTP</td>
<td>SPEC NO. 40 60 05 - 3.5.C75</td>
</tr>
<tr>
<td><strong>TAG NO.</strong></td>
<td></td>
<td>ADDENDUM/C.O. <strong>PSL-322</strong> Low Press. Switch</td>
</tr>
<tr>
<td>Ref. Dwg. No.:</td>
<td></td>
<td><strong>P WP-1, Refer to Elec. Dwgs</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>P WP-2, Refer to Elec. Dwgs</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Distribution Header. Refer Elect. Dwgs</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Potable Water Pump No.1 Discharge</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Potable Water Pump No.2 Discharge</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Potable Water Discharge</strong></td>
</tr>
<tr>
<td>PROCESS</td>
<td></td>
<td><strong>8&quot; PWP Discharge</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>8&quot; PWP Discharge</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>8&quot; Common Distribution Header</strong></td>
</tr>
<tr>
<td>Location:</td>
<td>2</td>
<td><strong>Potable Water</strong></td>
</tr>
<tr>
<td>Service:</td>
<td>3</td>
<td><strong>Potable Water</strong></td>
</tr>
<tr>
<td>Vessel / Line No.:</td>
<td>4</td>
<td><strong>Potable Water</strong></td>
</tr>
<tr>
<td>Fluid:</td>
<td>5</td>
<td><strong>Potable Water</strong></td>
</tr>
<tr>
<td>Temp. Min/Max:</td>
<td>6</td>
<td><strong>60-80F</strong></td>
</tr>
<tr>
<td>Press. Min/Max:</td>
<td>7</td>
<td><strong>0-100 psig</strong></td>
</tr>
<tr>
<td>Velocity Min/Max:</td>
<td>8</td>
<td><strong>0-2000GPM</strong></td>
</tr>
<tr>
<td><strong>PERFORMANCE</strong></td>
<td></td>
<td><strong>0-25 PSI</strong></td>
</tr>
<tr>
<td>Range:</td>
<td>9</td>
<td><strong>0 - 25 PSI</strong></td>
</tr>
<tr>
<td>Temperature:</td>
<td>10</td>
<td><strong>-4 to 140 degrees F.</strong></td>
</tr>
<tr>
<td>Repeatability:</td>
<td>11</td>
<td><strong>±1% of range.</strong></td>
</tr>
<tr>
<td>Deadband:</td>
<td>12</td>
<td><strong>Adjustable;</strong></td>
</tr>
<tr>
<td>SENSOR</td>
<td></td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Type:</td>
<td>13</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Element:</td>
<td>14</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Diaphragm Seal:</td>
<td>15</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Capillary Tubing:</td>
<td>16</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Mounting:</td>
<td>17</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Additional Features:</td>
<td>19</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td><strong>SWITCH</strong></td>
<td></td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Type:</td>
<td>20</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Power Supply:</td>
<td>21</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Relays:</td>
<td>22</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Rating:</td>
<td>23</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Switch Action:</td>
<td>24</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Setpoints:</td>
<td>25</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Enclosure/Housing:</td>
<td>26</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Mounting:</td>
<td>27</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Connections:</td>
<td>28</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Area Classification:</td>
<td>29</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Additional Features:</td>
<td>30</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td><strong>NOTES</strong></td>
<td></td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>General:</td>
<td>31</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Function:</td>
<td>32</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Installation:</td>
<td>33</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Set/Reset Point:</td>
<td>34</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Diaphragm Seal:</td>
<td>35</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>MANUFACTURER</td>
<td></td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
<tr>
<td>Manufacturer:</td>
<td>40</td>
<td><strong>Diaphragm/Piston Pressure Sensor.</strong></td>
</tr>
</tbody>
</table>

**All wetted parts shall be compatible with the process fluid. Refer to Materials Compatibility Chart.**

**Pressure Switch shall sense gauge or absolute pressure and open or close a contact when the pressure reaches the specified trip point.**

**Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.**

**Provide Set and Reset Point adjustable external adjusting nuts and pressure setting scales in psi. Provide metal cover with gasket for adjusting nuts.**

**A diaphragm seal is required for all mediums except air or potable water. Diaphragm material shall be compatible with the process fluid. Refer to Diaphragm Seal Data Sheet for requirements.**

**Provide products of one of the following, Or Equal:**

<p>| Ashcroft | <strong>40039002</strong> | 40 60 05-46 | 100% | <strong>PRODUCT</strong> | <strong>SWANNEE COUNTY WTP</strong> | <strong>SPEC NO. 40 60 05 - 3.5.C75</strong> | **ADDENDUM/C.O. <strong>PSL-322</strong> Low Press. Switch | <strong>PROCESS</strong> | <strong>Potable Water Pump No.1 Discharge</strong> | <strong>Potable Water Pump No.2 Discharge</strong> | <strong>Potable Water Discharge</strong> | <strong>Location:</strong> | <strong>2</strong> | <strong>Potable Water Pump No.1 Discharge</strong> | <strong>Potable Water Pump No.2 Discharge</strong> | <strong>Potable Water Discharge</strong> | <strong>Service:</strong> | <strong>3</strong> | <strong>Potable Water</strong> | <strong>Potable Water</strong> | <strong>Potable Water</strong> | <strong>Vessel / Line No.:</strong> | <strong>4</strong> | <strong>Potable Water</strong> | <strong>Potable Water</strong> | <strong>Potable Water</strong> | <strong>Temp. Min/Max:</strong> | <strong>60-80F</strong> | <strong>0-100 psig</strong> | <strong>0-2000GPM</strong> | <strong>Temp. Min/Max:</strong> | <strong>0-100 psig</strong> | <strong>0-2000GPM</strong> | <strong>Press. Min/Max:</strong> | <strong>8&quot; PWP Discharge</strong> | <strong>8&quot; PWP Discharge</strong> | <strong>8&quot; Common Distribution Header</strong> | <strong>Range:</strong> | <strong>0-25 PSI</strong> | <strong>0 - 25 PSI</strong> | <strong>-4 to 140 degrees F.</strong> | <strong>-4 to 140 degrees F.</strong> | <strong>-4 to 140 degrees F.</strong> | <strong>Repeatability:</strong> | <strong>±1% of range.</strong> | <strong>±1% of range.</strong> | <strong>±1% of range.</strong> | <strong>Deadband:</strong> | <strong>Adjustable;</strong> | <strong>Adjustable;</strong> | <strong>Adjustable;</strong> | <strong>SENSOR</strong> | <strong>Diaphragm/Piston Pressure Sensor.</strong> | <strong>Diaphragm/Piston Pressure Sensor.</strong> | <strong>Diaphragm/Piston Pressure Sensor.</strong> | <strong>Type:</strong> | <strong>Diaphragm/Piston Pressure Sensor.</strong> | <strong>Diaphragm/Piston Pressure Sensor.</strong> | <strong>Diaphragm/Piston Pressure Sensor.</strong> | <strong>Element:</strong> | <strong>Diaphragm/Piston Pressure Sensor.</strong> | <strong>Diaphragm/Piston Pressure Sensor.</strong> | <strong>Diaphragm/Piston Pressure Sensor.</strong> | <strong>Diaphragm Seal:</strong> | <strong>N/A</strong> | <strong>N/A</strong> | <strong>N/A</strong> | <strong>Capillary Tubing:</strong> | <strong>316 S.S. Capillary to extend from process connection to switch.</strong> | <strong>316 S.S. Capillary to extend from process connection to switch.</strong> | <strong>316 S.S. Capillary to extend from process connection to switch.</strong> | <strong>Mounting:</strong> | <strong>Integral Mount to Switch.</strong> | <strong>Integral Mount to Switch.</strong> | <strong>Integral Mount to Switch.</strong> | <strong>Area Classification:</strong> | <strong>Not Applicable</strong> | <strong>Not Applicable</strong> | <strong>Not Applicable</strong> | <strong>Additional Features:</strong> | <strong>Not Applicable</strong> | <strong>Not Applicable</strong> | <strong>Not Applicable</strong> | <strong>SWITCH</strong> | <strong>Snap Action Switch.</strong> | <strong>Snap Action Switch.</strong> | <strong>Snap Action Switch.</strong> | <strong>Type:</strong> | <strong>Snap Action Switch.</strong> | <strong>Snap Action Switch.</strong> | <strong>Snap Action Switch.</strong> | <strong>Power Supply:</strong> | <strong>SPDT, snap action.</strong> | <strong>SPDT, snap action.</strong> | <strong>SPDT, snap action.</strong> | <strong>Relays:</strong> | <strong>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</strong> | <strong>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</strong> | <strong>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</strong> | <strong>Rating:</strong> | <strong>Not less than 10A at 120 VAC; 0.5A at 125 VDC.</strong> | <strong>Not less than 10A at 120 VAC; 0.5A at 125 VDC.</strong> | <strong>Not less than 10A at 120 VAC; 0.5A at 125 VDC.</strong> | <strong>Switch Action:</strong> | <strong>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</strong> | <strong>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</strong> | <strong>Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.</strong> | <strong>Setpoints:</strong> | <strong>PSH=TBD in Field</strong> | <strong>PSH=TBD in Field</strong> | <strong>PSH=TBD in Field</strong> | <strong>Enclosure/Housing:</strong> | <strong>NEMA 4X; Epoxy painted; Die-cast low copper aluminum alloy housing.</strong> | <strong>NEMA 4X; Epoxy painted; Die-cast low copper aluminum alloy housing.</strong> | <strong>NEMA 4X; Epoxy painted; Die-cast low copper aluminum alloy housing.</strong> | <strong>Mounting:</strong> | <strong>Pipe Stand Mount; External Mounting Lugs; 316 S.S. Hardware.</strong> | <strong>Pipe Stand Mount; External Mounting Lugs; 316 S.S. Hardware.</strong> | <strong>Pipe Stand Mount; External Mounting Lugs; 316 S.S. Hardware.</strong> | <strong>Connections:</strong> | <strong>Process Conn.: 1/4 inch NPT; Electrical Conn.: 3/4 inch NPT.</strong> | <strong>Process Conn.: 1/4 inch NPT; Electrical Conn.: 3/4 inch NPT.</strong> | <strong>Process Conn.: 1/4 inch NPT; Electrical Conn.: 3/4 inch NPT.</strong> | <strong>Area Classification:</strong> | <strong>Not Applicable</strong> | <strong>Not Applicable</strong> | <strong>Not Applicable</strong> | <strong>Additional Features:</strong> | <strong>Set/Reset Point Adjustment (See Notes, Line 34).</strong> | <strong>Set/Reset Point Adjustment (See Notes, Line 34).</strong> | <strong>Set/Reset Point Adjustment (See Notes, Line 34).</strong> | <strong>NOTES</strong> | <strong>General:</strong> | <strong>All wetted parts shall be compatible with the process fluid.</strong> | <strong>Function:</strong> | <strong>Pressure Switch shall sense gauge or absolute pressure and open or close a contact when the pressure reaches the specified trip point.</strong> | <strong>Installation:</strong> | <strong>Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.</strong> | <strong>Set/Reset Point:</strong> | <strong>Provide Set and Reset Point adjustable external adjusting nuts and pressure setting scales in psi. Provide metal cover with gasket for adjusting nuts.</strong> | <strong>Diaphragm Seal:</strong> | <strong>A diaphragm seal is required for all mediums except air or potable water.</strong> | <strong>Diaphragm material shall be compatible with the process fluid. Refer to Diaphragm Seal Data Sheet for requirements.</strong> | <strong>MANUFACTURER</strong> | <strong>Provide products of one of the following, Or Equal:</strong> | <strong>Manufacturer:</strong> | <strong>Ashcroft</strong> |</p>
<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>High Pressure Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT</td>
<td>SUWANNEE COUNTY WTP</td>
</tr>
<tr>
<td>SHEET</td>
<td>3 OF 3</td>
</tr>
<tr>
<td>SPEC. NO.</td>
<td>40 60 05 - 3.5,C,75</td>
</tr>
<tr>
<td>ADDENDUM/C.O.</td>
<td></td>
</tr>
</tbody>
</table>

### TAG NO. 1
- **Ref. Dwg. No.:** 1
- **Location:** Distribution, Refer Elect. Dwgs
- **Service:** Potable Water Distribution
- **Vessel / Line No.:** 8" Common Distribution header
- **Fluid:** Potable Water
- **Temp. Min/Max:** 60-80°F
- **Press. Min/Max:** 0-100 psig
- **Velocity Min/Max:** 0-2000GPM

### PERFORMANCE
- **Range:** 0 - 25 PSI
- **Temperature:** -4 to 140 degrees F.
- **Repeatability:** ±1% of range.
- **Deadband:** Adjustable.

### SENSOR
- **Type:** Diaphragm/Piston Pressure Sensor
- **Element:** Transducer
- **Diaphragm Seal:** N/A
- **Capillary Tubing:** 316 S.S. Capillary to extend from process connection to switch.
- **Mounting:** Integral Mount to Switch.
- **Area Classification:** Not Applicable
- **Additional Features:**

### SWITCH
- **Type:** Snap Action Switch
- **Power Supply:** SPDT, snap action.
- **Relays:** Not less than 10A at 120 VAC; 0.5A at 125 VDC.
- **Rating:** PSH=TBD in Field
- **Switch Action:** Switch Opens/Closes at predefined setpoint(s); Normally Closed contacts.
- **Setpoints:**
  - **PSH:** TBD in Field
- **Enclosure/Housing:** NEMA 4X; Epoxy painted; Die-cast low copper aluminum alloy housing.
- **Mounting:** Pipe Stand Mount; External Mounting Lugs; 316 S.S. Hardware.
- **Connections:** Process Conn.: 1/4 inch NPT; Electrical Conn.: 3/4 inch NPT.
- **Area Classification:** Not Applicable
- **Additional Features:**

### NOTES
- **General:** All wetted parts shall be compatible with the process fluid. Refer to Materials Compatibility Chart.
- **Function:** Pressure Switch shall sense gauge or absolute pressure and open or close a contact when the pressure reaches the specified trip point.
- **Installation:** Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.
- **Set/Reset Point:** Provide Set and Reset Point adjustable external adjusting nuts and pressure setting scales in psi. Provide metal cover with gasket for adjusting nuts.
- **Diaphragm Seal:** A diaphragm seal is required for all mediums except air or potable water. Diaphragm material shall be compatible with the process fluid. Refer to Diaphragm Seal Data Sheet for requirements.

