Project Manual

CONSTRUCTION ISSUE

Washoe County
Department of Water Resources
Cold Springs Water Reclamation
Facility Expansion

Washoe County PWP-WA-2004-252

Bid Issue May 2004
Construction Issue August 2004

KJ Design 037012.10  KJ Construction 037012.12
Kennedy/Jenks Consultants
Cold Springs Water Reclamation Facility Expansion

PROJECT MANUAL
INCLUDING SPECIFICATIONS

FOR
WASHOE COUNTY
DEPARTMENT OF WATER RESOURCES
COLD SPRINGS WATER RECLAMATION FACILITY EXPANSION

Washoe County PWP-WA-2004-252

Issued May 2004

Prepared by:
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K/J 037012.10
WASHOE COUNTY
DEPARTMENT OF WATER RESOURCES
COLD SPRINGS WATER RECLAMATION FACILITY EXPANSION
PROJECT MANUAL

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FINAL
January 2004
037012.10
© Kennedy/Jenks Consultants 2004
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BIDDING REQUIREMENTS AND CONTRACT DOCUMENTS

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NOTICE TO CONTRACTORS

1. Sealed proposals will be received in the Washoe County Office of the Department of Water Resources, 4930 Energy Way (P.O. Box 11130) Reno, Nevada 89502 until 10:00 a.m. on June 22, 2004 for the Cold Springs Water Reclamation Facility Expansion. (Such sealed proposals will then be opened publicly at the Department of Water Resources at 4930 Energy Way, Reno, Nevada.)

2. The work shall consist of all work shown or described in the Contract Documents to construct, connect, start up, and place into operation the Cold Springs Water Reclamation Facility Expansion.

3. No proposal will be considered unless accompanied by cash, cashiers check, certified check, or bid bond, in an amount equal to five percent (5%) of the bid, made payable to the Washoe County Treasurer as provided for in the General Provisions.

4. Plans and Specifications with Bid Forms are available for public inspection and may be secured at the Washoe County Department of Water Resources, 4930 Energy Way, Reno, Nevada by prospective bidders, holding a valid State Contractor's License for the type and amount of work specified herein. Contractor must be qualified pursuant to NRS 338.1379 to bid on the contract or must be exempt from meeting such qualifications pursuant to NRS 338.1383.

5. There shall be a nonrefundable deposit of $110 for each set of Plans and Specifications.

6. The project Plans and Specifications refer to the "Standard Specifications for Public Works Construction", copies of which are available from the Regional Transportation Commission, 2050 Villanova Drive, Reno, Nevada for $30.00 per copy.

7. Attention of the Bidder is particularly called to the nondiscrimination provisions of NRS 338.125 and the Veteran's Preference provisions of NRS 338.130 as both are set forth in the Agreement. In addition, if the contract sum is $100,000 or more, then the Contractor is required to pay prevailing wages for the work hereunder. Copies of the prevailing wage rates are available at the Department of Water Resources.

8. A pre-bid conference will be conducted at Washoe County Department of Water Resources 10:00 a.m. on June 8, 2004. The conference will be held at the offices of the Washoe County Department of Water Resources, 4930 Energy Way, Reno, Nevada. A site visit will follow the pre-bid conference. The pre-bid meeting is not mandatory.

9. The following attachments are statements regarding CWSRF funded projects.
STATEMENTS FOR CWSRF FUNDED PROJECTS:
(See following pages)
Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246)

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

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

Economic Area

Nevada:

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

Non-SMSA Counties ........................................ 12.6
   Esmeralda, Lincoln, Nye.

164 Reno, NV:
SMSA Counties:
   6720 Reno, NV ........................................ 8.2
   Washoe

Non-SMSA Counties ........................................ 9.2
   Churchill; Douglas; Elko; Eureka; Humboldt; Lander;
   Lyon; Mineral; Pershing; Storey; White Pine; Carson City.

The goal for female utilization is 6.9% statewide.

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

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in
each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority of female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR 60.4. compliance with the goals will be measured against the total work hours performed.

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

As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is:

<table>
<thead>
<tr>
<th>City (Town)</th>
<th>Cold Springs</th>
</tr>
</thead>
<tbody>
<tr>
<td>County</td>
<td>Washoe</td>
</tr>
<tr>
<td>State</td>
<td>Nevada</td>
</tr>
</tbody>
</table>
It is EPA policy to award a fair share of subagreements to small, minority, and women's businesses. The recipient must take affirmative steps to assure that small, minority, and women's businesses are used when possible as sources of supplies, construction and services. Affirmative steps shall include the following:

1. Including qualified small, minority, and women's businesses on solicitation lists.
2. Assuring that small, minority, and women's businesses are solicited whenever they are potential sources.
3. Dividing total requirements, when economically feasible, into small tasks or quantities to permit maximum participation of small, minority, and women's businesses.
4. Establishing delivery schedules, where the requirements of the work permit, which will encourage participation by small, minority, and women's businesses.
5. Using the services and assistance of the Nevada Commission on Economic Development, Procurement Outreach Programs and the Las Vegas Minority Businesses Development Center.
6. If the contractor awards subagreements, requiring the contractor to take the affirmative steps in paragraphs (a) (1) through (a) (5) of this section.

Contact Rock Stacy at NDOT for a current listing of MBE/WBE Firms.
Cold Springs Water Reclamation Facility Expansion

PROPOSAL - SCHEDULE OF ITEMS AND PRICES

Washoe County
Department of Water Resources
4930 Energy Way
Reno, NV 89502

Gentlemen:

I (we) hereby submit my (our) proposal for Cold Springs Water Reclamation Facility Expansion (PWP-WA-2004-252).

Having carefully examined the contract documents as described in the Agreement form, together with addenda numbered 1, 2, 3, 4 and having examined all the conditions affecting the work, the undersigned proposes to furnish all labor, materials, tools and equipment called for by said documents and to contract for completion of the work as listed in the following Bid Proposal and to comply with all conditions of the Contract Documents.

I. Award of the Project will be made on a Lump Sum Basis. Major equipment, as listed on Table 300-1 (Major Equipment) and specified in Divisions 11 and 14 has been selected to serve as the basis of design for this project and must be used to formulate an acceptable Bid. The Bidder's Lump Sum Bid Price shall reflect the cost to construct the project using equipment explicitly named in the Specifications per items A through C below:

A. The Bidder shall use only specifically named Major Equipment Items as the basis of the Lump Sum Bid Price. Major Equipment pieces are listed on Table 300-1 (Major Equipment).

B. The Bidder shall use the price pre-listed on Table 300-1 (Major Equipment) for the Fine Screen, the Scum Pump, the Utility Water Supply System and the Submersible Wastewater Pumps to formulate the Lump Sum Bid Price. The named equipment supplier has provided these prices. The Owner has selected these specific pieces of equipment based on exclusive features or to match existing equipment at the facility. In these cases, no equals will be accepted. It is the contractor's responsibility to ensure that the equipment offered at the pre-listed price meets all requirements for equipment and appurtenances as shown on the drawings or called out in the specification. If additional equipment is required for a complete system, it is the contractor's responsibility to provide these items as part of his installation cost for these items.