### MANUFACTURE
- **Manufacturer:** Ashcroft

All wetted parts shall be compatible with the process fluid. Refer to Materials Compatibility Chart.
## MATERIALS COMPATIBILITY CHART

<table>
<thead>
<tr>
<th>Process Fluid</th>
<th>Diaphragm</th>
<th>O-Ring</th>
<th>Gasket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastewater / Sludge</td>
<td>316 SS</td>
<td>Buna-N</td>
<td>Buna-N</td>
</tr>
<tr>
<td>Potassium Carpenter</td>
<td>Carpenter 20</td>
<td>Viton</td>
<td>Viton</td>
</tr>
<tr>
<td>Sodium Hypochlorite</td>
<td>316 SS</td>
<td>Buna-N</td>
<td>Buna-N</td>
</tr>
<tr>
<td>Polymer</td>
<td>316 SS</td>
<td>Buna-N</td>
<td>Buna-N</td>
</tr>
<tr>
<td>Phosphoric Acid</td>
<td>316 SS</td>
<td>Buna-N</td>
<td>Buna-N</td>
</tr>
<tr>
<td>Alum</td>
<td>316 SS</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Chlorine Gas</td>
<td>Teflon</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Chlorine Solution</td>
<td>Teflon</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Sodium Chloride</td>
<td>Teflon</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Ammonia</td>
<td>316 SS</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Methanol</td>
<td>316 SS</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Carbon</td>
<td>316 SS</td>
<td>Buna-N</td>
<td>Buna-N</td>
</tr>
<tr>
<td>Lime</td>
<td>316 SS</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Ferric Chloride</td>
<td>Teflon</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Caustic Soda</td>
<td>Teflon</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Sodium Bisulfite</td>
<td>Teflon</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td>Teflon</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Scrubber Solution</td>
<td>Teflon</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
<tr>
<td>Fluoride</td>
<td>Hastelloy C</td>
<td>Viton</td>
<td>Viton</td>
</tr>
<tr>
<td>Phosphate</td>
<td>316 SS</td>
<td>Teflon</td>
<td>Teflon</td>
</tr>
</tbody>
</table>

## AREA CLASSIFICATION CHART

<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1, Division 1</td>
<td>A location (1) In which ignitable concentrations of flammable gases or vapors can exist under normal operating conditions; or (2) In which ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or (3) In which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors and might also cause simultaneous failure of electrical equipment in such a way as to directly cause the electrical equipment to become a source of ignition.</td>
</tr>
<tr>
<td>Class 1, Division 2</td>
<td>A location (1) In which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or (2) In which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation and might become hazardous through failure or abnormal operation of the ventilating equipment; or (3) That is adjacent to a Class I Division 1 location, and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.</td>
</tr>
<tr>
<td>Class 2, Division 1</td>
<td>A location (1) In which combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures; or (2) Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, through operation of protection devices, or from other causes; or (3) In which Group E combustible dusts may be present in quantities sufficient to be hazardous.</td>
</tr>
<tr>
<td>Class 2, Division 2</td>
<td>A location (1) In which combustible dust due to abnormal operations may be present in the air in quantities sufficient to produce explosive or ignitable mixtures; or (2) Where combustible dust accumulations are present but are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but could as a result of infrequent malfunctioning of handling or processing equipment become suspended in the air; or (3) In which combustible dust accumulations on, in, or in the vicinity of the electrical equipment could be sufficient to interfere with the safe dissipation of heat from electrical equipment, or could be ignitable by abnormal operation or failure of electrical equipment.</td>
</tr>
<tr>
<td>Class 3, Division 1</td>
<td>A location in which easily ignitable fibers or materials producing filings are handled, manufactured or used.</td>
</tr>
<tr>
<td>Class 3, Division 2</td>
<td>A location in which easily ignitable fibers are stored or handled (except in the process of manufacture).</td>
</tr>
</tbody>
</table>

* Source: NEC 2005 Edition - Article 500
## 3.5.D.INSTRUMENT INDEX

Suwannee County WTP

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
<th>Range/Setpoint</th>
<th>Drawing</th>
<th>Section</th>
<th>Article</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI-011</td>
<td>Well F-1 Discharge Pressure Gauge</td>
<td>0-100 psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.73</td>
<td></td>
</tr>
<tr>
<td>PSH-012</td>
<td>Well F-1 High Discharge Pressure Switch</td>
<td>60 psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.75</td>
<td>High: Field Adjustable psig</td>
</tr>
<tr>
<td>FSL--013</td>
<td>Flow switch Low</td>
<td>N/A</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.39</td>
<td></td>
</tr>
</tbody>
</table>

**Well F-2 Instruments**

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
<th>Range/Setpoint</th>
<th>Drawing</th>
<th>Section</th>
<th>Article</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI-021</td>
<td>Well F-2 Discharge Pressure Gauge</td>
<td>0-100 psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.73</td>
<td></td>
</tr>
<tr>
<td>PSH-022</td>
<td>Well F-2 High Discharge Pressure Switch</td>
<td>60 psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.75</td>
<td>High: Field Adjustable psig</td>
</tr>
<tr>
<td>FSL-023</td>
<td>Flow switch Low</td>
<td>N/A</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.39</td>
<td></td>
</tr>
</tbody>
</table>

**Instruments**

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
<th>Range/Setpoint</th>
<th>Drawing</th>
<th>Section</th>
<th>Article</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIT-100</td>
<td>Raw water Flow Indicating Transmitter</td>
<td>400-1100 gpm</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.29</td>
<td></td>
</tr>
<tr>
<td>FE-100</td>
<td>Raw water Flow Element</td>
<td>0-2500 gpm</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.29</td>
<td></td>
</tr>
<tr>
<td>LE-111</td>
<td>Ground Storage Tank Level Element</td>
<td>0-30 ft.</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.54</td>
<td></td>
</tr>
<tr>
<td>LIT-111</td>
<td>Ground Storage Tank Level Indicating Transmitter</td>
<td>0-30 ft.</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.54</td>
<td></td>
</tr>
<tr>
<td>AE/AIT-201</td>
<td>Free Chlorine Residual Analyzer</td>
<td>0-10 mg/l</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.16</td>
<td></td>
</tr>
<tr>
<td>FIT-200</td>
<td>Potable water Flow Indicating Transmitter</td>
<td>300-700 gpm</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.30</td>
<td></td>
</tr>
<tr>
<td>FE-200</td>
<td>Potable water Flow Element</td>
<td>0-2500 gpm</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.30</td>
<td></td>
</tr>
<tr>
<td>PI-321</td>
<td>Distribution Pressure Gauge</td>
<td>0-100 psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.73</td>
<td></td>
</tr>
<tr>
<td>PSL-322</td>
<td>Distribution Pressure Low</td>
<td>0-TBD psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.75</td>
<td>Low: Field Adjustable psig</td>
</tr>
<tr>
<td>PSH-323</td>
<td>Distribution Pressure High</td>
<td>0-TBD psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.75</td>
<td>High: Field Adjustable psig</td>
</tr>
</tbody>
</table>

**Potable Water Pump Instruments**

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
<th>Range/Setpoint</th>
<th>Drawing</th>
<th>Section</th>
<th>Article</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSL-300</td>
<td>Suction Pressure Switch - Low</td>
<td>4 psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.75</td>
<td>Low: Field Adjustable psig</td>
</tr>
<tr>
<td>PI-301</td>
<td>PW-1 Discharge Pressure Gauge</td>
<td>0-100 psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.73</td>
<td></td>
</tr>
<tr>
<td>PSH-302</td>
<td>PW-1 High Discharge Pressure Switch</td>
<td>95 psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.75</td>
<td>High: Field Adjustable psig</td>
</tr>
<tr>
<td>FSH--303</td>
<td>Flow switch Low</td>
<td>N/A</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.39</td>
<td></td>
</tr>
<tr>
<td>PI-311</td>
<td>PW-2 Discharge Pressure Gauge</td>
<td>0-100 psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.73</td>
<td></td>
</tr>
<tr>
<td>PSH-312</td>
<td>PW-2 High Discharge Pressure Switch</td>
<td>95 psi</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.75</td>
<td>High: Field Adjustable psig</td>
</tr>
<tr>
<td>FSH--313</td>
<td>Flow switch Low</td>
<td>N/A</td>
<td>I-2</td>
<td>40 60 05</td>
<td>3.4.C.39</td>
<td></td>
</tr>
</tbody>
</table>

- END OF SECTION -
### 3.5.E. Auto Dialer Input/Output list
#### Suwannee County WTP

<table>
<thead>
<tr>
<th>Sl.no</th>
<th>Description</th>
<th>Type</th>
<th>Output</th>
<th>Input</th>
<th>Drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emergency Call - Push Button</td>
<td>Discrete</td>
<td>Push Button</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>2</td>
<td>ATS - Utility Power Not Available</td>
<td>Discrete</td>
<td>ATS</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>3</td>
<td>ATS - Switchover to Generator Power</td>
<td>Discrete</td>
<td>ATS</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>4</td>
<td>Generator Run Status</td>
<td>Discrete</td>
<td>Generator</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>5</td>
<td>Supply Well Pump No. F-1 - Not in Auto</td>
<td>Discrete</td>
<td>MCC-1</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>6</td>
<td>Supply Well Pump No. F-1 System Fail</td>
<td>Discrete</td>
<td>MCC-1</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>7</td>
<td>Supply Well Pump No. F-2 - Not in Auto</td>
<td>Discrete</td>
<td>MCC-1</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>8</td>
<td>Supply Well Pump No. F-2 System Fail</td>
<td>Discrete</td>
<td>MCC-1</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>9</td>
<td>Ground Storage Tank Level High</td>
<td>Discrete</td>
<td>LE-111</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>10</td>
<td>Ground Storage Tank Level Low</td>
<td>Discrete</td>
<td>LE-111</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>11</td>
<td>Pre-Chlorination Metering Pump Fail</td>
<td>Discrete</td>
<td>SHCP</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>12</td>
<td>Post-Chlorination Metering Pump Fail</td>
<td>Discrete</td>
<td>SHCP</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>13</td>
<td>Low - Chlorine Residual</td>
<td>Discrete</td>
<td>AIT-201</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>14</td>
<td>Potable Water Pump No.1 Fail</td>
<td>Discrete</td>
<td>PWPCP</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>15</td>
<td>Potable Water Pump No.2 Fail</td>
<td>Discrete</td>
<td>PWPCP</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>16</td>
<td>Fire Flow Pump ON</td>
<td>Discrete</td>
<td>FPCP</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>17</td>
<td>Fire Flow Pump Failure</td>
<td>Discrete</td>
<td>FPCP</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
<tr>
<td>18</td>
<td>Fire Jockey Pump Failure</td>
<td>Discrete</td>
<td>FJCP</td>
<td>Auto Dialer</td>
<td>I-3</td>
</tr>
</tbody>
</table>
SECTION 40 61 96

PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
1. The specification includes and covers control descriptions of the equipment and packaged systems that are provided by Vendor and CONTRACTOR.
2. CONTRACTOR and Vendor shall furnish control strategy diagrams, configuration sheets and control strategy descriptions as shown, specified and required to configure the Vendor packaged and CONTRACTOR provided systems complete and operational.
3. CONTRACTOR and Vendor shall perform all relay logic programming, configuration and tuning of the system that are responsible for.
4. Coordination shall be required between Vendor and CONTRACTOR supplied equipment for overall operation of the system.

B. Related Sections:
1. Section 21 30 00, Packaged Fire Pump System
2. Section 26 24 19, Motor Control Center
3. Section 26 32 13, Engine Generators
4. Section 26 36 23, Automatic Transfer Switches
5. Section 33 12 23, Packaged Potable Water Pump Station
6. Section 33 16 13, Pre-Stressed Concrete Storage Tanks
7. Section 43 21 13, Vertical Lineshaft Well Pumps
8. Section 46 33 44, Skid-Mounted Peristaltic Metering Pump System

C. This Section describes all of the anticipated control descriptions under this Contract. The control strategies are generally divided by the responsible supplier and further subdivided by panel.

D. Process Control Functions:
1. Process control function shall be structured to permit the realization of all control strategy requirements. In addition, each control function shall be designed so that bumpless, balance free transfers are obtained during operating mode changeover and initialization. Where applicable, user-changeable parameters shall be automatically defaulted to a preset value if a specific value is not given during system generation.
2. The P&IDs represent the required process monitoring and control. The required control for the system is a combination of the representation on the P&IDs and the requirements specified herein. The P&IDs do not show all the required internal diagnostic indications. In addition, to the indications shown on the P&IDs the following, at a minimum shall be provided:
a. Indication of bad quality on any hard wired input/output point (such as zero milliamps on a 4 to 20 mA circuit).
b. For all motor start and stop commands check for run feedback after adjustable time delay (0 to 30 seconds). Provide a “FAIL TO START” and “FAIL TO STOP” alarm if unit fails to run or stop. Use the bad start or stop bit to remove the run command from the control logic.
c. For analog control loops, when control of field equipment is not in “COMPUTER,” the associated PID controller output shall track the position feedback.
d. Runtimes shall be provided for all pieces of equipment.

3. In addition to the indications shown on the P&IDs, the following shall be provided at a minimum:
   a. Analog Data Scaling: This control function shall scale all analog inputs to a common span and shall normalize the digital representation of each analog input to a percent of the operating span. The processed value shall be expressed as a binary number that specifies the analog input's position on a straight line lying between zero and full scale as defined for a given input by the zero span values in the data base.
   b. Amplitude Limit Check: This control function shall perform dual level, high/low amplitude limit checking and shall identify a limit violation every time a measured or virtual variable goes out-of-limits and returns back into limits. The control function shall determine the time at which each limit excursion occurred. A deadband shall be provided on each limit and shall be expressed as a percentage of span or in engineering units. Low and high limiting default values will be set-up for each measured or calculated variables used in the process control loops.
   c. Engineering Unit Conversion: This control function shall convert scaled analog data to engineering units by means of the following equation:

   \[ Y = (H - L) \frac{D}{DH} + L \]

   where:

   \[ Y \quad \text{Value in engineering units.} \]
   \[ H \quad \text{High value of span, expressed in engineering units.} \]
   \[ L \quad \text{Low value of span, expressed in engineering units.} \]
   \[ D \quad \text{Digitized scaled input value in counts.} \]
   \[ DH \quad \text{Full scale digitized value in counts.} \]
   d. Manual Control: It shall be possible for Operator or Plant Engineer to interrupt any sequence, loop or automatic operation and operate the same manually through the Operator Workstation.
   e. Verification of Digital Outputs: This control function shall verify that the equipment has responded to the digital commands before
proceeding to next step during automatic operation. If any discrepancy is detected, an alarm will be annunciated.

E. Hardware: CONTRACTOR shall provide all the hardware, as shown, specified or required to implement the control strategies as described.

F. Configuration: All set points, tuning parameters and engineering scales etc. shall be documented for each control point and each control strategy on configuration sheets or similar documents. These documents shall be updated during Factory Testing and finally during start-up.

G. Control Strategy Displays: Control strategy displays shall be submitted for review. Displays shall clearly show initial conditions, start, and progression of the control strategies. Each control strategy shall be displayed in a minimum number of displays for ease of monitoring by the Operator.

H. Plant Power Failure: Plant equipment shall automatically reset upon failure.

I. Restart: All equipment and motors shall be automatically restarted after power failure by the control system in an orderly fashion approved by the ENGINEER.

J. All relays, training parameters, scales, configuration values, mathematical constants, equations and set points given in the control strategies are adjustable over a wide range. The values given are initial and may change during Shop Drawing review and may have to be readjusted during start-up.