C. The Bidder is requested to include a price for an alternate fine screen (see Section 11330 for named alternate fine screens) in the space provided on Table 300-2 (Alternate Equipment). The option to use the alternate equipment may be exercised after the award of bid is made. The contractor's cost for this item will not affect the Lump Sum Bid Price.
## Table 300-1: Major Equipment Schedule

### Section 11330
**Description:** Fine Screen

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>HYCOR</td>
<td>HCL</td>
<td>$77,550</td>
</tr>
<tr>
<td>B</td>
<td>No Equal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Section 11320
**Description:** Grit Removal (grit removal and grit separation system)

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Smith and Loveless</td>
<td>Pista Grit</td>
<td>$51,416</td>
</tr>
<tr>
<td>B</td>
<td>Lakeside</td>
<td>SpiraGrit</td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td>WesTech</td>
<td>GVR</td>
<td>$</td>
</tr>
</tbody>
</table>

### Section 11305
**Description:** Scum Pump

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Vaughn</td>
<td>V3FR-062</td>
<td>$15,200</td>
</tr>
<tr>
<td>B</td>
<td>No Equal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Section 11375
**Description:** Oxidation Ditch Equipment

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Lakeside, Inc.</td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td>Passavant, US Filter</td>
<td>M52</td>
<td>$129,000</td>
</tr>
</tbody>
</table>

### Section 11336
**Description:** Secondary Clarifier Equipment (for both clarifiers)

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Envirotech US Filter</td>
<td>Tow-Bro</td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td>Elmaco</td>
<td>Type C3D</td>
<td>$162,700</td>
</tr>
<tr>
<td>C</td>
<td>WesTech Engineering Inc.</td>
<td>CLC Series</td>
<td>$</td>
</tr>
</tbody>
</table>
### Table 300-1: Major Equipment Schedule

#### Section 11330
**Description:** Fine Screen

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>HYCOR</td>
<td>HCL</td>
<td>$77,550</td>
</tr>
<tr>
<td>B</td>
<td>No Equal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Section 11320
**Description:** Grit Removal (grit removal and grit separation system)

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>Smith and Loveless</td>
<td>Pista Grit</td>
<td>$51,916</td>
</tr>
<tr>
<td>B</td>
<td>Lakeside</td>
<td>SpiraGrit</td>
<td>$</td>
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<tr>
<td>C</td>
<td>WesTech</td>
<td>GVR</td>
<td>$</td>
</tr>
</tbody>
</table>

#### Section 11305
**Description:** Scum Pump

<table>
<thead>
<tr>
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<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>Vaughn</td>
<td>V3FR-062</td>
<td>$15,200</td>
</tr>
<tr>
<td>B</td>
<td>No Equal</td>
<td></td>
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#### Section 11375
**Description:** Oxidation Ditch Equipment

<table>
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<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Amount Bid (a)</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>Lakeside, Inc.</td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td>Passavant, US Filter</td>
<td>$129,000</td>
</tr>
</tbody>
</table>

#### Section 11336
**Description:** Secondary Clarifier Equipment (for both clarifiers)

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Envirex US Filter</td>
<td>Tow-Bro</td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td>Elmac</td>
<td>Type C3D</td>
<td>$121,500</td>
</tr>
<tr>
<td>C</td>
<td>WesTech Engineering Inc.</td>
<td>CLC Series</td>
<td>$</td>
</tr>
</tbody>
</table>
Table 300-1: Major Equipment Schedule (cont).

### Section 11310A
Description: RAS and WAS Non-clog Pumps (5 pumps total)

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>Yeomans</td>
<td>412-3C</td>
<td>$48,500</td>
</tr>
<tr>
<td>B</td>
<td>Worthington</td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td>Cornell</td>
<td></td>
<td>$</td>
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</table>

### Section 11310B
Description: Diamond Peak Lift Station Non-clog Pumps (2 pumps)

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Yeomans</td>
<td>412 3C</td>
<td>$23,225</td>
</tr>
<tr>
<td>B</td>
<td>Worthington</td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

### Section 11215
Description: Utility Water Supply System

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Goulds</td>
<td>Aquavar</td>
<td>$6,950</td>
</tr>
<tr>
<td>B</td>
<td>No equal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Section 11303
Description: In-Plant Pump Station Pumps (2 pumps)

<table>
<thead>
<tr>
<th>Item</th>
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<th>Model (a)</th>
<th>Amount Bid (a)</th>
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<tbody>
<tr>
<td>A</td>
<td>Flygt ITT</td>
<td>NP</td>
<td>$8,675</td>
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<tr>
<td>B</td>
<td>No equal</td>
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<td></td>
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</tbody>
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### Section 11364
Description: Centrifuge

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Andritz</td>
<td>D4L</td>
<td>$210,000</td>
</tr>
<tr>
<td>B</td>
<td>Alfa Laval</td>
<td>506</td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td>Centrisys</td>
<td>CS 18</td>
<td>$</td>
</tr>
</tbody>
</table>
Table 300-1: Major Equipment Schedule (cont.)

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11319</td>
<td>Centrifuge Feed Pump</td>
<td>A</td>
<td>Borger</td>
<td>PL Series</td>
<td>$8,771</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Vogelsang</td>
<td>VX136 Series</td>
<td>$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11306</td>
<td>Polymer Feed Equipment</td>
<td>A</td>
<td>Stranco US Filter</td>
<td>$</td>
<td></td>
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<td></td>
<td></td>
<td>B</td>
<td>DynaBlend</td>
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<td>$12,075</td>
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<table>
<thead>
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<th>Section</th>
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<th>Model (a)</th>
<th>Amount Bid (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14550</td>
<td>Shaftless Screw Conveyors with Electrically Actuated Discharge Gates</td>
<td>A</td>
<td>Spirac, Inc</td>
<td>U2605DX/304 SS</td>
<td>$49,900</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Custom Conveyor</td>
<td>$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>Parkson Corporation</td>
<td>$</td>
<td></td>
</tr>
</tbody>
</table>

Subtotal of Major Equipment (use lowest priced equipment from each category above). $762,812

Tax $56,257

MAJOR EQUIPMENT TOTAL (Insert as Item 1, page 0-12) $819,069

(a) Information required from Bidders. Only include cost for one manufacturer and model of equipment. Cost to be quoted is for equipment only. No “or equal” equipment will be allowed to serve as substitutes.

If the Bidder decides to propose “or equal” equipment, the name and model of the equipment, along with the cost for that item shall be listed in the space provided in Table 300-2 (Alternate Equipment). The equipment portion of the Lump Sum Bid Price shall be based on the value assigned to the Major Equipment items, as listed by the Bidder on Table 300-1 (Major Equipment). Proposed alternate equipment shall not be used to formulate the Lump Sum bid Price and will not be used to determine the award of the bid. The Bidder is not obligated to list alternate equipment.
### Table 300-2: Alternate Equipment Schedule

#### Section 11330
**Description:** Fine Screen (a)

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>HYCOR</td>
<td>Helisieve</td>
<td>$ 6,200</td>
</tr>
<tr>
<td>B</td>
<td>Andritz</td>
<td>Aquaspir</td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td>Lakeside</td>
<td>Microstrainer</td>
<td>$</td>
</tr>
</tbody>
</table>

#### Section 11320
**Description:** Grit Removal (grit removal and grit separation systems)

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

#### Section Reserved
**Description:**

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

#### Section 11375
**Description:** Oxidation Ditch Equipment

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

#### Section 113611
**Description:** Secondary Clarifier Equipment

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>
### Table 300-2: Alternate Equipment Schedule (cont.)

#### Section 11310A
**Description:** RAS/WAS pumps

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

#### Section 11310B
**Description:** Diamond Peak Lift Station Non-Clog Pumps

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

#### Section 11215
**Description:** Utility Water Supply System

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

#### Section 11303
**Description:** In-Plant Pump Station Pumps

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

#### Section 11364
**Description:** Centrifuge

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Amount Bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>
Cold Springs Water Reclamation Facility Expansion

Table 300-2: Alternate Equipment Schedule (cont.)