1.2 SUBMITTALS

A. The control strategies are written descriptions of the basic configuration and/or programming the relay logic required to implement regulatory and sequential control of the unit processes as shown on the P&IDs. They do not in all cases describe the process characteristics fully. Finalizing and tuning of strategies, as required, by process characteristic’s shall be accomplished during start-up. The process inputs/outputs referred to in the Control Strategies are shown on the P&IDs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTROL STRATEGY: SUPPLY WELLS F-1 & F-2

A. General Description:
1. Two groundwater supply wells, F-1 & F-2, will extract and transfer groundwater to the Ground Storage Tank (GST). Each well will be equipped with a constant speed pump, powered by a motor starter, specified in Division 26. Each well pump will be controlled and monitored by the Motor control center (MCC-1), provided by the CONTRACTOR.

2. MCC-1 shall be a relay logic panel with switches, control relays, timers and indicating lights for control and monitoring of the supply wells.

3. The two wells are valved together to fill the GST. It is anticipated that only one well pump will operate at any time.

4. MCC-1 shall be a relay logic panel. The panel shall use relays for automatic and manual operation of the well pumps from the MCC-1.

5. Provision of fully operational supply well pump control system is CONTRACTOR’s responsibility.

B. Well Pump Operating Modes:

1. The following switches and pilot lights will indicate each well pump control and status conditions at MCC-1:
   a. Switches:
      1) H/O/A
      2) Duty/Standby/Off
   b. Normal Status Indicators:
      1) Control Power On
      2) Running indication for each pump.
      3) Pump in Auto
   c. Alarm Indicating lights for each supply well pump:
      1) Well Pump Fail Alarm.
      2) Pump High Discharge Pressure Alarm.
      3) Pump low flow Alarm.

2. Manual - The operator can start/stop the pump manually by placing the H/O/A switch in HAND.

3. Automatic:
   a. If both pumps are in automatic, the relay logic panel shall determine which pump runs based on duty/standby/off switch position.
   b. The MCC-1 shall receive a discrete signal from the GST level transmitter (LIT-111) located at the GST. Pump shall start/stop based on the level run and level stop signals from the GST. The discrete signals generated at the GST level transmitter shall be hardwired to the MCC-1.
   c. Failure of Duty pump start when called to run shall automatically start the Standby pump.

C. Alarms:

1. A general pump fail alarm for each supply well pump shall be sent to the Auto Dialer as listed under specification section 40 60 05.3.4.E, Autodialer Input/Output list when the pump fails to run when called for. The general pump fail alarm shall activate when pressure switch high, flow switch low or motor overload occurs on each pump as shown on Electrical drawings.
2. The alarms shall de-activate when the general fail alarm (pressure switch high, flow switch low or motor overload) conditions return to normal.

D. Hardwired Interlocks - Provide for each supply well pump, interlocks and disable pump run, when the pump is in either Manual or Auto operation mode.
   1. Supply Well Pumps shall shut down on GST Stop level stop signal is enabled.
   2. Supply Well Pumps shall start on GST level Run signal is enabled.
   3. Pumps shall shut down and alarm to auto dialer when pressure high, flow low or motor overload alarms are enabled.

3.2 CONTROL STRATEGY: RAW WATER FLOW METER – (FIT-100)

A. General Description:
   1. A raw water flow meter shall be provided on the common discharge header of the well pumps as shown on drawings.
   2. The I&C subcontractor shall install the flow meter as per the manufacturer’s recommendations.
   3. Calibration of the transmitter and to ensure signal transmission to the sodium hypochlorite control panel (SHCP, as shown on the drawings) is contractor’s responsibility.
   4. The flow transmitter shall display totalized flow and current flow.

B. Hardwired Interlocks:
   1. The raw water flow signal shall be hardwired to the SHCP for pre chlorination injection.

3.3 CONTROL STRATEGY: GROUND STORAGE TANK (GST) – LEVEL (LIT-111)

A. General Description:
   1. The ground storage tank shall be provided with an ultrasonic level transmitter as specified in specification section 40 60 05.3.5.E
   2. The I&C subcontractor shall install the ultrasonic level transmitter as per the manufacturer’s recommendations.
   3. Calibration of the transmitter and to ensure signal transmission to the Auto Dialer Panel (as shown on the drawings) is contractor’s responsibility.
   4. The level transmitter shall display the GST level and have ability to transmit 4-20mA for future use.
   5. The level transmitter shall have at a minimum four (4) discrete outputs and shall be programmed at the elevations as indicated below:
      a) Level Run setpoint to Well Pump (MCC-1) – 105 ft
      b) Level Stop setpoint to Well Pump (MCC-1)– 110 ft
      c) GST High Alarm to Auto Dialer – 115 ft
      d) GST Low Alarm to Auto Dialer – 100 ft.
B. Alarms -
1. Level high and low alarms shall be sent to the Auto Dialer as listed under specification section 40 60 05.3.4.E, Autodialer Input/Output list.
2. The alarms (level high or level low) shall de-active when the level conditions return to normal.

C. Hardwired Interlocks -
1. The duty well supply pump shall start when GST level run signal is enabled.
2. The duty well supply pump shall stop when GST level stop signal is enabled.

3.4 CONTROL STRATEGY: SODIUM HYPOCHLORITE FEED SYSTEM

A. General Description:
1. The proposed system consists of one sodium hypochlorite storage tank, two metering pumps.
2. One metering pump (SHP-1) will supply the pre-chlorination system; one metering pump (SHP-2) will supply the post-chlorination system. The storage tank shall supply sodium hypochlorite for the metering pumps. Level sight gauge shall be provided on the tank for manual readout of tank level. The sodium hypochlorite control panel (SHCP) shall be a relay logic panel, provided for monitoring and controlling the chemical feed pumps. SHCP shall have switches and indicating lights per specification section 46 33 44, Skid-Mounted Peristaltic Metering Pump System.
3. The following description is for I&C subcontractor understanding only. The provision a fully operational sodium hypochlorite control panel shall be the responsibility of the Sodium Hypochlorite System Supplier. I&C subcontractor and SHCP supplier shall coordinate with each other for the integration of the alarm signals to the Auto Dialer.

B. Pre-chlorination Metering Pump (SHP-1) Controls: The pre-chlorination metering pump shall run when the treated water flow range is within the setpoint (Operator Adjustable).
1. Automatic:
   a. The sodium hypochlorite control panel (SHCP) shall receive 4 – 20 ma analog signal from the raw water flow meter (FIT-100) and connected to the SHP-1 drive.
   b. When SHP-1 is in automatic switch position on the relay logic panel, the pump shall start and stop based on the raw water flow range (4-20mA).
   c. Speed Control - The SHCP shall receive a 4 – 20 ma flow signal from the raw water flowmeter and the speed shall be adjusted based on the raw water flow.
2. Manual - The operator can start the pump manually by placing the H-O-A switch in HAND. Speed control shall be with the local potentiometer only.
3. Alarms -
   a. A general pump fail alarm shall be sent to the Auto Dialer when the
metering pump failure occurs.
b. The general pump fail alarm shall be sent to Auto Dialer on drive
malfunction or when the pump hose leak detector is activated and
other signals per manufacturer’s recommendations.

4. Hardwired Interlocks -
a. Pumps shall stop zero raw water flow low signal.

C. Post-chlorination Metering Pump (SHP-2) Controls: The post-chlorination
metering pump shall start/stop based on the distribution pressure low/high signals
are enabled.
1. Automatic:
a. The sodium hypochlorite control panel (SHCP) shall receive 4 – 20 ma
analog signal from the chlorine analyzer (AIT-201) and connected to
the SHP-2 drive.
b. When SHP-2 is in automatic switch position the relay logic panel, the
pump shall start when the pressure switch low (PSL-322) is enabled
and stop when the pressure switch high (PSH-323) is enabled.
c. Speed Control - The SHCP shall receive a 4 – 20 ma signal from the
free chlorine residual analyzer (AIT-201) and the speed shall be
adjusted based on the free chlorine residual. Operator shall input
initial dosage input and a residual setpoint (mg/l) and based on the
output of the chlorine residual analyzer (AIT-201) the speed of the
pump shall adjust automatically.

2. Manual: The operator can start/stop the pump manually by placing the H-
O-A switch in HAND. Speed control shall be with the local potentiometer
only.

3. Alarms:
a. A general pump fail alarm shall be sent to the Auto Dialer when the
metering pump failure occurs.
b. The general pump fail alarm shall be sent to Auto Dialer on drive
malfunction or when the pump hose leak detector is activated and
other signals per manufacturer’s recommendations.

4. Hardwired Interlocks -
a. Pumps shall start when distribution pressure switch low (PSL-322) is
enabled.
b. Pumps shall stop when distribution pressure switch high (PSH-323) is
enabled.

3.5 CONTROL STRATEGY: POTABLE WATER PUMPS – PWP-1 & PWP-2

A. General Description:
1. Two potable water pumps, PWP-1 & PWP-2, will pump water to the
distribution system. Each pump will be equipped with a constant speed
motor, provided by the Supplier. Each pump will be controlled and
monitored by the potable water pump control panel (PWPCP) provided by
the Supplier.
2. PWPCP shall be a relay logic panel with switches, control relays, timers and indicating lights for control and monitoring of the potable water pumps. The panel shall use relays for automatic and manual operation of the potable water pumps.

3. The two wells are valved together to provide distribution water. It is anticipated that only One (1) well pump will operate at any time.

4. The following description is for I&C subcontractor understanding only. The provision of a fully operational potable water pump control panel (PWPCP) shall be the responsibility of the potable water pump Supplier. I&C subcontractor and PWPCP supplier shall coordinate with each other for the integration of the alarm signals to the Auto Dialer.

B. Pump Operating Modes:

1. The following switches and pilot lights will indicate each well pump control and status conditions at PWPCP:
   a. Switches:
      1) H/O/A
      2) Duty/Standby
   b. Normal Status Indicators:
      1) Control Power On
      2) Running indication for each pump.
      3) Pump in Auto
   c. Alarm Indicating lights for each potable water pump:
      1) Pump Fail Alarm.
      2) Pump High Discharge Pressure Alarm.
      3) Pump low flow Alarm.

2. Manual - The operator can start/stop the pump manually by placing the H-O-A switch in HAND.

3. Automatic:
   a. If both pumps are in automatic, the relay logic panel shall determine which pump runs based on duty/standby switch position.
   b. The PWPCP shall receive a discrete signal from the distribution pressure switch low and high.
   c. When PWP-1 & PWP-2 is in automatic switch position the relay logic panel, the pump shall start when the pressure switch low (PSL-322) is enabled and stop when the pressure switch high (PSH-323) is enabled.
   d. Failure of Duty pump start when called to run shall automatically start the Standby pump.

C. Alarms:

1. A general pump fail alarm for each potable pump shall be sent to the Auto Dialer as listed under specification section 40 60 05.3.4.E, Autodialer Input/Output list when the pump fails to run when called for. The general pump fail alarm shall activate when pump discharge pressure switch high, flow switch low or motor overload occurs on each pump as shown on Electrical drawings.
a. The alarms shall de-active when the general fail alarm (pressure switch high, flow switch low or motor overload) conditions return to normal.

D. Hardwired Interlocks -..Provide for each supply well pump, interlocks and disable pump run, when the pump is in either Manual or Auto operation mode.
   1. Potable water Pumps shall shut down on distribution pressure low signal is enabled.
   2. Potable water Pumps shall start on distribution pressure high signal is enabled.
   3. Pumps shall shut down and alarm to auto dialer when pressure high, flow low or motor overload alarms are enabled.

### 3.6 CONTROL STRATEGY: POTABLE WATER FLOW METER – (FIT-200)

A. General Description:
   1. A potable water flow meter shall be provided on the distribution header of the facility as shown on drawings.
   2. The I&C subcontractor shall install the flow meter as per the manufacturer’s recommendations.
   3. Calibration of the transmitter and to ensure signal transmission to the Chart Recorder (IR 202, as shown on the drawings) is contractor’s responsibility.
   4. The flow transmitter shall display totalized flow and current flow.

B. Alarms:
   1. A low chlorine residual alarm shall be sent to the Auto Dialer.
   2. The alarm shall de-activate when the chlorine residual alarm reaches normal condition.

### 3.7 CONTROL STRATEGY: FREE CHLORINE RESIDUAL ANALYZER – (AIT-201)

A. General Description:
   1. A free chlorine residual analyzer (AIT-201) shall be provided to sample the distribution water as shown on drawings.
   2. The I&C subcontractor shall install the analyzer as per the manufacturer’s recommendations.
   3. Calibration of the transmitter and to ensure signal transmission to the Chart Recorder (IR 202, as shown on the drawings) is contractor’s responsibility.
   4. The analyzer shall display free chlorine residual.

B. Alarms:
   1. A low chlorine residual alarm shall be sent to the Auto Dialer.
   2. The alarm shall de-activate when the chlorine residual alarm reaches normal condition.

### 3.8 CONTROL STRATEGY: CHART RECORDER – (IR-202)

A. General Description:
   1. One Chart Recorder (IR-202) shall be provided to record distribution flow and free chlorine residual as shown on drawings.
2. The I&C subcontractor shall install the chart recorders per the manufacturer’s recommendations.
3. The chart recorder shall have the ability to receive and transmit two (2) analog signals.
4. The free chlorine residual analog signal shall be re-transmitted to the sodium hypochlorite control panel (SHCP) for post-chlorination metering pump dose speed.
5. Calibration of the chart recorder and to ensure signal transmission from the chart recorder to the SHCP is contractor’s responsibility.

3.9 CONTROL STRATEGY: FIRE FLOW AND JOCKEY PUMP PANELS – FPCP & FJCP.

A. General Description:
   1. Fire flow system includes a fire flow pump and a Jockey pump to meet the fire demand. Fire flow pump will be controlled and monitored by the fire flow control panel (FPCP). Fire Jockey pump will be monitored by the fire jockey control panel (FJCP). The fire flow system including the control panels shall be provided by the supplier.
   2. Refer to specification section 21 30 00, Packaged Fire Pump System for additional information.
   3. The following description is for I&C subcontractor understanding only. The provision a fully operational fire system control panels (FPCP & FJCP) shall be the responsibility of the fire pump system supplier. I&C subcontractor and fire flow system supplier shall coordinate with each other for the integration of the alarm signals to the Auto Dialer.

B. Alarms:
   1. A general pump fail alarm for fire flow and jockey pump shall be sent to the Auto Dialer as listed under specification section 40 60 05.3.4.E, Autodialer Input/Output list, when the pump fails to run when called for.
   2. A fire flow pump Run signal shall also be generated to Auto Dialer to indicate the fire flow pump run status.
   3. The alarms shall de-active when the pump fail alarm conditions return to normal.

3.10 CONTROL STRATEGY: ELECTRICAL GENERATORS & AUTOMATIC TRANSFER SWITCH (ATS)

A. General Description:
   1. Electrical system includes a engine generator and automatic transfer switch. The electrical system including the control panels shall be provided by the supplier.
   2. Refer to specification section 26 32 13, Engine Generator and specification section 26 36 23, Automatic Transfer Switch for additional information.
3. The following description is for I&C subcontractor understanding only. The provision a fully operational electrical generator and ATS control panels shall be the responsibility of the fire pump system supplier. I&C subcontractor and electrical system supplier shall coordinate with each other for the integration of the alarm signals to the Auto Dialer.

B. Alarms:
1. Utility Power Fail (indicating power loss) and ON Engine Generator power, alarms shall be sent to the Auto Dialer as listed under specification section 40 60 05.3.4.E, Autodialer Input/Output list.
2. Generator Run Status signal shall also be generated from Engine Generator to Auto Dialer to indicate the generator run status.
3. The alarms shall de-active when the alarm conditions return to normal.

3.11 CONTROL STRATEGY: EMERGENCY CALL – PUSH BUTTON

A. General Description:
1. An Emergency Call - Push Button for Operator safety shall be provided as located on the Electrical Drawings.
2. The I&C subcontractor shall install the Emergency Push Button per the manufacturer’s recommendations.
3. Signal transmission to the Auto Dialer as shown on the drawings is contractor’s responsibility.

B. Alarms:
1. The push button activation shall be sent to the Auto Dialer.
2. The push button when activated shall be programmed to auto dial 911 for emergency help and indicate the site address.
3. The auto dialer shall be programmed to re-dial after a time delay until the Emergency push button is reset. The alarm shall de-activate when the emergency push button is reset.

++ END OF SECTION ++
SECTION 43 21 13

CENTRIFUGAL VERTICAL LINESHAFT WELL PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, tools and equipment required to furnish and install centrifugal vertical lineshaft well pumps complete and operational with motors, accessories, and services as shown and as specified.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the centrifugal vertical lineshaft well pumps Work.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 05 05 33, Anchor Systems.
   3. Section 09 91 00, Painting.
   4. Section 40 05 05, Exposed Piping Installation.
   5. Section 40 60 05, Instrumentation and Control Equipment for Process Equipment.
   7. Division 26, Electrical.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
      b. ASTM A 582/A 582M, Specification for Free-Machining Stainless Steel Bars.
   5. Hydraulics Institute, (HI).
   6. Institute of Electrical and Electronics Engineers, (IEEE).
   a. SSPC SP 10, Near-White Blast Cleaning.
11. Local and state building codes and ordinances.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:
   1. Manufacturer shall have a minimum of five years experience producing
      substantially similar equipment and shall be able to show evidence of at
      least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component
      manufacturer from a single centrifugal vertical lineshaft well pumps
      manufacturer.
   2. The centrifugal vertical lineshaft well pumps equipment manufacturer to
      review and approve or to prepare all Shop Drawings and other submittals for
      all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service
      conditions and shall be integrated into the overall assembly by the
      centrifugal vertical lineshaft well pumps equipment manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Fabrication, assembly, installation, and wiring diagrams.
   2. Product Data:
      a. Descriptive literature including cross-sectional views of the pump
         indicating the materials of construction and preliminary dimension
         prints of pumps and motors.
      b. Performance curves for the complete pump assemblies showing the
         relationship between head and capacity, efficiency, brake and motor
         horse-power, and NPSH from shut-off head to the minimum operating
         head specified. Curves shall be corrected for pump losses and shaft
         friction horse-power losses. Pump losses shall include column and
         discharge head losses.
      c. Impeller type.
      d. Bowl and shaft WR square.
      e. Maximum down thrust at design points and shutoff, and maximum up
         thrust.
      f. Weight of pumps and motors (including all components).
      g. Motor manufacturer, type, enclosure, phase, voltage, rated
         horsepower, full load and locked rotor amperage, temperature rating,
         and expected minimum life under design conditions, minimum
         efficiency at full load, and descriptive literature including description
of motor insulation, for each type of motor to be furnished.
h. A list of deviations from the Contract Documents.

B. Informational Submittals: Submit the following:
1. Source Quality Control Submittals:
a. Results from certified shop tests.
b. Names and addresses of the nearest factory authorized service organization.
2. Warranty:
a. Submit a copy of the Warranty.

C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:
1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Acceptance at Site:
1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 WARRANTY

A. The equipment shall be warranted to be free from defects in workmanship, design, and materials for a period of one (1) year from the date of authorized startup. If any part of the equipment should fail under normal use during the warranty period, it
shall be repaired or replaced to the satisfaction of the ENGINEER, and the equipment shall be restored to satisfactory service at no additional cost to the OWNER.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. General:
   1. Pumps shall be vertical lineshaft type, suitable for deep well pumping of clean water.
   2. Materials in Contact with Potable Water:
      a. All surfaces, including coatings which will be in contact with water that is potable or will become potable following additional treatment.
         1) Be listed by the National Sanitation Foundation as being suitable for contact with potable water, as applicable.
      3. Pumps shall operate satisfactorily on a continuous basis at all points within the required range of operation without overheating, cavitation, and excessive vibration or strain.

B. Design Criteria:
   1. Pumps shall be specially designed, constructed, and installed for the service intended and shall comply with the following minimum conditions:
## Design Conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location:</td>
<td>Wells F1 and F2</td>
</tr>
<tr>
<td>Use:</td>
<td>Potable Supply</td>
</tr>
<tr>
<td>Number Required:</td>
<td>2</td>
</tr>
<tr>
<td>*Design Flow, (gpm):</td>
<td>500</td>
</tr>
<tr>
<td>*Design TH, (ft.):</td>
<td>105</td>
</tr>
<tr>
<td>Minimum Bowl Efficiency at Design, (percent):</td>
<td>80</td>
</tr>
<tr>
<td>Bowl O.D. Maximum (in.):</td>
<td>10</td>
</tr>
<tr>
<td>Motor, (Hp):</td>
<td>20</td>
</tr>
<tr>
<td>Maximum Operating Speed, (rpm):</td>
<td>1800</td>
</tr>
<tr>
<td>Pump Column Diameter, (in.):</td>
<td>6</td>
</tr>
<tr>
<td>Discharge Size, (in.):</td>
<td>6</td>
</tr>
<tr>
<td>**Available NPSH at Design, (ft.):</td>
<td>75</td>
</tr>
<tr>
<td>***Flow at 2nd Design Point, (gpm):</td>
<td>550</td>
</tr>
<tr>
<td>TH at 2nd Design Point, (ft.):</td>
<td>95</td>
</tr>
<tr>
<td>Maximum Shutoff Head, (ft.):</td>
<td>185</td>
</tr>
<tr>
<td>Minimum Shutoff Head, (ft.):</td>
<td>140</td>
</tr>
<tr>
<td>Approximate Static Liquid Elevation in Well, (ft.):</td>
<td>-65.0</td>
</tr>
<tr>
<td>Elevation of Pump, (ft.):</td>
<td>-140.0</td>
</tr>
<tr>
<td>Pump Discharge Center-line Elevation, (ft.):</td>
<td>0.63</td>
</tr>
<tr>
<td>Liquid Pumped:</td>
<td>Clean Water</td>
</tr>
<tr>
<td>Temperature, (°F):</td>
<td>72</td>
</tr>
<tr>
<td>Liquid, (pH):</td>
<td>7.4</td>
</tr>
<tr>
<td>Drive Type:</td>
<td>Constant speed w/ ATL starter</td>
</tr>
<tr>
<td>Motor: Volts/Phase/Hz</td>
<td>460/3/60</td>
</tr>
</tbody>
</table>

* At maximum speed. Does not include entrance, pump, column, and discharge head losses.

** Flow at the 2nd design point TH shall be within ten percent of the value specified.

*** Pump horsepower requirements shall not exceed stated horsepower at any point on operating curve.

### 2.2 MANUFACTURERS

A. Products and Manufacturers:
   1. Provide pumps as manufactured by one of the following:
      a. Goulds Pumps Water Technology
      b. Fairbanks Nijhuis.
      c. Peerless Pump.
      d. Or approved equal.
   2. Provide motors as manufactured by one of the following:
      a. Emerson Motors.
      b. General Electric Company.
c. Siemens.
d. Or approved equal.

2.3 DETAILS OF CONSTRUCTION

A. Pump Materials and Construction:
   1. All materials in contact with process water shall be NSF-61 listed for use with potable water and shall be compatible with the liquid pumped.
   2. Pump Base: A base of fabricated steel shall be provided for mounting the driver and the supporting pump column. The discharge outlet shall be flanged. Flanges shall be ANSI B16.1, Class 125.
   3. Pump Bowls: The castings shall be of close-grained cast-iron or ductile iron, smooth and free of all casting imperfections. Bowls shall be capable of withstanding a hydrostatic pressure equal to 150% of the pressure at the specified operating point, or, 125% of the shut-off head, whichever is greater.
   4. Bowl Bearings: Bearings shall be bronze, grease-packed, sealed, with Type 304 stainless steel sand collars, and a minimum B-10 life of 40,000 hours.
   5. Impellers: Impellers shall be Type 316L stainless steel of the enclosed type, statically and dynamically balanced. They shall be securely fastened to the impeller shaft with keys or lock nuts. They shall be adjustable vertically by means of a nut in the driver and fitted with Grade 316L stainless steel wear rings.
   6. Pump Shaft: The pump shaft shall be of Type 416 stainless steel. The shaft diameter shall be sized for the total axial thrust plus the weight of all rotating parts supported by it and the horsepower transmitted. The maximum combined shear stress shall not exceed 30 percent of the elastic limit in tension or be more than 18 percent of the ultimate tensile strength of the shafting material.
   7. Lineshafts: The lineshafts shall be of Type 416 stainless steel. It shall be furnished in lengths not greater than 5-feet with the ends faced squarely to assure perfect alignment after installation. The shafting shall be coupled with threaded steel couplings, designed with a safety factor of one and half times the shaft safety factor and shall be left-hand thread to tighten during pump operation.
   8. Lineshaft Bearings: The shaft bearings shall be able to run dry at pump startup without the use of a prelubrication system and shall be mounted in bearing retainers held in position in the column couplings by means of the butted ends of the column pipes. The bearings shall be located at intervals of no more than five feet and shall be Vescomite Hilube-type or equal.
   9. Discharge Head Assembly: A 1/4-inch tapped connection shall be provided on the pump discharge nozzle for installation of a pressure gage. Provide plug for tapped connections. The discharge head assembly shall be provided with acrylic yarn/graphite packing. The motor shall be provided with a sleeve-type coupling to connect the pump to shaft and motor drive shaft.
   10. Discharge Column Pipe: The column pipe shall be steel, standard I.D. of not less than pump column diameter. The pipe shall be furnished in sections.
of nominal 5-foot lengths and be interchangeable. The ends of each section shall be machined parallel and the threads machined so that the ends will butt, to ensure proper alignment when assembled.

11. Anchor bolts and inserts shall be furnished under this Section and shall be sized and installed in accordance with the manufacturer's recommendations. The anchor bolts shall be Type 316 stainless steel, conforming to the requirements of Section 05 05 33, Anchor Systems.

12. All bolts, nuts and cap screws shall have hexagon heads and be Type 316 stainless steel.

13. Provide Type 316 L stainless steel strainer on each suction bell inlet. The maximum opening shall not be more than 75 percent of the maximum opening of the water passage through the bowl or impeller.

14. Stainless steel nameplates giving the manufacturer's model and serial number, rated capacity, head, speed and all other pertinent data shall be attached to the pump.

B. Motors:

1. Motors for pumps shall be TEFC, premium efficient, hollow shaft, ball bearing type. Motors shall be squirrel cage induction type, NEMA Design B, suitable for operation on 460 volt, 3 phase, 60 Hz power, with torque and starting currents in accordance with NEMA MG 1. Pump and motor shall be selected so that the required horsepower at any point on the operating curve from shut off to run-out does not exceed the nameplate horsepower. Motor shall have a 1.15 service factor. Service factor shall not be utilized in sizing motors for pumps. Motors shall be arranged for mounting on the pump head. Motor shall have 40 degrees C ambient rating, and Class F insulation.

2. Motors shall have stator moisture protection by means of vacuum/pressure impregnation of epoxy. Windings shall be copper.

3. Motors shall be provided with a non-reverse ratchet.

4. Space heater shall be furnished to provide sufficient wattage to maintain the internal temperature of the motor at a level approximately 10°C above the ambient temperature while the motor is not in operation. Space heaters shall be of the silicone rubber strip type attached directly to the stator end turns. The leads shall be brought out to an auxiliary terminal box. Space heaters shall be rated for operation on a single phase, 60-hertz, 120-volt system.

5. Bearings shall be selected to have ABMA rated (minimum) life of ten years when operated continuously at rated speed of motor and at total load consisting of the weight of the motor rotor plus combined dead weight and hydraulic thrust load imposed on the motor by the pump, when pumping at design point. Thrust bearings shall be of the angular contact ball or spherical roller type. Bearings shall be adequate to carry the weight of all rotating parts and continuous thrust loads existing under all conditions of pump operation from zero to shutoff.

6. Each bearing shall be grease lubricated. Motors shall have a stainless steel plate indicating all essential lubricating information such as type, viscosity,
frequency of changes, etc.

7. Motors shall be supplied with a lifting hook and shall have Type P base specifically constructed for vertical installation. Universal position motors are unacceptable.

8. Motor conduit boxes shall be of cast-iron or fabricated steel, neoprene gasketed and bolted, and oversized to provide adequate space for connections. Motor conduit box shall be split from top to bottom, and shall be capable of being rotated to four positions 90 degrees apart. The motor leads shall be permanently marked in agreement with connection diagrams. Provide drain holes on each end of motor.

9. Motor nameplates shall be Type 316 stainless steel with embossed or pre-printed lettering and fastened to the motor frame with Type 316 stainless steel pins. Nameplates shall have stamped on them the motor manufacturer’s name, voltage, number of Hertz and phases, horsepower rating, amperes and temperature rise at rated load, full load speed, locked rotor amperes or code letter, service factor, NEMA nominal efficiency, model number, insulation class, bearing number, serial number and maintenance manual number. Nameplate markings shall be in accordance with NEMA MG 1-10.

10. Outdoor Motors shall have coating resistant to degradation or chalking in sunlight, conforming to the requirements of Section 09 91 00, Painting.

2.4 ELECTRICAL AND CONTROLS

A. Refer to Division 26, Electrical for electrical provisions and requirements.

B. Refer to Section 40 60 05, Instrumentation and Control Equipment for Process Equipment for instrumentation requirements.

C. Refer to Section 40 61 96, Process Control Descriptions for control requirements.

2.5 TOOLS, SPARE PARTS, AND MAINTENANCE MATERIALS

A. Each pump shall be furnished with a manufacturer's repair kit which shall include as a minimum the following:
   1. Two sets of special tools required for normal maintenance and operation.
   2. One set of gaskets and packings.
   3. A complete set of all fasteners, bolts, nuts, pins, keys, washers and the like which are not of standard manufacture.
   4. All bearing grease, and any other lubricants required for initial operation, properly labeled and boxed.

B. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the OWNER at the conclusion of the Project.
2.6 SURFACE PREPARATION AND SHOP PAINTING

A. Pumps, motor, drive and appurtenances shall receive manufacturer’s shop primer and shop finish coating conforming to the requirements of Section 09 91 00, Painting.

B. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.