<table>
<thead>
<tr>
<th>Section 11319</th>
<th>Description: Centrifuge Feed Pump</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Manufacturer</td>
</tr>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 1330</th>
<th>Description: Polymer Feed Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Manufacturer</td>
</tr>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 14550</th>
<th>Description: Shaftless Screw Conveyors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Manufacturer</td>
</tr>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

(a) Bidder requested to submit a cost on one of the named alternates for the Headworks Fine Screen. Listing an alternate for other major equipment items is optional.

(b) If the alternate equipment is selected by the Owner (following award of the project), the price shown on Table 300-1 (Major Equipment) will be substituted with the price shown on Table 300-2 (Alternate Equipment) by change order to arrive at a revised Lump Sum Price. Any additional costs incurred to accommodate alternate equipment (including but not limited to re-design, foundations, structures, piping, electrical service, and controls) shall be determined and added to the cost of substituting equipment prior to execution of the change order.

D. For project items not specifically listed in Table 300-1 (Major Equipment), the Bidder may use one of the “named” equipment items or an “or equal” item. “Or equal” compliance will be addressed at product submittal time.

II. Supervisory Control and Data Acquisition (SCADA) Human/Machine Interface (HMI) programming and an allowance for miscellaneous laboratory/furniture items are discussed in Items E and F respectively.
Cold Springs Water Reclamation Facility Expansion

**F X.** SCADA and HMI **programming** will be covered under Construction Management and are **NOT** a part of this contract. SCADA and HMI **equipment** shall be provided by the contractor under this contract.

**F X.** A $10,000 allowance shall be included in the Lump Sum Price for purchase of miscellaneous laboratory/furniture items. No contractor overhead and profit will be allowed for these items.

**III.** The Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Major Equipment Total (From Table 300-1)</td>
<td>$819,069</td>
</tr>
<tr>
<td>2. Miscellaneous Laboratory/Furniture Items</td>
<td>$10,000</td>
</tr>
<tr>
<td>3. Lump Sum for All Other Contract Requirements</td>
<td>$5,661,008</td>
</tr>
<tr>
<td>4. Total Lump Sum Bid Price (Lines 1 + 2 + 3)</td>
<td>$6,490,077</td>
</tr>
</tbody>
</table>

The Total Lump Sum Bid Price shown above shall be the basis for determining the amount paid for the completed project including all work and contractor requirements shown or described in the Contract Documents.

If the undersigned is notified of the acceptance of his proposal, he agrees to execute the agreement for the work covered in his proposal for the above stated prices as full compensation for furnishing all materials and labor, and doing all of the work, in strict accordance with the Contract Documents.

The undersigned agrees, upon being notified of the acceptance of his proposal, that he shall execute the Agreement within ten (10) calendar days and commence work within seven (7) calendar days following the date of the Notice to Proceed. The undersigned further agrees to complete the work specified within the time stated in the Notice to Contractors.

The undersigned states that he has a thorough understanding of the conditions embodied in the Contract Documents and Specifications.

Enclosed find cashier's check, certified check, bidders bond or cash in an amount equal to at least five percent (5%) of the amount bid.

The Subcontractors as listed on the following page shall be those utilized for this project unless otherwise approved by the Owner and in compliance with the provisions of NRS 338.141.
Cold Springs Water Reclamation Facility Expansion

NAME OF FIRM: K.G. Walters Construction Co, Inc.

BY: Walt Johnson

TITLE: President

ADDRESS: P.O. Box 4359
Santa Rosa CA 95402

DATE: 7/7/04

NEVADA CONTRACTOR'S LICENSE NO: 17382, 17383, 42498

LICENSEE'S MONETARY LIMIT: unlimited

WASHOE COUNTY BUSINESS LICENSE:

WITNESS: Valerie Carmichael

Secretary
GENERAL CONTRACTOR BUSINESS FIRM INFORMATION

K. G. Walters Construction Co., Inc. 17382, 17383, 42498
(Firm Name) (Nevada Contractors License No.)

Walt Johnson (Name of Officer) is authorized to bid and to enter
into this Contract for the above listed firm.

The firm is: (check one)

[ ] a corporation [ ] a partnership [ ] sole proprietorship

Principal Officers:

Name          Title          Signature
Walt Johnson  President       
Tom Crotty    Vice Pres.      
Dave Backman  Vice Pres.      
Valerie Carmichael  secretary

 Owners Not Listed Above:

______________________________________________

______________________________________________

______________________________________________

______________________________________________

Walt Johnson (Name of Officer) certify that the above list includes
all officers, Owners and financial partners of the above-mentioned firm corporate structures to the
best of my knowledge.

Signature and Title of Officer

President

Bidding and Contract Documents 0 - 14

FINAL
January 2004
037012.10
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LIST OF SUBCONTRACTORS

List below the name, address, and Contractor's license number of each subcontractor who will provide labor or a portion of the work on the project for which the subcontractor will be paid an amount exceeding 5 percent of the Contractor's total bid. In addition, for each portion of the work to be completed by a subcontractor, list that subcontractor's name, address and Contractor's license number. For each of those listed, also describe the type or kind of work the subcontractor will perform.

<table>
<thead>
<tr>
<th>KIND OF WORK</th>
<th>NAMES AND ADDRESSES</th>
<th>LICENSE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rebar</td>
<td>Regional Steel Corp</td>
<td>0039587</td>
</tr>
<tr>
<td></td>
<td>Tracy, CA</td>
<td></td>
</tr>
<tr>
<td>2. Elect. &amp; Inst</td>
<td>Thunder Elect.</td>
<td>0052420</td>
</tr>
<tr>
<td></td>
<td>S.F., CA</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Within two (2) hours after the completion of the opening of the bids, the general contractors who submitted the three lowest bids must submit a list of containing the name of each subcontractor who will provide labor or a portion of the work or improvement to the contractor for which he will be paid an amount exceeding one percent of the prime contractor's total bid or $50,000 or whichever is greater, and the number of the license issued to the subcontractor pursuant to chapter 624 of NRS. If a general contractor fails to submit such a list within the required time, his bid shall be deemed not responsive.
**LIST OF SUBCONTRACTORS**

Below are the names, addresses, and Contractor's license number of each subcontractor who will provide labor or a portion of the work on the project for which the subcontractor will be paid an amount exceeding 1 percent of the Contractor's total bid. In addition, for each portion of the work completed by a subcontractor, list that subcontractor's name, address and Contractor's license number. For each of those listed, also describe the type or kind of work the subcontractor will perform.

<table>
<thead>
<tr>
<th>KIND OF WORK</th>
<th>NAMES AND ADDRESSES</th>
<th>LICENSE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HVAC</td>
<td>D. M. Morris</td>
<td>0099625</td>
</tr>
<tr>
<td></td>
<td>Spots, NV</td>
<td></td>
</tr>
<tr>
<td>2. Rebar</td>
<td>Regional Steel Corp.</td>
<td>0039587</td>
</tr>
<tr>
<td></td>
<td>Tracy, CA</td>
<td></td>
</tr>
<tr>
<td>3. Elec. &amp; Inst.</td>
<td>Thunder Elect.</td>
<td>0052620</td>
</tr>
<tr>
<td></td>
<td>S.F., CA</td>
<td></td>
</tr>
<tr>
<td>4. Paint &amp; Coatings</td>
<td>T &amp; S Variety</td>
<td>25637</td>
</tr>
<tr>
<td></td>
<td>Reno, NV</td>
<td></td>
</tr>
<tr>
<td>5. Masonry</td>
<td>Northeast Masonry</td>
<td>25821</td>
</tr>
<tr>
<td></td>
<td>Carson City, NV</td>
<td></td>
</tr>
<tr>
<td>6. HVAC Piping</td>
<td>A. Y. Pascariella SNC</td>
<td>25565</td>
</tr>
<tr>
<td></td>
<td>Sports, NV</td>
<td></td>
</tr>
<tr>
<td>7. Metal Rod</td>
<td>Kovach Inc.</td>
<td>0024295</td>
</tr>
<tr>
<td></td>
<td>Mesa, AR</td>
<td></td>
</tr>
</tbody>
</table>

Note: This list is due 2-hours following bid opening.

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January 2004
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List of Subcontractors

List below the name, address, and Contractor's license number of each subcontractor who will provide labor or a portion of the work on the project for which the subcontractor will be paid an amount exceeding 1 percent of the Contractor's total bid. In addition, for each portion of the work to be completed by a subcontractor, list that subcontractor's name, address and Contractor's license number. For each of those listed, also describe the type or kind of work the subcontractor will perform.

<table>
<thead>
<tr>
<th>KIND OF WORK</th>
<th>NAMES AND ADDRESSES</th>
<th>LICENSE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Landscaping</td>
<td>Steven Groves Co</td>
<td>51367</td>
</tr>
<tr>
<td>2. Fence</td>
<td>Smith Fence</td>
<td>5493</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: This list is due 2-hours following bid opening.

FINAL
January 2004
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BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, K. G. WALTERS

CONSTRUCTION CO., INC. ________, as Principal, and HARTFORD FIRE INSURANCE

COMPANY, 33 NEW MONTGOMERY STREET, SAN FRANCISCO, CA 94105

(legal description and address of Surety)

authorized to do business of Surety in the State of Nevada, as Surety, are held and firmly bound
unto Washoe County, as Owner, in the sum of TEN PERCENT ________ Dollars ($ 10% ____),
(which is not less than 5% of the contract price) for the payment of which, well and truly to be
made, we hereby jointly and severally bind ourselves, our heirs, executors, and administrators,
successors, and assigns.

Signed this ______ day of ______, 2004 .

The conditions of the above obligation is such that whereas the Principal has submitted to
Washoe County, a certain bid, attached hereto and hereby made a part hereof, to enter into a
Contract in writing for the Cold Springs Water Reclamation Facility Expansion.

Now therefore, if said bid shall be rejected, or in the alternative, if said bid shall be accepted and
the Principal shall execute and deliver a Contract in the form of contract attached hereto (properly,
completed in accordance with said Bid) and shall furnish a Bond for his Faithful Performance of
said Contract, and a Bond for the payment of all persons performing labor or furnishing materials
in connection therewith, and shall provide and comply with the insurance requirements, and shall
in all other respects perform the agreement created by the acceptance of said bid, then this
obligation shall be void.

Otherwise, the same shall remain in force and effect, and the sum herein specified paid over to
the Owner, it being expressly understood and agreed that the liability of the Surety for any and all
claims hereunder shall, in no event, exceed the amount of this obligation as herein stated.

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

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

[Signature]

[Corporate Seal]
Cold Springs Water Reclamation Facility Expansion

BID BOND (continued)

(Seal) Principal  K.G. WALTERS CONSTRUCTION CO., INC.

By  

Walt Johnson, President

(Seal) Surety  HARTFORD FIRE INSURANCE COMPANY

By  

RICHARD S. SVEC, ATTORNEY-IN-FACT

STATE OF NEVADA )
COUNTY OF WASHOE )

On this _____________ day of ____________, 20___, personally appeared before me, a Notary Public, __________________________, who acknowledged to me that he/she was the Principal authorized to sign the foregoing Bid Bond.

______________________________
NOTARY PUBLIC

STATE OF NEVADA )
COUNTY OF WASHOE )

On this _____________ day of ____________, 20___, personally appeared before me, a Notary Public, __________________________, who acknowledged to me that he/she was the Surety authorized to sign the foregoing Bid Bond.

______________________________
NOTARY PUBLIC

FINAL
January 2004
037012.10
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Bidding and Contract Documents
CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of California
County of Sonoma ss.

On July 7, 2004, before me, Suzette Ransom, Notary Public, personally appeared Walt Johnson.

Name(s) of Signer(s)

X personally known to me
□ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that he/she they executed the same in (his/her) their authorized capacity (ies), and that by his/her their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or Type of Document: ______________________________

Document Date: ___________________________ Number of Pages: __________

Signer(s) Other Than Named Above: ______________________________

Capacity(ies) Claimed by Signer

Signer's Name: ______________________________

□ Individual
□ Corporate Officer — Title(s): ______________________________
□ Partner — □ Limited □ General
□ Attorney in Fact
□ Trustee
□ Guardian or Conservator
□ Other: ______________________________

Signer is Representing: ______________________________
CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of California  
County of Santa Clara

On JULY 7, 2004 before me, Anna Sweeten, Notary Public, 
personally appeared Richard S. Svec

☐ personally known to me- OR - ☐ proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal

SIGNATURE OF NOTARY

OPTIONAL

Though the data below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent reattachment of this form.

CAPACITY CLAIMED BY SIGNER

☐ INDIVIDUAL
☐ CORPORATE OFFICER

TITLE(S)

☐ PARTNER(S) ☐ LIMITED
☐ GENERAL

☐ ATTORNEY-IN-FACT
☐ TRUSTEE(S)
☐ GUARDIAN/CONSERVATOR
☐ OTHER:

DESCRIPTION OF ATTACHED DOCUMENT

TITLE OR TYPE OF DOCUMENT

NUMBER OF PAGES

DATE OF DOCUMENT

SIGNER(S) OTHER THAN NAMED ABOVE

SIGNER IS REPRESENTING

NAME OF PERSON(S) OR ENTITY(IES)
KNOW ALL PERSONS BY THESE PRESENTS THAT the Hartford Fire Insurance Company, Hartford Accident and Indemnity Company and Hartford Underwriters Insurance Company, corporations duly organized under the laws of the State of Connecticut; Hartford Insurance Company of Illinois, a corporation duly organized under the laws of the State of Illinois; Hartford Casualty Insurance Company, Twin City Fire Insurance Company and Hartford Insurance Company of the Midwest, corporations duly organized under the laws of the State of Indiana; and Hartford Insurance Company of the Southeast, a corporation duly organized under the laws of the State of Florida; having their home office in Hartford, Connecticut, (hereinafter collectively referred to as the "Companies") do hereby make, constitute and appoint, up to the amount of unlimited:

Rick F. Prentice, William J. Prentice, Anna Sweeten, Richard S. Svec, Suman K. Toor of San Jose, CA

their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, to sign its name as surety(ies) only as delineated above by \( \times \), and to execute, seal and acknowledge any and all bonds, undertakings, contracts and other written instruments in the nature thereof, on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

In Witness Whereof, and as authorized by a Resolution of the Board of Directors of the Companies on September 12th, 2000, the Companies have caused these presents to be signed by its Assistant Vice President and its corporate seals to be hereto affixed, duly attested by its Assistant Secretary. Further, pursuant to Resolution of the Board of Directors of the Companies, the Companies hereby unambiguously affirm that they are and will be bound by any mechanically applied signatures applied to this Power of Attorney.

Paul A. Bergenholz, Assistant Secretary

John P. Hyland, Assistant Vice President

STATE OF CONNECTICUT  
COUNTY OF HARTFORD

On this 19th day of September, 2000, before me personally came John P. Hyland, to me known, who being by me duly sworn, did depose and say: that he resides in the County of Hartford, State of Connecticut; that he is the Assistant Vice President of the Companies, the corporations described in and which executed the above instrument; that he knows the seals of the said corporations; that the seals affixed to the said instrument are such corporate seals; that they were so affixed by authority of the Boards of Directors of said corporations and that he signed his name thereto by like authority.