2.7 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Pump columns and discharge heads shall be hydrostatically tested to twice the discharge head or one and a half times the shutoff head, whichever is greater.
   2. Running Test: Pump assembly shall be operated at the specified design points as shown on the approved curves. Results of the test shall be shown in a plot of test curves showing head, flow, horsepower, overall efficiency and current. Readings shall be taken at a minimum of five evenly spaced capacity points including shutoff, design point and minimum head for which pump is designed to operate.
   3. All tests shall be witnessed by a Registered Professional Engineer (RPE), who may be an employee of the manufacturer. The RPE shall sign and seal all copies of test curves and shall certify that hydrostatic tests were performed. The State of registration, registration number and the name on the seal shall be clearly legible. Conduct tests in conformance with the methods described in Section A6 of AWWA E101. The serial numbers of the pumps shall be on the test curves and hydrostatic tests.
   4. Pumps shall not be shipped until the ENGINEER has approved the test reports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in complete accordance with manufacturer's instructions and recommendations and the approved Shop Drawings.

B. Pumping units shall be installed on concrete bases and grouted as shown.

C. Installation shall include furnishing and applying an initial supply of manufacturer-recommended lubrication.

Suwannee County WTP
Centrifugal Vertical Lineshaft Well Pumps
40039002.0000 43 21 13-9
D. Support piping independent of pump.

E. Check and align pump, motor and shafting. CONTRACTOR shall provide necessary devices to properly align and connect the line shaft to the motor shaft.

3.2 START-UP AND TEST

A. CONTRACTOR shall verify that structures, pipes and equipment are compatible.

B. Site Tests:
   1. Inspect motors prior to supplying electricity to (energizing) equipment.
      a. Inspect equipment for physical damage.
      b. Inspect equipment for proper anchorage, mounting, grounding, connection, and lubrication.
      c. Check for unusual noise and indications of overheating during initial or test operation.

C. Make adjustments required to place system in proper operating condition.

D. Field Vibration Tests:
   1. A bump test shall be performed on pump in each of two orthogonal planes, one of which shall include the discharge elbow, to ensure that the pumps will not develop lateral and torsional critical speeds. These tests shall be performed after the pump has been installed on its foundation, and under both operating and non-operating conditions. Other suitable tests may be substituted subject to ENGINEER'S approval of CONTRACTOR'S written request and description of the tests proposed.
   2. Vibration measurements shall be made at the upper motor bearing of pump while operating over its speed range. Measurements shall be made in each of two orthogonal horizontal directions one of which shall be in the plane of the greatest vibration and in the vertical (pump axial) direction. Measured levels in the horizontal direction of the operating pump shall not exceed those in the Hydraulic Institute Standards, latest edition.
   3. If any pump exhibits vibration or unbalance in excess of the specified limits, CONTRACTOR shall adjust or modify the pump assembly as necessary to attain the specified capacity and retest at no additional cost to the OWNER.
   4. Submit certified report of successful vibration tests for approval.

E. Submit report of test results.

F. Testing, checkout and start-up of the equipment shall be performed under the technical direction of the manufacturer's factory-trained representative. The drive system shall not be energized without authorization from the manufacturer's representative.
3.3 MANUFACTURER’S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of one visit, minimum four hours on-Site for assistance in the installation of equipment; minimum two hours shall be for checking the completed installation; and a minimum of two hours for start-up and training. Manufacturer’s representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and
      incidental as shown, specified and required to furnish and install a
double walled, high density polyethylene (HDPE) tank with ancillary accessories.
The tank shall be suitable for the storage of 10 percent of sodium
hypochlorite and shall be constructed of NSF 61-approved wetted materials.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate
      the installation of items that must be installed with HDPE tank.
   2. Size and location of pipe connections, etc. shall be coordinated with the
      requirements of applicable chemical feed systems.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 26 00 05, Electrical Work.
   3. Division 40, Sections on Piping and Valves.
   4. Section 40 60 05, Instrumentation and Control for Process Systems.
   5. Section 40 60 96, Process Control Descriptions.

1.2 SUBMITTALS

A. Shop Drawings: Comply with Section 01 33 00, Submittal Procedures, and the
   additional requirements below. Submit for approval the following:
   1. Layout and all critical dimensions, including thickness of tank wall.
   3. Fitting locations and details.
   4. Accessories.
   5. Anchor and hold-down details.
   6. Manufacturer's literature, illustrations, chemical compatibility data,
calibration charts, specifications, engineering data and installation
   instructions.
   7. Tank color.
   8. Demonstration of chemical compatibility with chemical to be stored,
   percentage of chemical, and temperature of chemical.
B. Manufacturer’s Qualifications: Submit documentation in accordance with requirements of Part 1.3.B.

C. Test Reports: Submit copies of test reports required by Part 1.3.C.

D. Warranty: Submits copies of the Warranty required by Part 1.5.

E. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01 78 23, Operation and Maintenance Data. The Operation and Maintenance Manuals shall include, but not be limited to, the following:
   1. Manufacturer’s written instructions for unloading, handling, and storing HDPE tanks and appurtenances.
   2. Installation instructions for installing tank on a concrete slab.

F. Local Service Representative or distributor: Provide name, address and telephone number of manufacturer and local, factory-trained service representative or distributor.

G. Quality Assurance Report that includes the following:
   1. Tank Description.
   4. Specific Gravity & Hoop Stress Design.
   5. Color.
   6. Review of Audit for Wall Thickness.
   7. Fitting Placement Sign Off.
   8. Accessory Inspection.

1.3 QUALITY ASSURANCE

A. Reference Standards: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASTM D 1998-06, Polyethylene Upright Storage Tanks
   2. ASTM D 618, Conditioning Plastics and Electrical Insulating Materials for Testing
   3. ASTM D 638, Tensile Properties of Plastics
   4. ASTM D 790, Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
   5. ASTM D 883, Definitions of Terms Relating to Plastics
   6. ASTM D 1505, Density of Plastics by the Density-Gradient Technique
   7. ASTM D 1525, Test Method for Vicat Softening Temperature of Plastics
   8. ASTM D 1693, Test Method for Environmental Stress-Cracking of Ethylene Plastics
   9. ASTM D 2765, Degree of Crosslinking in Crosslinked Ethylene Plastics as Determined by Solvent Extraction
10. ASTM D 2837, Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
11. ASTM D 3892, Practice for Packaging/Packing of Plastics
12. ASTM F 412, Definitions of Terms Relating to Plastic Piping Systems
13. ARM (Association of Rotational Molders) Standards: Low Temperature Impact Resistance (Falling Dart Test Procedure)
14. ANSI Standards: B-16.5 Pipe Flanges and Flanged Fittings
15. OSHA Standards: 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids
19. NSF/ANSI Standard 61 – Drinking Water System Components (Type II resin)

B. Manufacturer's Qualifications: Manufacturer shall have at least 10 years of experience in producing double wall HDPE tanks of similar size for 10% sodium hypochlorite and shall provide evidence of at least 10 installations in satisfactory service for a minimum of 5 years.

C. Source Quality Control:
   1. All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.
      a. The tolerance for fitting placements shall be +/- 0.5 in. in elevation and 2 degrees radial at ambient temperature.
   2. Test specimens shall be taken from fitting location areas or piggy-back test molds.
   3. Low Temperature Impact Test - ARM Standard:
      a. Test specimens shall be conditioned at -40 degrees Fahrenheit for a minimum of 2 hours.
      b. The test specimens shall be impacted in accordance with ARM Standard Test Method. Test specimens <2" thickness shall be tested at 100 ft.-lb. Test specimens > 2" thickness shall be tested at 200 ft.-lb.
   4. Hydrostatic Water Test:
      a. The hydrostatic water test shall consist of filling the tank to full capacity with all tank connections sealed from the outside for a minimum of four hours and conducting a visual inspection for leaks, from tank and tank connections.

D. Each tank shall be inspected for defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking, and/or delamination that will impair the serviceability of the vessel. All cut edges where openings are cut into the tank shall be trimmed smooth.
1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. In general, tank shall be:
   1. Chocked and tied down to prevent being blown by wind.
   2. Vented to allow for temperature changes that may affect their integrity.
   3. Provided with opening protection to exclude foreign matter.
   4. Protected from sunlight (UV) degradation.
   5. Stored on site in cradles or polyethylene shrink wrap, if storage is required prior to installation.

B. Delivery of Materials:
   1. Refer to Section 01 65 00, Product Delivery Requirements, and supplementary requirements below.
   2. Deliver materials to the site to insure uninterrupted progress of the Work.
   3. Deliver anchor bolts and anchorage devices that are to be embedded in cast-in-place concrete in ample time not to delay that Work.
   4. Tanks delivered to the job site shall be inspected by the CONTRACTOR for damage, unloaded and stored with a minimum of handling.
   5. All fittings shall be installed, removed and shipped separately. Upon delivery, CONTRACTOR shall inspect all fittings and accessories for damage and verification that the system is complete.

C. Storage of Materials:
   1. Refer to Section 01 66 00, Product Storage and Handling Requirements, and supplementary requirements below.
   2. Store materials to permit easy access for inspection and identification. Protect equipment including packaged materials from weather, corrosion, and deterioration.

D. Handling of Materials:
   1. Refer to Section 01 66 00, Product Storage and Handling Requirements, and supplementary requirements below.
   2. Handle all HDPE tanks and appurtenances as recommended by the manufacturer to avoid damage. Polyethylene tanks that are damaged will not be acceptable. Protect all HDPE tank appendages from damage and contamination.
      a. Comply with manufacturer's recommendations in handling and storing tanks.
      b. Whenever feasible, shipments shall be made by truck.
      c. All tie-down straps shall give provision for thermal expansion and shall be padded where in contact with the equipment.
      d. Openings shall be protected from damage by covering with suitable plywood or hardboard, securely fastened. Flange adapters shall not be shipped installed. The tank shall be positively vented at all times.
      e. Pipe, tubing, fittings, and miscellaneous small parts shall be crated or boxed. Additional protection, such as end wrapping, cross bearing, or
other interior fastening may be required to assure such individual equipment pieces are not damaged in transit.

f. The equipment shall be inspected by the ENGINEER before unloading at the installation site and any resulting damage shall be the carrier’s and/or fabricator’s responsibility to repair at no cost to OWNER.

g. The tank and appurtenances shall be unloaded and stored in accordance with the manufacturer’s written instructions.

1.5 WARRANTY

A. All material supplied under these Specifications shall be warranted by the CONTRACTOR and the manufacturers for a period of three (3) years, commencing on the date of shipment.

B. The material shall be warranted to be free from defects in workmanship, design and materials. If any part of the system should fail during the warranty period, it shall be replaced at no expense to the OWNER.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Provide one of the following polyethylene tank manufacturers:
   1. Snyder Industries, Inc.
   2. Poly Processing Company.
   3. Or approved equal.

2.2 SERVICE CONDITIONS

A. General Design Conditions:
   1. Normal Temperature: Ambient, indoor installation, 40 degrees Fahrenheit - 95 degrees Fahrenheit. Chemicals may be delivered at higher or lower temperatures, depending on season.
   2. Maximum Temperature: 100 degrees Fahrenheit.
   4. External Loads: Appurtenances as shown and specified herein.
   5. Configuration: Double wall, Flat-bottom, vertical, cylindrical with dished tops.

B. Tank shall be suitable for:

<table>
<thead>
<tr>
<th>Tank Identification</th>
<th>Working Capacity, (gal)</th>
<th>Chemical</th>
<th>% Conc.</th>
<th>S.G.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHST</td>
<td>300 (min)</td>
<td>Sodium Hypochlorite</td>
<td>10</td>
<td>1.17</td>
</tr>
</tbody>
</table>
C. Working capacity is defined as full capacity of the tank to the tank shoulder.

D. Tank shall be designed using a hoop stress of 600 psi. Wall thickness calculations shall assume that all tank contents have a specific gravity of not less than 1.9.
   1. The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation:

   \[ T = \frac{P \times OD}{2SD} \text{ or } 0.433 \times SG \times OD \times H \times OD/2SD \]

   Where:
   - \( T \) = wall thickness, in
   - \( P \) = pressure, psi
   - \( SG \) = specific gravity, gm/cc
   - \( H \) = fluid head, ft
   - \( OD \) = outside diameter, ft
   - \( SD \) = hydrostatic design stress, 600 psi

2.3 MATERIALS OF CONSTRUCTION

A. Polyethylene:
   1. The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer. Tanks made from linear polyethylene resin shall be as manufactured by Exxon Chemical, or resin of equal physical and chemical properties. Tanks made from crosslinked polyethylene resin shall be as manufactured by Exxon Mobil Paxon 7000, or resin of equal physical and chemical properties.
   2. Tank color shall be “natural”.

2.4 DETAILS OF CONSTRUCTION

A. Design:
   1. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell. The bottom knuckle radius of flat bottom tanks shall conform to ASTM D 1998.
   2. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall.

B. Construction:
   1. Tank shall be upright, cylindrical, flat bottomed, one-piece seamless construction by rotational molded.
   2. The tank shall be designed for above-ground, vertical installation and shall be capable of containing chemicals at atmospheric pressure.
   3. Tank shall be of the type and size shown on the Drawings and specified herein.
   4. Use all titanium hardware for mounting and connections of accessories.
5. All gaskets and accessories shall be compatible with the chemical in storage. Dome mounted gaskets shall be EPDM, wall mounted gaskets shall be Viton.
6. All wetted materials shall be NSF-61 listed for use with potable water and shall be compatible with the liquid contained.

C. Fittings:
1. Bolted Double 150 lb. Flange Fittings:
   a. Provide bolted double flange fittings.
   b. The bolted double flange fittings shall be constructed with 2 ea/ 150 lb. flanges, 2 ea. 150 lb. flange gaskets, and the correct number and size of all-thread bolts for the flange specified by the flange manufacturer. The flanges shall be constructed of PVC Type 1, Grade 1. Gaskets shall be a minimum of 1/4" thickness and constructed of 60-70 durometer Viton. There shall be a minimum of 4 each all-thread bolts. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in Type II polyethylene material. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully cover the bolt head and a minimum of 1/4" of the threads closest to the bolt head. The polyethylene shall be a minimum of 1/4" of the threads closest to the bolt head. Each encapsulated bolt shall have a gasket to provide a bolt sealing surface against the inner flange.
   c. Alternatively double flange sidewall fittings 3” diameter and smaller shall be bolted flange fittings constructed with one 150-lb inner polyethylene flange, one 150-lb outer Schedule 80 PVC flange, one 150-lb. flange gasket, and the correct number of all-thread bolts that are molded into the inner flange assembly. The inner and outer connection nipples shall be molded into the inner polyethylene flange. The entire assembly shall have only one full-face flange gasket and shall not require separate flange bolt gaskets.

2. Fittings shall provide a flexible containment seal between the inner primary tank and the outer secondary containment tank. The fitting systems shall provide access for connecting piping to the inner primary tank while maintaining containment integrity between the inner primary tank and the outer secondary containment tank.

2.5 ACCESSORIES

A. Level Indication:
   1. Each tank shall be provided with a 3/4-inch diameter clear PVC sight glass.
   2. Each sight glass shall be provided with PVC vented ball valves for isolation, true union type.
   3. The sight glass shall be mounted on the tank in view of the tank fill area, as shown.
4. The sight glass shall be provided with a calibrated gallonage tape, with level minor every 20 gallons and major marks every 100 gallons.