Jean H. Woziaik  
Notary Public  
My Commission Expires June 30, 2004

I, the undersigned, Assistant Vice President of the Companies, DO HEREBY CERTIFY that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which is still in full force effective as of JULY 7, 2004

Signed and sealed at the City of Hartford.

Colleen Mastroianni, Assistant Vice President
You are hereby notified that, under the Terrorism Risk Insurance Act of 2002, effective November 26, 2002, we must make terrorism coverage available in your bond/policy. However, the actual coverage provided by your bond/policy for acts of terrorism, as is true for all coverages, is limited by the terms, conditions, exclusions, limits, other provisions of your bond/policy, any endorsements to the bond/policy and generally applicable rules of law.

Any terrorism coverage provided by this bond/policy is partially reinsured by the United States of America under a formula established by Federal Law. Under this formula, the United States will pay 90% of covered terrorism losses exceeding a statutorily-established deductible paid by sureties/insurers until such time as insured losses under the program reach $100 billion. If that occurs, Congress will determine the procedures for, and the source of, any payments for losses in excess of $100 billion.

The premium charge that has been established for terrorism coverage under this bond/policy is either shown on this form or elsewhere in the bond/policy. If there is no premium shown for terrorism on this form or elsewhere in the bond/policy, there is no premium for the coverage.

Terrorism premium: $0
Inquiries Regarding Claims

Hartford Fire Insurance Company
Hartford Casualty Insurance Company
Hartford Accident and Indemnity Company
Hartford Underwriters Insurance Company

Twin City Insurance Company
Hartford Insurance Company of Illinois
Hartford insurance Company of the Midwest
Hartford Insurance Company of the Southeast

Please address inquiries regarding Claims for all surety and fidelity products issued by The Hartford’s underwriting companies to the following:

Phone Number : 888-266-3488
Fax - Claims : 860-757-5835 or 860-547-8265
E-mail : claims@1stesurety.com

Mailing Address : The Hartford
The Hartford Fidelity & Bonding (BOND)
Hartford Plaza
690 Asylum Avenue
Hartford, CT 06115
Cold Springs Water Reclamation Facility Expansion

PREFERENTIAL BID STATUS

(COMPLETION OF THIS PORTION OF THE PROPOSAL IS OPTIONAL)

In accordance with NRS 338.147, a Bidder that submits copy of a certificate of eligibility to receive a preference in bidding on public works issued to him by the state contractors board shall be deemed to have submitted a better bid than a competing contractor who has not provided a copy of such a valid certificate of eligibility if the amount of his bid is not more than 5 percent higher than the amount bid by the competing bidder.

✓ Copy of Certificate of eligibility to receive a preference in bidding is attached.

(Initial or check if applies)

[Signature]

[President]

[Title]
CERTIFICATE OF ELIGIBILITY
PER NRS 338.147 and NRS 338.1389

CERTIFICATE NUMBER: BPC-00-03-14-0108


THIS CERTIFICATE OF ELIGIBILITY IS ISSUED ON MAY 1, 2004 AND EXPIRES ON APRIL 30, 2005 UNLESS SOONER REVOKED OR SUSPENDED BY THE NEVADA STATE CONTRACTORS BOARD.

NANCY MATHIAS, LICENSING ADMINISTRATOR
FOR MARGI GREIN, EXECUTIVE OFFICER

4/23/04

The Nevada State Contractors Board assumes no liability or responsibility for the accuracy or validity of the information contained in the Contractors Statement of Compliance or the Affidavit of Certified Public Accountant as Proof of Contractors Compliance with the Provisions of NRS 338.147 and NRS 338.1389. The above-named General Contractor shall bear the responsibility to ascertain the accuracy and validity of the affidavits provided to support the issuance of this certificate.
STATE OF NEVADA  
COUNTY OF  

I, Walt Johnson, (Name of Party signing this Affidavit & the Proposal Form) President (Title), being duly sworn do depose and say: That K.G. Walters Construction Co., Inc. (name of person, firm, association or corporation) has not, either directly or indirectly, entered into an agreement participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with this Contract.

Signature  

Title  

Sworn to before me this 4th day of July, 2004.

Signature  

Title  

Suzette Ransom
Notary Public
CERTIFICATION REGARDING
DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS
PRIMARY COVERED TRANSACTIONS

The prospective bidder, K.G. Walters Construction Co., Inc., certifies to the best of its knowledge and belief, that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by any Federal, State, or Local department or agency.

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001, a false statement may result in a fine of up to $10,000 or imprisonment for up to 5 years, or both.

Walt Johnson
President
Typed Name & Title of Authorized Certifying Official

Signature of Authorized Representative 7/17/04

I am unable to certify to the above statement. My explanation is attached.

Signature: Date: 7/17/04
AGREEMENT FORM

COLD SPRINGS WATER RECLAMATION FACILITY EXPANSION

THIS AGREEMENT (also herein referred to as "Contract"), is made and entered into this 13th day of August, 2004, by and between Washoe County, a political subdivision of the State of Nevada, acting through the Washoe County Commissioners hereinafter called "OWNER" and KG Walters Construction Co., Inc. hereinafter called the "CONTRACTOR".

WITNESSETH:

That the OWNER and the CONTRACTOR, for the consideration hereinafter named, agree as follows:

Article 1. Scope of Work
The Contractor shall furnish all of the materials and perform all of the work described in the contract documents entitled Cold Springs Water Reclamation Facility Expansion, issued by the Department of Water Resources, Department of Water Resources, and shall do everything required by this Agreement.

Article 2. Time of Completion
The work to be performed under this Agreement shall be completed within three hundred and sixty-five, (365), calendar days of the "Notice to Proceed" and contains the following three milestones that the contractor must honor:

Milestone 1 – Beneficial Use of the "Liquid Stream Processes" (see Section 01010, 1.08).
Milestone 2 – Beneficial Use of the remaining portions of the project. This milestone is defined as "Substantial Completion" of the project.
Milestone 3 – Final Completion of the entire project.

Should the Contractor fail or refuse to complete the work for any of the three milestones within the stipulated time (see Section 01010, 1.08) there shall be deducted from monies due him, not as a penalty, but as liquidated damages, the sum of Five Hundred Dollars ($500.00) for each calendar day required to complete the work in addition to the period of time hereinbefore set forth. The liquidated damages will be assessed independently for each milestone.

Article 3. Progress Payments
On or about the first of each month, the Contractor shall make and certify an estimate of the amount and fair value of the work done, and may apply for partial payment therefore. The Contractor shall revise the estimate as the Owner may direct. Whenever the monthly estimate, after approval, shows that the value of the work completed during the previous month exceeds one percent (1%) of the total contract price, the Owner will process a pay request. The Owner will thereupon cause the amount therein to be paid to the Contractor. Such certificate will authorize payment in an amount equal to the value of the work completed less any sums that may be lawfully retained by the Owner.
The Owner shall retain ten percent (10%) of such estimated value of the work done as part security for the fulfillment of the Contract and shall pay monthly to the Contractor, while carrying on the work the balance not retained, after deducting therefrom all previous payments. No partial payment shall be made when, in the judgment of the Owner, the work is not being diligently prosecuted by the Contractor.

The amount of payments withheld as provided herein shall be retained for a period of forty (40) days from the date of filing of the Notice of Completion.

Owner shall pay to Contractor at the end of each quarter this Agreement is in effect, interest for the quarter on the amount withheld at a rate to be determined by Owner in accordance with NRS 338.515. If the amount due the Contractor pursuant to this provision for any quarter is less than Five Hundred Dollars ($500.00), the Owner may withhold the interest until: (1) the end of a subsequent quarter after which the amount of interest due is Five Hundred Dollars ($500.00) or more; (2) the end of the fourth consecutive quarter for which no interest has been paid to the Contractor; or (3) the final payment is due under the Agreement; whichever occurs first.

Contractor shall pay the Subcontractors progress payments and pay interest on amounts retained from said progress payments in accordance with the provisions of NRS 338.510 through NRS 338.535.

**Article 4. Acceptance and Final Payment**

As soon as practical following the completion of the work, the Contractor shall make request by letter to the Owner for a final inspection and acceptance of the work, and if, in Owner’s opinion, all provisions of the Specifications and Agreement have been satisfied, Owner will cause a Notice of Completion to be filed with the County Recorder.

At the expiration of forty (40) calendar days following the filing of the Notice of Completion, final payment shall be made as follows: After deducting all previous payments from the total value of the work, the remaining balance shall be paid, providing that no claims, liens or outstanding debts have been filed against the work, and the contract is not subject to arbitration or litigation between parties. Notwithstanding the expiration of forty (40) calendar days, the Contractor, upon demand by the Owner, shall submit evidence satisfactory to the Owner that all payrolls, materials, bills, and other indebtedness relating to the work performed, have been paid before final payment is made.

**Article 5. The Contract Sum**

The Owner shall pay the Contractor, as full compensation for furnishing all materials and labor and doing all the work in strict accordance with the Specifications and to the satisfaction of the Owner, the amounts as set forth in the Bid Proposal. This sum is to be paid in the manner and under the conditions hereinbefore specified.

**Article 6. Performance and Payment Bonds**

The Contractor agrees that he will before this Contract becomes effective, furnish the Owner a Faithful Performance Bond and a Labor and Material Payment Bond, furnished by a company or companies acceptable to the Owner, each in an amount equal to one hundred percent (100%) of the total Contract sum.
The Faithful Performance Bond shall be conditioned that the work under the Contract shall be performed in accordance with the specifications and terms of this Agreement and shall guarantee the work for a period of one (1) year.

The Labor and Material Payment Bond shall be conditioned to provide and secure payment for all material, provisions, provender and supplies, teams, trucks and other means of transportation used in, or upon or about the work and for any labor done thereon.

**Article 7. The Contract Documents**

The following is an enumeration of the Contract Documents, and are fully a part of the Contract as if hereto repeated:

1. NOTICE TO CONTRACTORS
2. INSTRUCTION TO BIDDERS
3. BID PROPOSAL-SCHEDULE OF ITEMS AND PRICES
4. BID BOND
5. AFFIDAVIT OF PAYMENTS FOR PREFERENTIAL BID AWARD STATUS
6. AFFIDAVIT OF NON-COLLUSION
7. DEBARMENT CERTIFICATE
8. AGREEMENT FORM
9. FAITHFUL PERFORMANCE BOND
10. LABOR AND MATERIAL PAYMENT BOND
11. SPECIAL CONDITIONS
13. TECHNICAL SPECIFICATIONS
14. ATTACHMENT 1 - PUBLIC WORKS CONSTRUCTION INSURANCE SPECIFICATIONS
15. ADDENDA
17. ANY VALIDLY EXECUTED CHANGE ORDER, DIRECTIVES OR AMENDMENTS HERETO

**Article 8. Nondiscrimination:** In accordance with NRS 338.125, in connection with the performance of work under this contract, the Contractor agrees not to discriminate against any employee or applicant for employment because of race, creed, color, national origin, sex or age. Such agreements shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. Any violation of such provision by the Contractor shall constitute a material breach of the Contract. Further, Contractor agrees to insert this nondiscrimination provision in all subcontracts hereunder, except subcontracts for standard commercial supplies or raw materials.

**Article 9. Veteran's Preference**

Contractor agrees to give preference as provided in NRS 338.130. If this provision is not complied with, the Contract shall be void, and any failure or refusal to comply with this provision shall render the Contract void.
**Article 10. Prevailing Wage Rates**

In the event that the Contract sum as listed above is One Hundred Thousand Dollars ($100,000.00) or more, Contractor agrees that he shall pay the prevailing wage rates in effect at the time of the bid and comply with NRS 338. The Contractor shall forfeit, as a penalty to the Owner, not less than $10 nor more than $25 for each calendar day or portion thereof that each workman employed:

1) Is paid less than the designated rate for any work done under the contract, by the contractor or any subcontractor under him.

2) Is not reported to the labor commission and the Owner.

In addition, Contractor shall keep accurate records showing the name, occupation and actual per diem wages and benefits paid to each workman employed by him in connection with this project. The records shall be open to inspection by the Owner, its officers and agents and at all reasonable hours.

**Article 11. Indemnification/Hold Harmless**

Washoe County has established specific indemnification and insurance requirements for agreements/contracts with Contractors to help assure that reasonable insurance coverage is maintained. Indemnification and hold harmless clauses are intended to assure that Contractors accept and are able to pay for the loss liability related to their activities.

If this provision is not complied with, the Contract shall be void, and any failure or refusal to comply with this provision shall render the Contract void.

**Article 12. Termination**

In addition to other provisions of this Agreement, Owner has the right to terminate the Agreement without cause at any time upon giving Contractor seven (7) days notice in writing. In the event the Agreement is terminated by Owner in accordance with this provision, Owner agrees to pay Contractor for all work satisfactorily completed and for materials installed prior to the date of termination.
IN WITNESS WHEREOF, the parties hereto have executed this Agreement the day and year first above written.

WASHOE COUNTY

James M. Shaw
Chairman
Board of County Commissioners

ATTEST:

Amy Harvey, Washoe County Clerk

CONTRACTOR:

By: [Signature]
Title: [Title]
Date: 8/25/04

STATE OF NEVADA
COUNTY OF WASHOE
SS:

On this 24th day of August, 2004, personally appeared before me, a Notary Public, WALT JOHNSON, who acknowledged to me that he/she executed the foregoing Agreement.

LeVONNE SCHEFFLER
Notary Public - State of Nevada
Appointment Recorded in Washoe County
No. 69-382292 - Expires January 10, 2008

NOTARY PUBLIC

FINAL
January 2004
037012.10
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Bidding and Contract Documents
PERFORMANCE AND COMPLETION BOND
FOR PUBLIC WORKS - REQUIRED PURSUANT TO NRS CHAPTER 339

KNOW ALL MEN BY THESE PRESENTS: That ________________

(Name and Address [or legal description] of Contractor)

As Principal, hereinafter called "Principal", and ________________

(Legal Designation and Address of Surety)

authorized to do business of surety in the State of Nevada, as Surety, hereinafter called "Surety", are held and firmly bound unto Washoe County, a political subdivision of the State of Nevada, as Obligee, hereinafter called "Owner", in the amount of ________________ Dollars ($________________) said sum being 100% of the contract amount payable by the Owner under the terms of the Contract referred to below, for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has by written agreement dated ________________, 20__, entered into a contract with Owner for construction of the Cold Springs WRF Expansion which contract and its plans and specifications are attached hereto and by reference made a part hereof, as if fully and completely set out in full herein, and is hereinafter referred to as the "Contract"; and

WHEREAS, said Principal is required by the Nevada Revised Statutes 339.025, and all act amendatory thereof and supplemental thereto, to furnish a bond in connection with said Contract guaranteeing the faithful performance thereof; and

WHEREAS, the Principal under the terms of the Contract agrees to replace and/or repair without cost to the Owner any damage or imperfections due to faulty labor or materials incorporated in said work, including the landscaping, for a period of one (1) year, from and after the date of completion and acceptance by Owner of the work contracted to be performed.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH that if Principal shall well and truly perform and complete in all its parts of the work described in said Contract within the time and in the manner therein specified and shall, for a period of one (1) year from the date of the work contracted to be performed is completed and accepted by Owner, replace and repair any and all defects arising in said work, whether resulting from defective material or workmanship, and shall also observe, perform, fulfill, and keep all and every covenant and agreement in said Contract on the part of the Principal to be kept, performed and complied with within the time and manner therein specified and shall truly and fully comply with all guarantees required in said Contract, then this obligation shall become null and void; otherwise, it shall remain and be in full force and effect.