B. Leak Detection
   1. Tank shall be fitted with a mechanical means of leak detection.
   2. Leak detection shall be achieved with a ½” diameter bulkhead fitting with vented ball valves. The valve shall be able to be opened to determine if any fluid is present in the annular space between the primary and secondary tank.
   3. Alternatively, the secondary tank shall be fitted with a visual level gauge for level indication of the annular space, SureSite or equal.

C. Vents:
   1. Provide a 6-inch U-type tank vent, or a vent as recommended by the manufacturer.
   2. Each tank vent line shall be equipped with a plastic insect screen.

D. Drain:
   1. Provide a 1-inch drain connection fitting as recommended by the manufacturer.

E. Fill:
   1. Provide a 2-inch fill connection fitting as recommended by the manufacturer.

2.6 SPARE PARTS

A. Provide spare parts in accordance with manufacturer’s recommendations.

2.7 IDENTIFICATION

A. Label: Permanently attach label to each tank with the following minimum information:
   1. Chemical to be stored including:
      a. Concentration.
      b. Specific gravity.
      c. Maximum temperature.
   2. Tank manufacturer.
   3. Date of manufacture.
   4. Tank serial number.
   5. Tank material.
   6. Tank capacity.
   7. Tank shall be furnished with OSHA approved 20-inch by 24-inch Chemical Warning signs with NFPA 704 hazard numbers for the chemical services intended. Chemical signs shall include, as a minimum, the name of the product stored in the tank, precautionary measures, signal word (danger,
warning, caution), statement of hazard, precautionary measures, instructions in case of contact, exposure, etc. and NFPA 704 hazard numbers.

8. All packing, packaging, and marking provisions of ASTM Practice D3892 shall apply to this standard.

PART 3 – EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. Inspect tank and accessories prior to installation. If damaged, notify ENGINEER and manufacturer at once.

C. Do not install damaged tanks or accessories until repairs or replacements are made in accordance with manufacturers written instructions and approval by ENGINEER.

D. Inspect concrete pads for proper elevation, dimensions, evenness and anchor bolt locations. Correct if required.

3.2 INSTALLATION

A. Install tank in complete conformance with manufacturer's instructions.

B. Install lining material between the tank bottom and the concrete pad according to the manufacturer’s recommendations. Lining material must be compatible with chemical stored in tank.

C. Coordinate with CONTRACTOR for installation of expansion joints and other fittings specified in Section 40 24 33, Chlorine Piping, Valves, and Specials.

3.3 FIELD QUALITY CONTROL

A. Refer to Section 01 75 11, Checkout and Startup Procedures.

B. Required Manufacturer Services: Retain a qualified representative of the manufacturer for a minimum period of 8 hours to perform the following services:
   1. Equipment Installation:
      a. Oversee installation of the equipment and accessories specified herein.
      b. Inspect the completed installation, note deficiencies, and provide certificate of proper installation when deficiencies are corrected.
2. Furnish test forms and procedures for field testing.

C. Field Testing:
   1. Provide all test apparatus required at no extra cost to OWNER.
   2. Follow testing procedures recommended by the manufacturer and approved by the ENGINEER.
   3. After installation is complete but before piping connections are made, block all outlets from the exterior and fill each tank with water to the overflow elevation.
   4. Each tank must maintain the overflow elevation level with zero-leakage for a 24-hour period.
   5. Repair all leaks in accordance with manufacturer's instructions.

D. Manufacturer's Installation Report:
   1. Prepare manufacturer's installation reports and submit within 30 days after completion of field testing and operation instruction. The reports shall be prepared in accordance with the requirements of Section 01 78 23, Operation and Maintenance Data, and shall include the following:
      a. Field testing reports.
      b. Installation certificate certifying that the tank system has been installed according to the tank manufacturer’s recommendations and the requirements of the Contract Documents.

3.4 CLEANING AND REPAIRING

A. After installation is complete and connections made, pre-approve with OWNER to clean tank and nozzles with clean water. CONTRACTOR shall verify with tank manufacturer and submit to ENGINEER proper procedures on rinsing to ensure tank is not damaged during cleaning.

++ END OF SECTION ++
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals required to furnish and install a welded steel hydropneumatic tank (hereinafter "pressure tank") and appurtenances as shown and as specified.
   2. Tank shall be of the following type and use:
      a. One (1) Conventional-type, horizontal pressure tank for storage and delivery of pressurized potable water.

B. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 05 05 33, Anchor Systems.
   3. Section 09 91 00, Painting.
   4. Section 26 00 05, Electrical Work.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society of Mechanical Engineers:
      a. BPVC D1-89, Section VIII, Rules for Construction of Pressure Vessels, Division 1
      a. ANSI B.16.5, 150 pound flanged fittings.
      a. ASTM A 36, Specification for Carbon Structural Steel.
      b. ASTM A 53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. ASTM A 181, Specification for Carbon Steel Forgings, for General-Purpose Piping.
   5. The Society for Protective Coatings, (SSPC).
      a. SSPC, Structures Painting Council Standards for Blast Cleaning Surface Preparations and Painting of Steel Surfaces.
      a. UL Standard No. 96A, Installation Requirements for Lightning Protection Systems.
1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
   2. Welding procedures, welders and welding operators shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

B. Certification of Design: A statement shall be provided by the pressure tank manufacturer or supplier and signed and sealed by a Registered Professional Engineer, licensed in the State of Florida, who may be an employee of the manufacturer or supplier, stating:
   1. The design of the tank, supports, and appurtenances has been reviewed and they are entirely suitable for the specified service conditions.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Layout and all critical dimensions.
      b. Materials.
      c. Fitting and penetration locations and details.
      d. Accessories.
      e. Anchors and hold downs, as required.
   2. Product Data:
      a. Manufacturer's literature, illustrations, calibration charts, specifications, engineering data and installation instructions.
      b. Copies of coating manufacturer’s technical data sheets, including surface preparation, number of coats, dry film thickness, test performance data including paint analysis, NSF compliance documentation, and application instructions for each product proposed for use.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Certification of Design.
   2. Source Quality Control Submittals:
      a. Shop test reports.
   3. Site Quality Control Submittals:
      a. Field inspection reports as specified in Part 3 of this specification.
   4. Warranty:
      a. Submit a copy of the Manufacturer’s warranty.

C. Closeout Submittals: Submit the following:
   1. Operations and Maintenance Data:
a. Submit complete installation, operations and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information.

b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operation and Maintenance Data.

1.5 SHOP TEST

A. Shop test the pressure tank by filling it with a combination of air and water to 1.5 times the specified high pressure level. Measure the drop in liquid level following the next 24-hour period to determine the volume of liquid loss. No measurable leakage of tank's content shall be permitted. No visible running leaks, water puddles or damp spots which show on the exterior surface of the structure shall be permitted.

B. Submit six copies of a certification that the test was performed and the tank has no leaks.

C. Submit six copies of radiographic test reports including repair action on welds and retest results, as needed.

1.6 WARRANTY

A. Manufacturer shall guarantee the tank against defective materials or workmanship for a period of five years from the date of authorized start-up. In case leakage or other defects appear within the five year period, the manufacturer shall proceed to make repairs promptly, upon written notice by the OWNER, at no additional cost to the OWNER.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. CONTRACTOR shall furnish and install steel pressure tank and appurtenances as shown on the contract drawings and specified herein.

B. Loading Conditions:
   1. The tank and all anchorages shall be designed to meet applicable wind load criteria. The design must consider both the tank full and the tank empty condition.

2.2 DETAILS OF CONSTRUCTION

A. The pressure tank shall be fabricated of low carbon steel.
B. Tank Manufacturers: Provide one of the following:
   1. Dixie Tank Company.
   2. RECO USA
   3. Or approved equal.

C. Tank Schedule:

<table>
<thead>
<tr>
<th>Design Pressure Range, (psi):</th>
<th>70-90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Required Volume, (gallons):</td>
<td>7,000 gallons</td>
</tr>
<tr>
<td>Tank Diameter, (inches):</td>
<td>96</td>
</tr>
<tr>
<td>Service:</td>
<td>Potable Water</td>
</tr>
</tbody>
</table>

D. Construction:
   1. Conventional-type, horizontal.
   2. Steel shall conform to ASTM A 36, at a minimum.
   3. Tank shall be fabricated using a minimum number of joints.
   4. All welds shall be non-porous and free from pinholes, cracking and under-cutting. Sharp edges and high spots shall be ground smooth. Corners shall be ground to a minimum radius of 1/8-inch. All weld flux, spatter and foreign matter shall be removed. All welds shall be continuous and smooth and by ASME Code qualified welders.
   5. The tank shall be sealed air tight at all openings prior to shipment and installation.
   6. All materials in contact with process water shall be NSF-61 listed for use with potable water and shall be compatible with the liquid contained.

E. Accessories:
   1. All anchor bolts, bolts, nuts, hardware and accessories shall be Type 316 stainless steel.
   2. Connections:
      a. Tank connection types, sizes, and locations shall be as shown.
      b. Flanges of vertical nozzles shall be installed parallel to the tank shell.
      c. Flanges shall be designed to accept through bolts for connection to external piping.
      d. One full bottom drain connection shall be provided located at the tank bottom.
   3. Saddles:
      a. Provide a sufficient number of saddles to support weight of full tank under applicable wind loading.
      b. Saddles shall be as shown in the drawings.
      c. Tank saddles shall have a sufficient number of equally-spaced steel lugs for anchoring the saddles to the concrete foundation footings. Anchor lugs shall be designed to adequately resist the wind loads imposed on the tank.
Provide anchor bolts conforming to the requirements of Section 05 05 33, Anchor Systems.

4. Manways:
   a. Manways shall be hinged and installed with holddown bolts and gaskets.
   b. Manways shall be 24-inch diameter and installed on the tank head as shown on the drawings.

5. Air Volume Control:
   a. A 2” FNPT connection shall be provided at the top of the pressure tank for installation of an Air Rite Model 610HP air charging system capable of continuous pressure monitoring, as manufactured by Whitewater Manufacturing Company, or approved equal. The air charging system shall be a motor-driven air compressor controlled by an electrode that senses the water level in the pressure tank. The air compressor and controls shall be fully integrated into the unit and shall be installed on the tank centerline away from the tank inlet. Internal controls shall be completely protected from the elements. Threads shall be sufficiently sealed with Loctite or Teflon tape to prevent air leakage.

6. Liquid Level Gage:
   a. General: Provide indication of process liquid level with a sight gauge and gauge-glass protector, as shown.
   b. Liquid-level sight gauge shall be provided with automatic means for shutting off air and water discharge in the event of gauge glass breakage.

7. Provide a stainless steel nameplate indicating the following using 5/32-inch high letters for the tank:
   a. Stored product.
   b. Year tank was completed.
   c. The nominal diameter, in inches.
   d. The nominal capacity in gallons.
   e. The design pressure, in psi.
   f. Maximum operating temperature.
   g. The name of fabrication manufacturer and Contract No. or Serial No.

8. Stainless steel nameplate shall be mounted at a suitable height from the tank bottom and at a location accessible to view from the front of the tank.

2.3 COATINGS

A. General: Coatings, including surface preparation and application, shall conform to the requirements of Section 09 91 00, Painting.

B. Exterior Coating System shall be as specified in Section 09 91 00, Painting.

C. Interior Coating System: New and Existing Ferrous Metals, Interior Surfaces of Potable Water Storage Reservoirs at Ambient Temperatures and of Greater Than 1,500 Gallon Capacity, Galvanized Metals and Non-Ferrous Metals and Exterior Surfaces of Piping; Submerged and Intermittently Submerged, including up to 4.0
feet above liquid surface; Certified per ANSI/NSF Standard 61; Moderate VOC Content, Interior:
1. Surface Preparation: In accordance with Section 09 91 00, Painting, and with manufacturer’s approved instructions for surface and atmospheric condition.
2. Primer/Finish:
   a. Generic Components:
      1) Minimum 68 percent solids, polyamidoamine epoxy or cycloaliphatic amine epoxy; 250 grams per liter VOC, maximum.
   b. Products and Manufacturers: Provide one of the following:
      1) Series V140F Pota-Pox Plus (Tnemec Company, Inc.); Carboguard 891 (The Carboline Company); Macropoxy 646 Epoxy NSF (Sherwin-Williams Company): Three coats, 5.0 to 8.0 dry mils, per coat.

2.4 LIGHTNING PROTECTION SYSTEM

A. Grounding:
   1. Conductors: Refer to Section 26 00 05, Electrical Work, for tank grounding conductor requirements.
   2. Connectors and Ground Rods: Refer to Section 26 00 05, Electrical Work, for tank grounding connectors and ground rod requirements.

PART 3 - EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the conditions under which the Work is to be installed and notify the ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. Inspect tank immediately upon delivery to Site. If damaged, notify ENGINEER and manufacturer at once.

C. Do not install damaged tanks until manufacturer-approved repairs are made to the satisfaction of the ENGINEER.

3.2 INSTALLATION

A. Install tank and equipment as shown, in complete conformance with manufacturer's instructions, recommendations, and approved Shop Drawings.
B. Provide concrete footings beneath tank as required by the tank manufacturer and as shown. Inspect the footings for proper elevation and dimensions, and correct if necessary.

3.3 CLEANING AND DISINFECTION

A. Remove all debris from tank bottoms. Vacuum bottom clean with shop vacuum and dry thoroughly prior to initial filling. Remove all nozzle factory seals prior to filling.

B. Remove all debris and waste materials resulting from installation Work.

C. Disinfection:
   1. Disinfect pressure tank, piping, and all appurtenances.
   2. A suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered for acceptance by ENGINEER.
      a. Prior to disinfection, clean piping as specified and flush thoroughly.
      b. Conform to procedures described in ANSI/AWWA C651. Continuous feed method of disinfecting shall be used, unless alternative method is acceptable to ENGINEER.
   3. Water for initial flushing, testing, and disinfection will be furnished by OWNER. CONTRACTOR shall provide all temporary piping, hose, valves, appurtenances, and services required. Cost of water required for re-disinfection will be paid by CONTRACTOR to OWNER at the water utility’s standard rates.
   4. Chlorine shall be provided by CONTRACTOR.
   5. Chlorine concentration in the water entering the tank, piping, and appurtenances shall be between 50 and 100 ppm, such that a minimum residual concentration of 25 mg/l remains after a 24-hour retention period. Disinfect the piping and all related components. Repeat as necessary to provide complete disinfection.
   6. After required retention period, the chlorinated water shall be flushed to a closed drain line, unless otherwise directed by ENGINEER. Properly dispose of chlorinated water to storm sewers, ditches, or overland without adequate de-chlorination.

3.4 TESTING

A. Demonstrate to the satisfaction of the ENGINEER that the completed system meets the functional requirements as specified and as shown, and that the completed system is properly calibrated.

B. After installation of the pressure tank is complete, the CONTRACTOR shall submit to the ENGINEER an inspection report that certifies the completed pressure tank system is installed and operational (including appurtenances) in accordance with the
intention of the said tank design engineer and the requirements of the Contract Documents.

++ END OF SECTION ++
SECTION 46 33 41
CHEMICAL INJECTORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as required to furnish and install chemical injectors as shown and specified.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the chemical injector Work.