And the said Surety, for value received, hereby stipulates and agrees, if requested to do so by the Owner, to perform and fully complete the work mentioned and described in said Contract, pursuant to the terms, conditions, and covenants thereof, if for any cause, said Principal fails or
PERFORMANCE AND COMPLETION BOND
FOR PUBLIC WORKS - REQUIRED PURSUANT TO NRS CHAPTER 339

KNOW ALL MEN BY THESE PRESENTS: That K.G. WALTERS CONSTRUCTION

COMPANY, INC., 195 CONCOURSE BLVD., STE. B, SANTA ROSA, CA. 95403

(Name and Address [or legal description] of Contractor)

As Principal, hereinafter called "Principal", and HARTFORD FIRE INSURANCE COMPANY,

33 NEW MONTGOMERY ST., SAN FRANCISCO, CA. 94105

(Legal Designation and Address of Surety)

authorized to do business of surety in the State of Nevada, as Surety, hereinafter called "Surety", are held and firmly bound unto Washoe County, a political subdivision of the State of Nevada, as Obligee, hereinafter called "Owner", in the amount of SIX MILLION FOUR HUNDRED NINETY* Dollars ($6,490,077.00) said sum being 100% of the contract amount payable by the Owner under the terms of the Contract referred to below, for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents. *THOUSAND SEVENTY SEVEN AND 00/100 DOLLARS

WHEREAS, Principal has by written agreement dated AUGUST 13, 2004, entered into a contract with Owner for construction of the Cold Springs WRF Expansion which contract and its plans and specifications are attached hereeto and by reference made a part hereof, as if fully and completely set out in full herein, and is hereinafter referred to as the "Contract"; and

WHEREAS, said Principal is required by the Nevada Revised Statutes 339.025, and all act amendatory thereof and supplemental thereto, to furnish a bond in connection with said Contract guaranteeing the faithful performance thereof; and

WHEREAS, the Principal under the terms of the Contract agrees to replace and/or repair without cost to the Owner any damage or imperfections due to faulty labor or materials incorporated in said work, including the landscaping, for a period of one (1) year, from and after the date of completion and acceptance by Owner of the work contracted to be performed.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH that if Principal shall well and truly perform and complete in all its parts of the work described in said Contract within the time and in the manner therein specified and shall, for a period of one (1) year from the date of the work contracted to be performed is completed and accepted by Owner, replace and repair any and all defects arising in said work, whether resulting from defective material or workmanship, and shall also observe, perform, fulfill, and keep all and every covenant and agreement in said Contract on the part of the Principal to be kept, performed and complied with within the time and manner therein specified and shall truly and fully comply with all guarantees required in said Contract, then this obligation shall become null and void; otherwise, it shall remain and be in full force and effect.

And the said Surety, for value received, hereby stipulates and agrees, if requested to do so by the Owner, to perform and fully complete the work mentioned and described in said Contract, pursuant to the terms, conditions, and covenants thereof, if for any cause, said Principal fails or

Bidding and Contract Documents 0 - 26

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neglects to so perform and fully complete said work; the said Surety further agrees to commence said work to full completion within twenty (20) days after notice thereof from the Owner, and to fully complete the same with all due diligence and in accordance with the plans and specifications.

Further, Surety for value received, hereby stipulates and agrees that no prepayment or delay in payment and no change, extension, addition, or alteration of the work or any provision of the Contract or in the plans, profiles, detailed drawings, specifications, and no extension of time and no forbearance on the part of the Owner shall operate to release or exonerate the Surety upon this bond, and consent thereto without notice to or consent by Surety is hereby given, and Surety hereby waives provisions of any law relating thereto. It is expressly agreed and understood that this bond is made and executed contemporaneously with the Contract above mentioned, and in consideration of the covenants and agreements therein made and entered into on the part of the Owner; and that the due execution and delivery hereof is condition precedent to liability on the part of the Owner; on said above mentioned Contract. It is further understood and agreed that this bond is made in compliance with NRS 339.025 and all acts amendatory thereof and supplemental thereto; and that all benefits therein set forth inure to the benefits of the Owner.

IN WITNESS WHEREOF, the above bounden Principal and the above bounden Surety have hereunto set their hands and seals, this 16TH day of AUGUST, 2004.

PRINCIPAL: K.G. WALTERS CONSTRUCTION COMPANY, INC. By: [Signature]

State of Nevada Contractor's License # Subscribed and sworn to before me this day of ___________, 20__. Notary Public

Type: __________________________

Title: __________________________

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**Cold Springs Water Reclamation Facility Expansion**

**Surety:**
HARTFORD FIRE INSURANCE COMPANY

**Name of Surety**

By: [Signature]
(Note: Signature to be Notarized)

**Type:** RICHARD S. SVEC
Attorney-in-Fact

**Amount of Bond Premium (to be filled in by the Surety Company):**

$ 58,423.00

Subscribed and sworn before me this ____ day of _____________, 20__

________________________
Notary Public

**Surety Licensed Nevada Resident Agent:** Marian Keefe

**Company Name:** Aon Risk Services Inc. of Nevada

**Address:** 3801 W. Sahara Ave Ste 600
Las Vegas NV 89102

**Telephone:** 702-323-0300

By: [Signature]
(Note: Signature to be Notarized)

**Type:** Performance Bond

**Bond No.:** 57BCSCJ2857

Subscribed and sworn to before me this 17th day of August, 2004

________________________
Notary Public

GAIL PETERSEN
Notary Public State of Nevada
No. 99-37824-1
My appl. exp. Aug. 21, 2007

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**Bidding and Contract Documents**

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FINAL
January 2004
037012.10
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CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of California
County of Santa Clara

On August 16, 2004 before me, Joyce M. Honerlah, Notary Public,
personally appeared Richard S. Svec

☑ personally known to me- OR - ☐ proved to me on the basis of satisfactory evidence to be
the person whose name is subscribed to the within instrument and acknowledged to me that she
executed the same in her authorized capacity, and
that by her signature on the instrument the person, or
the entity upon behalf of which the person acted,
executed the instrument.

[Signature]
WITNESS my hand and official seal.

[Signature]
SIGNATURE OF NOTARY

OPTIONAL

Though the data below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent reattachment of this form.

CAPACITY CLAIMED BY SIGNER

☐ INDIVIDUAL
☐ CORPORATE OFFICER

TITLE(S)

☐ PARTNER(S) ☐ LIMITED
☐ GENERAL

☒ ATTORNEY-IN-FACT
 ☐ TRUSTEE(S)
 ☐ GUARDIAN/CONSERVATOR
 ☐ OTHER:

DESCRIPTION OF ATTACHED DOCUMENT

TITLE OR TYPE OF DOCUMENT

NUMBER OF PAGES

DATE OF DOCUMENT

SIGNER(S) OTHER THAN NAMED ABOVE

SIGNER IS REPRESENTING
NAME OF PERSON(S) OR ENTITY(IES)
CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of California
Countv of Sonoma } ss.

On August 20, 2004 before me, Suzette Ransom, Notary Public,

personally appeared Walt Johnson.