C. Related Sections:
   1. Section 40 05 05, Exposed Piping Installation.
   2. Section 40 05 31, Thermoplastic Process Pipe.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. All chemical injectors provided under this Section shall be obtained from a single supplier or manufacturer who, with the CONTRACTOR, shall assume full responsibility for the completeness of the system. The supplier or manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1.3 SUBMITTALS

A. Shop Drawing submittals shall conform with Section 01 33 00, Submittal
Procedures, and shall include the following:
1. Illustrations, specifications and engineering data including: dimensions, materials, size, corrosion resistance, and weights for equipment and appurtenances.
2. Manufacturer's installation instructions and recommendations.

B. Informational Submittals: Submit the following:
1. Warranty:
   a. Submit a copy of the Warranty.

C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
   a. Submit complete Operation and Maintenance Manuals, including, maintenance data and schedules, description of operation, and spare parts information.
   b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to insure uninterrupted progress of the Work.

B. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect materials from corrosion and deterioration in accordance with Section 01 66 00, Product Storage and Handling Requirements.

C. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.5 WARRANTY

A. Furnish manufacturer’s written three-year warranty from date of substantial completion against failure or faulty workmanship of the chemical injectors. Services during the warranty period shall include repair or replacement, and all costs related to visits to site, as necessary to remedy defects.

PART 2 - PRODUCTS

2.1 CHEMICAL INJECTORS
A. Chemical Injectors: Injector configuration shall provide for a single feed point into water line. Materials of construction of wetted components shall be compatible with chemical solution and be capable of withstanding maximum pump discharge line pressure, output capacity, and water main pressure.
   1. Concentrations of chemicals that will be injected: 10% Sodium Hypochlorite.
   2. Installation locations:
      a. Pre-Chlorination Point: Located at the raw water flow meter assembly, as shown.
      b. Post-Chlorination Point: Located on the potable water pump skid suction line, as shown.

B. Materials of construction shall be Hastelloy C 276 for 10% Sodium Hypochlorite. Injector tube shall be sized to match chemical feed line.

C. Water Main Connection: Threaded corporation stop connection shall be NPT or AWWA inlet and capable of withstanding maximum water main pressure of 150 psi. The injector assembly must withstand a maximum operating pressure of 150 psi and shall be manufactured by Saf-T-Flo, or approved equal.

D. A stainless steel safety chain shall be included to prevent accidental withdrawal of solution tube past corporation stop. Safety chain length shall be preset by manufacturer. Operator shall be able to safely withdraw or insert injector tube into center of water main while under pressure and without having to shut down the main. Injector shall allow for rodding in place.

E. Flexible hose shall be clear, reinforced polypropylene tubing capable of a burst pressure of 200 psi.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspect all chemical injectors and appurtenances prior to installation. Do not install damaged equipment until repairs are made in accordance with manufacturer’s written instructions.

B. Installation of the chemical injectors and appurtenances shall be in accordance with the Drawings and with the manufacturer’s instructions and recommendations.
3.2 MANUFACTURER'S FIELD SERVICES

A. A factory trained manufacturer’s representative shall be provided to ensure that installation of the chemical injectors complies with manufacturer's recommendations and requirements. The representative shall make a minimum of one visit, minimum two hours on-Site for verifying the completed installation and that the equipment conforms to the specification requirements. Representative shall visit the site as often as necessary until all trouble is corrected and the equipment or system is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, shall be at no cost to the OWNER.

++ END OF SECTION ++
PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment, tools, and incidentals required to furnish, install, test, and place into satisfactory operation, duplex dual discharge sodium hypochlorite peristaltic metering pump skid complete and operational with pumps, motors, drives, control panel, control equipment, and appurtenances as shown and specified herein.

B. Coordination:
1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before peristaltic metering pump skid Work.

C. Related Sections:
1. Section 03 00 05, Concrete.
2. Section 05 05 33, Anchor Systems.
3. Section 09 91 00, Painting.
4. Section 26 00 05, Electrical Work.
5. Section 40 24 33, Chlorine Piping, Valves, and Specials.
6. Section 40 60 05, Instrumentation and Control for Process Systems.
7. Section 40 61 96, Process Control Descriptions.

1.2 REFERENCES

A. Standards referenced in this Section are:
4. API 675, Positive Displacement Pumps Controlled Volume.
6. Institute of Electrical and Electronics Engineers (IEEE).
8. National Sanitation Foundation (NSF).
1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have minimum of five years experience producing substantially similar equipment to that required and shall be able to document of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain all materials and equipment included in this Section regardless of component manufacturer, from a single peristaltic metering pump skid Supplier.
   2. Peristaltic metering pump skid Supplier shall review and approve or prepare all Shop Drawings and other submittals for components furnished under this Section.
   3. Materials and equipment shall be fully compatible with specified service conditions, and shall be integrated into overall skid assembly by peristaltic metering pump skid Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Complete layout and installation drawings for overall skid assembly, individual components, showing mounting details, dimensions, fitting locations, and materials of construction.
      b. Schematics, wiring diagrams, and installation details.
      c. Drawings of control panels in accordance with Section 40 60 05, Instrumentation and Control for Process Systems.
   2. Product Data:
      a. Complete product data for each size and type of pump, motor, and accessories, including manufacturer’s brochure, specifications, weight, performance data, turndown, and capacity.

B. Informational Submittals: Submit the following:
   1. Manufacturer’s Instructions:
      a. Setting drawings, templates, and directions for installing anchor bolts and other anchorage devices.
      b. Instructions for handling, storing, and installing equipment.
   2. Source Quality Control Submittals:
      a. Results of source quality control tests and inspections.
   3. Site Quality Control Submittals:
      a. Results of field quality control tests.
   4. Warranty:
C. Closeout Submittals:
   1. Operation and Maintenance Data: Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operations and Maintenance Data.
   2. Spare Parts, Extra Stock Materials, and Tools:
      a. Furnish the following for each type and size of pump furnished:
         1) One spare metering pump.
         2) One 50-inch roll of tubing for each chemical application.
         3) Two complete sets of special tools required for normal maintenance and operation.
         4) Required control panel spare parts, per Section 40 60 05, Instrumentation and Control for Process Systems.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
   2. Inspect all boxes, crates, and packages upon delivery to the Site and notify ENGINEER in writing of loss or damage to products. Promptly remedy loss and damage to new condition in accordance with manufacturer’s instructions.
   3. Conform to Section 01 65 00, Product Delivery Requirements.
   4. Deliver the peristaltic metering pump skid system completely assembled, tested, and ready for installation.

B. Storage and Protection:
   1. Keep materials and equipment off ground using pallets, platforms, or other supports. Protect steel, packaged materials, and electronics from corrosion and deterioration.
   2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

1.6 WARRANTY

A. Provide manufacturer’s written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace materials and equipment specified in this Section found to be defective during a period of two years after date of authorized startup.

PART 2 – PRODUCTS

2.1 SERVICE CONDITIONS
A. General:
1. All wetted surfaces of skids, metering pumps and appurtenances, and all sealing gaskets shall be suitable for continuous exposure to the sodium hypochlorite (10 percent solution) and shall be NSF or food grade approved.
2. Piping, valves and appurtenances not specified herein shall meet the requirements of Section 40 24 33, Chlorine Piping, Valves, and Specials.

2.2 EQUIPMENT PERFORMANCE AND CONSTRUCTION

A. Skid System:
1. Provide a duplex, dual discharge, skid mounted chemical metering pump system complete with skid assembly, chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. Components of each of the skid systems shall include the following items:
   a. Peristaltic metering pumps
   b. Pump motors
   c. Hose leak sensor
   d. Calibration column
   e. Pressure gauges
   f. Ball valves
   g. Pressure relief valves
   h. Control panel
   i. Controls
   j. All piping, valves, gaskets, supports, hardware, wiring, junction boxes, and accessories necessary for a fully functioning skid. Piping shall be terminated within 2 inches from the edge of skid. Electrical cables shall terminate in the control panel.
2. The skid shall be constructed of chemical resistant (10 percent sodium hypochlorite) materials such as PVC, polypropylene, polyethylene or approved equal.
3. Non-metallic, chemical and corrosion-resistant pipe supports and clips shall be used to secure the piping to the skid.
4. Unions shall have Viton o-rings and shall allow for easy maintenance of the system.
5. All connections within the feed system shall be quick connect, socket or flanged. Threaded connections are unacceptable.
6. All piping shall be Schedule 80 PVC and assembly shall be performed by the peristaltic metering pump skid Supplier.
7. All valves shall be PVC true union vented ball valves with Viton type “O” rings.
8. Each skid shall be completely assembled and tested by the Supplier prior to delivery to the job site.
9. Skid shall include provision to capture leakage with a means to drain to a container. Leak capture provision shall be molded or welded together; use of screws or silicone is not acceptable.

10. The skid shall include a back panel, suitable for the specified chemical service and shall be mountable to wall and concrete pad. Mounting hardware and installation shall be supplied by the CONTRACTOR and shall meet the requirements of Section 05 05 33, Anchor Systems.

11. All wiring on the skid shall be performed prior to shipping and shall terminate in a NEMA 4X junction box located on the skid. Terminals shall be provided in the junction box for all connections between the remote control panel and the junction box.

B. Peristaltic Metering Pump Skid Supplier: Provide a skid system from one of following:
   2. Tuff Skid.
   3. Or approved equal.

C. Metering Pumps:
   1. Provide skid-mounted peristaltic metering pumps, complete with pump head, flexible extruded tube, and integral variable speed drive.
   2. Provide equipment compatible with specified service conditions:

<table>
<thead>
<tr>
<th>Service Conditions</th>
<th>Pre and Post-Chlorination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Required</td>
<td>2</td>
</tr>
<tr>
<td>Service (Chemical and % Solution)</td>
<td>10% Sodium Hypochlorite</td>
</tr>
<tr>
<td>Skid Configuration</td>
<td>Duplex, Dual Discharge</td>
</tr>
<tr>
<td>Specific Gravity of Pumped Fluid at 60 degrees F</td>
<td>1.17</td>
</tr>
<tr>
<td>pH of Pumped Fluid</td>
<td>13</td>
</tr>
<tr>
<td>Temperature Range of Pumped Fluid (degrees F)</td>
<td>35 – 100</td>
</tr>
<tr>
<td>Minimum Flow Rate (gallons per hour)</td>
<td>0.15</td>
</tr>
<tr>
<td>Maximum Flow Rate (gallons per hour)</td>
<td>1.10</td>
</tr>
<tr>
<td>Design Discharge Pressure (psi)</td>
<td>55</td>
</tr>
<tr>
<td>Pump Speed Range (rpm)</td>
<td>0.1 to 125</td>
</tr>
<tr>
<td>Motor Size (hp)</td>
<td>0.25</td>
</tr>
</tbody>
</table>

3. Process fluid shall only be in contact with the inside of the pump hose.
4. All wetted components shall meet NSF Standard 61 requirements.
5. Pump shall be capable of self priming and have a suction lift capability of 30 ft. of water.
6. Pump shall be capable of running dry without damage to pump or hose.
7. Connect hose to PVC pipe using barbed couplings with stainless steel hose clamps.
8. Leak sensor installed in the pump housing to be wired to pump skid control panel for leak indication and metering pump shutdown.
9. Metering pump Products and Manufacturers: Provide one of the following:
   b. Flex-Pro Model M-3, manufactured by Blue-White Industries.
   c. Or approved equal.

D. Pump Head:
1. Pump head shall consist of either a fixed track with hinged or removable guard door or front cover, adjustable tube retainer mechanism, and roller rotor assembly, or, an easily replaceable modular pump head.
2. Tubing or pump head shall be replaceable without disassembly and without using tools.
3. Capable of delivering continuous discharge pressure specified in table in Article 2.2 of this Section.
4. Rotor shall be capable of rotating in either direction without damaging pump or tubing.
5. Pump shall not require use of check valves or dynamic seals in contact with pumped fluid.
6. Pump head shall include leak detection sensor which shall shut down system immediately in the event of a leak or tube failure. Sensor shall not contact pumped fluid.
7. Speed Adjustment:
   a. Two modes: manual scale with zero to 100 percent scale indication, and automatic via remote 4-20 mA DC signal.
   b. Adjustment shall be possible while pump is operating.
   c. Infinitely-variable to meet or exceed minimum-to-maximum flow range specified in table in Article 2.2.
8. Pump drive shall be completely contained within integral enclosure, complete with brackets, supports, fasteners, and appurtenances suitable for mounting. Enclosure finish shall provide long-term protection from environmental conditions and from direct contact with sodium hypochlorite. Unpainted enclosures are not acceptable. Each pump shall have stainless steel nameplate with manufacturer name, model, serial number, rating, range, speed, and other pertinent data.

E. Tubing:
1. During normal operation, tubing’s inner wall shall be the only surface in contact with pumped fluid.
2. Tubing shall be extruded from material compatible with pumped fluid, and shall meet NSF Standard 61 requirements.
F. Drive:
1. Drive motors shall be variable speed, brushless DC with integral gearbox.
2. Circuitry shall be microprocessor-controlled with pulse width modulation, and with temperature- and load-compensation and protection.
3. Drive Speed: Infinitely variable to meet or exceed associated pump speed range specified in table in Article 2.2.
4. Drive Enclosure: NEMA 4X, compatible with the specified chemical service.
5. Rating: Continuous 24-hour per day operation, 40 degrees C ambient temperature.
7. Controls shall have manual override. Provide interface for the following signals:
   a. Analog Input:
      1) 4-20 mA DC (250 ohms) speed reference signal with surge arrestor for each metering pump.
      2) Provisions for alternative remote accessory potentiometer for speed control for each metering pump. Provide potentiometers on the metering pump skid control panel for manual override of each pump.
   b. Analog Output: 4-20 mA DC (250 ohms) pump speed signal.
   d. Digital Output (dry contact closure, rated five amps at 250 volts AC): Stop/run status, and tube monitor alarm status signals.
   e. Fluid level monitor: Programmable flow totalization to alert operator when supply tank is low.
8. Minimum requirements for operator interface functionality:
   a. Backlit graphical liquid crystal display (LCD) capable of up to four lines of text with 16 characters per line to display pump speed, running status, flow rate, and programming instructions.
   b. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
   c. Menu-driven, on-screen programming of manual or auto control, flow, and remote signal calibration, and general programming.
   d. Programmable “Auto Restart” feature to resume pump status after power outage.
   e. Programmable “Keypad Lock” to allow operator lockout of all keys except emergency start/stop.
   f. Programmable “Maximum Speed” to allow operator to set maximum speed of pump.
G. Calibration Columns:
1. Construction: Transparent, clear tube. Calibration columns must have an inlet port (bottom) and outlet port (top) that can be connected to piping via threaded or solvent welded joints.
2. Calibration columns shall be calibrated in gallons.
3. Provide ball-type PVC isolation valve at pump inlet port.
4. Size calibration columns to provide at least 30 seconds of storage at maximum rated pump flow.

H. Pressure Relief Valves:
1. Conform to the requirements of Section 40 24 33, Chlorine Piping, Valves, and Specials.
2. Size relief valves for each specific application.
3. Valves shall be field-adjustable without removing from piping, and shall initially be set ten psi higher than design discharge pressure of the associated pumps.
4. Pressure relief valve material shall be compatible with pumped fluid and piping system material.

I. Piping, Valves and Appurtenances:
1. Skid piping shall be Schedule 80 PVC with socket or flanged ends. Cement shall be Weld-on 724.
2. Vented, true-union ball valves shall be utilized. Isolation valves shall be provided at all equipment connections including connections to bulk storage tanks. Seals shall be compatible with the chemical being pumped.
3. Unions shall have socket ends, Viton O-rings and shall be Schedule 80 PVC.
4. Provide flanges for connection to Schedule 80 PVC suction and discharge piping as shown on the Drawings.
5. A cross connection shall be provided with a ball valve between the pre-chlorination pump and post-chlorination pump discharge lines.
6. Conform to the requirements of Section 40 24 33, Chlorine Piping, Valves, and Specials.

J. Peristaltic Metering Pump Skid Control Panel:
1. Provide a control panel for the metering pump system.
2. Panel construction shall be non-metallic NEMA 4X and shall conform to Section 40 60 05, Instrumentation and Control for Process Systems.
3. Provide 120 volt, single-phase, 60 Hertz power feeder to control panel. Include main disconnect, transformer(s), common terminal strip, and circuit breaker load center for all 120-volt panel power requirements.
4. A corrosion-resistant electrical receptacle with weatherproof in-use cover shall be provided for the metering pumps.
5. The inside cover of the terminal box shall include a wiring diagram detailing the function of all terminals.

7. When in Auto, the pumps shall be designed to accept an isolated, normally open, maintained contact, for remote control. Manual pump speed from 0-100 percent with adjustment during pump hand operation.
   a) Hose monitoring status: Leak detection on each metering pump.

8. Provide pump control panel per specification Section 40 60 05, Instrumentation and Control for Process Systems Skid Panel:
   a) Provide disconnect and the following contacts and pilot devices: (All lights to be LED type).
      1) Start/Stop.
      2) Run.
      3) Fail.
      4) Not in Auto.
   b) Provide the following pilot devices and functions in the control panel for the Pre-Chlorination pump:
      1) Run with input from raw water flow meter.
      2) Off with input from raw water flow meter (no flow).
      3) Common Fail with output to Autodialer.
      4) Hand-Off-Auto.
      5) Speed Potentiometer – local to panel.
      6) Speed indication.
      7) Speed adjustment based on raw water flow meter analog signal.
   c) Provide the following pilot devices and functions in control panel for Post-Chlorination pump:
      1) Run with input from distribution pressure switch low.
      2) Off with input from distribution pressure switch high.
      3) Common Fail with output to Autodialer.
      4) H-O-A.
      5) Speed Potentiometer – local to panel.
      6) Speed indication.
      7) Speed adjustment based on chlorine residual analyzer analog signal.
   d) Panel shall be capable of accepting hardwired control signals to and from the flow meter, distribution pressure switches and chlorine residual analyzer.
   e) Provide all pump status indications and setpoint control.

9. The control panel shall use relay logic for the following:
   a) Automatic pacing of the pre-chlorination metering pump based on raw water flow.
   b) Automatic pacing of the post-chlorination metering pump based on the chlorine residual analyzer, along with the distribution pressure switch for start/stop of the post chlorination metering pump.

10. All pilot devices for status and control, as shown and as specified in Section 40 60 05, Instrumentation and Control for Process Systems, shall be mounted
on hinged front doors of control panel. Nameplate legend for pilot devices shall be as shown on the drawings and as specified in this Section.

2.3 FINISHING

A. Shop Painting:
   1. Equipment shall receive manufacturer's standard finish paint system, resistant to the specified chemical service, applied prior to shipment.
   2. Apply in the shop, primer coating to metallic parts (excluding exempt surfaces, described below) of pumps, motors, drives, frames, supports, and appurtenances.
   3. Do not paint corrosion-resistant parts such as plastic, fiberglass, and stainless steel.
   4. Gears, bearing surfaces, machined surfaces, and other surfaces that are to remain unpainted shall receive heavy application of grease or other rust-resistant coating. Maintain coating during storage and until equipment is placed into operation.

2.4 SOURCE QUALITY CONTROL

A. Metering Pump Skid: Test the complete peristaltic metering pump skid in the shop as follows:
   2. Inspect all components prior to and during shop testing.
   3. Capacity/head tests, including pump’s rated design point, at shutoff, and at maximum flow.
   4. Verify operation in all operating modes.
   5. Inspect control components and panels for defects.
   6. Perform manufacturer’s standard quality tests for control panel and equipment.
   7. Inspect valves and appurtenances for defects.
   8. Perform manufacturer’s standard quality tests for valves and appurtenances.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which products are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. Install materials and equipment in conformance with Laws and Regulations, applicable standards, manufacturer’s instructions and recommendations, and the Contract Documents.

B. Anchorages and Base Plates:
   1. Provide anchorages in new or existing concrete, as applicable, in accordance with equipment manufacturer’s recommendations and with Section 05 05 33, Anchor Systems.
   2. Where used, pour concrete bases up to one inch below equipment base or support leg as applicable. Base with equipment mounted thereon shall then be accurately shimmed to grade and spaces between filled with non-shrink grout in accordance with Section 03 00 05, Concrete. After grout has reached its initial set, neatly cut back exposed edges 1/2-inch.

C. General:
   1. Perform drilling and fitting required for installation. Set equipment accurately in location, alignment, and elevation, plumb, true, and free of rack.
   2. Making plate cutouts or openings at the Site is not allowed.
   3. Fit exposed connections accurately together to form tight hairline joints.
   4. Provide utility connections in accordance with the Contract Documents.
   5. Align and adjust equipment including motors, belts, drives, support stands, and appurtenances in presence of ENGINEER.
   6. Prior to energizing electric motor drive equipment, rotate drive motor by an external source to demonstrate free operation of all mechanical parts. Do not energize equipment until safety devices are installed, connected, and functional.

D. Conform to Section 01 75 11, Checkout and Startup Procedures.

3.3 FIELD QUALITY CONTROL

A. Site Tests:
   1. Following installation, CONTRACTOR and qualified field service representative of Supplier shall conduct operating tests of all equipment, functions, and controls at the Site in presence of ENGINEER.
   2. Comply with Section 01 79 13, System and Facility Performance Testing Procedures.
   3. Field Operating Test:
      a. Field test equipment and its controls in local mode, followed by demonstrating proper operation and controls in automatic mode. Demonstrate that each part individually and all parts together function properly in manner intended. All testing equipment and labor shall be by CONTRACTOR.
b. Should tests result in malfunction, make necessary repairs, revisions, and adjustments and restart test from the beginning. Repeat tests and repairs, revisions, and adjustments until, in opinion of ENGINEER, installation is complete and equipment is functioning properly and accurately, and is ready for permanent operation.

B. Manufacturer’s Services: Provide a qualified, factory-trained serviceman to perform the following:

1. Inspect, calibrate, adjust, and test equipment after installation and ensure proper operation. Prior to initial start-up, a signed written statement shall be provided by the equipment supplier or manufacturer stating the equipment has been installed by the CONTRACTOR in accordance with the Drawings, Specifications and equipment supplier’s or manufacturer’s shop drawings and is ready to be placed into operation.

2. Training: Furnish services of Supplier’s qualified factory trained specialists to instruct OWNER’s operations and maintenance personnel in recommended operation and maintenance of materials and equipment. Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01 79 23, Instruction of Operations and Maintenance Personnel.

3. Manufacturer’s representative shall make a minimum of 2 visits, with minimum of 4 hours at the Site for each visit. First visit shall be for checking, adjusting, and calibrating completed installation and starting up the system; second visit shall be to instruct operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.

4. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.
PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install submersible tank mixing equipment complete and operational.
   2. Included are mixer units, motors, drives, power cords, retrieval mechanisms, junction boxes, local control stations, mounting hardware, and all appurtenances.
   3. Extent of the equipment is shown on Schedule of Service Conditions contained in Part 2 of this Section.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the submersible tank mixing equipment Work.

C. Related Sections:
   1. Section 26 00 05, Electrical Work.
   2. Section 40 60 05, Instrumentation and Control for Process Systems.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
      a. AWS D1.1/D1.1M, Structural Welding Code-Steel.
   6. Institute of Electrical and Electronics Engineers, (IEEE).
1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:
   1. Manufacturer shall have a minimum of five years experience producing
      substantially similar equipment and shall be able to show evidence of at least
      five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component
      manufacturer from a single submersible tank mixing equipment manufacturer.
   2. The submersible tank mixing equipment manufacturer to review and approve
      or to prepare all Shop Drawings and other submittals for all components
      furnished under this specification.
   3. All components shall be specifically constructed for the specified service
      conditions and shall be integrated into the overall assembly by the
      CONTRACTOR and submersible tank mixing equipment manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Manufacturer's literature, data sheets, fabrication, assembly and mounting
         drawings of the following components showing materials of construction,
         and significant dimensions in sufficient detail to demonstrate compliance
         with specified requirements.
         1) Mixer Unit.
         2) Motor.
         3) Electrical Information:
            a) Local control station.
            b) Wiring diagrams showing all electrical connections to the motor
               and controls.
         4) All other components of submersible tank mixing equipment as
            appropriate, including setting drawings and instructions for installation
            of mounting appurtenances or tank penetrations, including tolerances.

B. Informational Submittals: Submit the following:
   1. Support Design Information:
      a. Weight of the complete assembly.
   2. Quality Control Submittals:
      a. Submit a written report giving the results of required field tests.
   3. A copy of the manufacturer’s warranty statement.

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Manuals:
a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 78 23, Operation and Maintenance Data.

D. Maintenance Material Submittals: Furnish the following:
   1. Tools:
      a. Furnish all required special tools as specified in Part 2 of this specification.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer’s instructions.

1.6 WARRANTY

A. Provide manufacturer’s written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace materials and equipment specified in this Section found to be defective during a period of three years after date of authorized startup.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. Description:
   1. Mixer shall be submersible type, intended for continuous use in a potable water storage tank. Mixer shall be capable of continuous operation regardless of tank
drain and fill cycles. Mixer shall be able to be raised and lowered and shall be able to be removed from a ground storage tank for inspection or service without the need for personnel to enter the tank.

B. Performance Criteria:
   1. Schedule of Service Conditions:
      a. Location: Ground Storage Tank.
      c. Total Number of Units: One.
      d. Power Source: 120 VAC.
      e. Operation: Continuous, 24/7 operation.
      f. Maximum Opening Required: 12-inch.

2.2 MANUFACTURERS

A. Manufacturers: Provide equipment of one of the following:
   2. PWM100, by PAX Water Technologies.
   3. Or approved equal.

2.3 DETAILS OF CONSTRUCTION

A. Mixer:
   1. Submersible tank mixer shall be of Type 316 stainless steel construction, with NSF-approved wetted components for potable water service.
   2. Provide a submersible mixer able to completely mix the contents of the GST (up to 0.5 million gallons):
      a. During continuous mixer operation, all chlorine concentrations within the tank shall converge to within 0.4 mg/L at least once every 72 hours.
      b. During continuous mixer operation, all temperatures within the tank shall converge to within 0.8 deg C at least once every 24 hours.
   3. Upon request, manufacturer shall be able to provide Computational Fluid Dynamics modeling demonstrating that the mixer can provide complete tank mixing within the specified time period.

B. Motor:
   1. Motors shall of Type 316 stainless steel construction, with a watertight chamber designed for submersible operation.
   2. Motors shall be rated for operation on either a 120 volt AC, single phase, 60 Hz supply.
   3. Provide motor of proper size to drive the mixer continuously without overheating or compromising the motor life expectancy.
   4. Motors shall have a 1.15 service factor, and shall comply with the latest ANSI, NEMA, ABMA and IEEE Standards as a minimum.
5. All required seals shall be suitable for use in chlorinated water.

C. Power Cable:
   1. Provide submersible, Type SPC cable (power plus ground plus control), UL listed and labeled. No splices will be allowed in the cable.
   2. Size conductors in accordance with NEC Standards.
   3. Power cable shall be of sufficient length to provide adequate slack when mixer is placed on tank floor. Length of proposed cable shall be submitted for approval.

D. Removal Mechanism:
   1. Provide a lifting system, retrieval chain, or other means for lifting the mixer from the tank.
   2. All chains, cables, or other removal mechanism components shall be of stainless steel construction.

E. Local Control Station:
   1. CONTRACTOR shall furnish a local control station for the mixing system:
      a. Control station construction shall be NEMA 4X, conforming to the applicable requirements of Section 40 60 05, Instrumentation and Control for Process Systems.
      b. Furnish a 120 volt, single phase, 60 Hz power feeder to the local control station. Local control station shall be ready to be hard-wired to the 120 volt source.
      c. Operation: Mixer motor shall be started at the local control station from an “ON/OFF” selector switch.
         1) In the “ON” mode, the mixer shall run continuously.
         2) Provide an indication light showing motor “RUN” status.
      d. Manufacturer to furnish a junction box to be installed by CONTRACTOR at the tank access hatch, as shown.

2.4 MOUNTING HARDWARE

A. Furnish all hardware required to mount any ancillary mixer components, including, but not limited to, lifting mechanisms, control/junction boxes, tank/hatch penetrations, cables, and/or any other required equipment, as sized by the equipment manufacturer.

B. Mounting hardware shall be constructed of stainless steel.

2.5 TOOLS AND SPARE PARTS

A. Spare Parts:
   1. Submersible Mixer Unit shall not require any spare parts or maintenance.
B. Each mixer shall be furnished with the following tools:
   1. Two sets of any special tools required for removal of mixing unit from the
      storage tank.

2.6 SOURCE QUALITY CONTROL

A. Mixing system shall be tested prior to deployment at the manufacturer’s factory
   testing facilities:
   1. Perform a motor and cable insulation test for moisture content or insulation
      defects.
   2. Prior to submergence, run the unit dry to establish correct rotation and
      mechanical integrity.
   3. Run the mixer for 30 minutes submerged.
   4. After initial operating test, stop motor and wait 30 minutes while still
      submerged, then perform the insulation test again with the motor still
      submerged.
   5. Each test shall be witnessed by a Registered Professional Engineer, who may
      be an employee of the manufacturer. The Registered Professional Engineer
      shall sign and seal the required tests were performed. The test results shall
      show the serial numbers of all equipment tested.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspection:
   1. Inspect and verify that structures or surfaces on which equipment will be
      installed have no defects which will adversely affect installation.
   2. Inspect all equipment prior to installation.
   3. Promptly report defects which may affect Work to ENGINEER.

3.2 INSTALLATION

A. General: Install in a manner and to the tolerances recommended by the equipment
   manufacturer and approved Shop Drawings.

B. Install motor cable entry penetration at the tank hatch as shown. Cable entry point
   shall include a weather tight seal to be approved during shop drawing review process.
3.3 START-UP AND FIELD TEST

A. Perform operating tests to demonstrate that the equipment operates to the satisfaction of the OWNER. Make adjustments required to place equipment in proper operating condition.

3.4 FIELD QUALITY CONTROL

A. All equipment will be given running tests by CONTRACTOR at the job Site, in the presence of the ENGINEER, following installation of the equipment and controls. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments. Such tests and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

++ END OF SECTION ++