Name(s) of Signer(s)

☑ personally known to me
☐ proved to me on the basis of satisfactory evidence

☑ to be the person(s) whose name(s) are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

WITNESS my hand and official seal.

Place Notary Seal Above

Suzette Ransom

Signature of Notary Public

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or Type of Document: ____________________________________________

Document Date: __________________________ Number of Pages: ______

Signer(s) Other Than Named Above: __________________________________

Capacity(ies) Claimed by Signer

Signer's Name: __________________________________________

☐ Individual
☐ Corporate Officer — Title(s): ________________________________
☐ Partner — ☐ Limited ☐ General
☐ Attorney in Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: __________________________________________

Signer Is Representing: ________________________________________

© 1997 National Notary Association • 9350 De Soto Ave., P.O. Box 2402 • Chatsworth, CA 91311-2402
Prod. No. 5907 Reorder Call Toll-Free 1-800-876-6827
Cold Springs Water Reclamation Facility Expansion

LABOR AND MATERIAL PAYMENT BOND
FOR PUBLIC WORKS - REQUIRED PURSUANT TO NRS CHAPTER 339

KNOW ALL MEN BY THESE PRESENTS: That K.G. WALTERS CONSTRUCTION COMPANY, INC., 195 CONCOURSE BLVD., STE. B, SANTA ROSA, CA. 95403

(Name and Address [or legal designation] of Contractor)

as principal, hereinafter called "Principal", and HARTFORD FIRE INSURANCE COMPANY, 33 NEW MONTGOMERY ST., SAN FRANCISCO, CA. 94105

(Legal designation and address of Surety)

authorized to do business of surety in the State of Nevada, as Surety, hereinafter called "Surety", are held and firmly bound unto Washoe County, a political subdivision of the State of Nevada, as Obligee, hereinafter called "Owner", for the use and benefit of claimants supplying labor or materials to the Principal or to any of the Principal’s subcontractors in the prosecution of the work provided for in the Contract referred to below in the amount of SIX MILLION FOUR HUNDRED NINETY THOUSAND* Dollars ($6,490,077.00) said sum being 100% of the contract amount payable by the Owner under the terms of the Contract referred to below, for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

*SEVENTY SEVEN AND 00/100 DOLLARS

WHEREAS, Principal has by written agreement dated AUGUST 13, 2004, entered into contract with Owner for construction of Cold Springs Water Reclamation Facility Expansion which contract and its plans and specifications are attached hereto and by reference made a part hereof, as if fully and completely set out in full herein, and is hereinafter referred to as the "Contract"; and

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH that, if Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, and shall save and hold harmless and indemnify Owner from and against any and all claims and demands of liens for work performed and materials supplied, then this obligation shall be void; otherwise it shall remain in full force and effect.

THIS BOND is executed for the purpose of complying with the laws of the State of Nevada as contained in Chapter 339 of the Nevada Revised Statutes and all acts amendatory thereof and supplemental thereto, and this Bond shall inure to the benefit of any and all persons who perform labor upon or furnish materials to be used in or furnish appliances, teams or power contributing to the work described in said Contract, in accordance with provisions of Chapter 339 of Nevada Revised Statutes.

Any suit or action brought on this bond shall be maintained in accordance with provisions as set forth in Chapter 339 of Nevada Revised Statutes, and all acts amendatory thereof and supplemental to.
Cold Springs Water Reclamation Facility Expansion

IN WITNESS WHEREOF, the above bounden Principal and the above bounden Surety have hereunto set their hands and seals, this 16TH day of AUGUST, 2004.

PRINCIPAL: K.G. WALTERS CONSTRUCTION
COMPANY, INC.

By: [Signature]
(Note: Signature to be Notarized)
Type: [Type]
Title: [Title]

State of Nevada Contractor's License #

Subscribed and sworn to before me this day of ____________, 20__.

Notary Public

Surety:
HARTFORD FIRE INSURANCE COMPANY

By: [Signature]
(Note: Signature to be Notarized)

Type: RICHARD S. SVEC
Attorney-in-Fact

Amount of Bond Premium (to be filled in by the Surety Company):

$ INCLUDED IN PERFORMANCE BOND

Subscribed and sworn before me this _______ day of ____________, 20__.

Notary Public

Surety' Licensed Nevada Resident Agent: [Signature]

Company Name: [Company Name]

Address: 2300 W. Sahara Ave Ste. 700
Las Vegas NV 89102

Telephone: 702-227-0300

Bidding and Contract Documents 0 - 30

FINAL
January 2004
037012.10
© Kennedy/Jenks Consultants 2004
Cold Springs Water Reclamation Facility Expansion

By: ____________________________
(Note: Signature to be Notarized)

Type: Performance Bond

Bond No. 57BCSCJ2857

Subscribed and sworn to before me this 17th day of August, 2004.

Notary Public

GAIL PETERSEN
Notary Public State of Nevada
No. 99-37824-1
My appt. exp. Aug. 21, 2007
CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of California
County of Santa Clara

On _August 16, 2004_ before me, Joyce M. Honerlah, Notary Public,

personally appeared Richard S. Svec

☐ personally known to me- OR - ☐ proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that she executed the same in her authorized capacity, and that by her signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal

[Signature of Notary]

OPTIONAL

Though the data below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent reattachment of this form.

<table>
<thead>
<tr>
<th>CAPACITY CLAIMED BY SIGNER</th>
<th>DESCRIPTION OF ATTACHED DOCUMENT</th>
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</thead>
<tbody>
<tr>
<td>☐ INDIVIDUAL</td>
<td>☐ TITLE OR TYPE OF DOCUMENT</td>
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<tr>
<td>☐ CORPORATE OFFICER</td>
<td>☐ NUMBER OF PAGES</td>
</tr>
<tr>
<td>☐ PARTNER(S)</td>
<td>☐ DATE OF DOCUMENT</td>
</tr>
<tr>
<td>☐ LIMITED</td>
<td>☐ SIGNER(S) OTHER THAN NAMED ABOVE</td>
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<tr>
<td>☐ GENERAL</td>
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</tbody>
</table>
IMPORTANT NOTICE TO OBLIGEES/POLICYHOLDERS – TERRORISM RISK INSURANCE ACT OF 2002

You are hereby notified that, under the Terrorism Risk Insurance Act of 2002, effective November 26, 2002, we must make terrorism coverage available in your bond/policy. However, the actual coverage provided by your bond/policy for acts of terrorism, as is true for all coverages, is limited by the terms, conditions, exclusions, limits, other provisions of your bond/policy, any endorsements to the bond/policy and generally applicable rules of law.

Any terrorism coverage provided by this bond/policy is partially reinsured by the United States of America under a formula established by Federal Law. Under this formula, the United States will pay 90% of covered terrorism losses exceeding a statutorily-established deductible paid by sureties/insurers until such time as insured losses under the program reach $100 billion. If that occurs, Congress will determine the procedures for, and the source of, any payments for losses in excess of $100 billion.

The premium charge that has been established for terrorism coverage under this bond/policy is either shown on this form or elsewhere in the bond/policy. If there is no premium shown for terrorism on this form or elsewhere in the bond/policy, there is no premium for the coverage.

| Terrorism premium: | $0 |

Form B-3333-0

© 2002, The Hartford
POWER OF ATTORNEY

KNOW ALL PERSONS BY THESE PRESENTS THAT the Hartford Fire Insurance Company, Hartford Accident and Indemnity Company and Hartford Underwriters Insurance Company, corporations duly organized under the laws of the State of Connecticut; Hartford Insurance Company of Illinois, a corporation duly organized under the laws of the State of Illinois; Hartford Casualty Insurance Company, Twin City Fire Insurance Company and Hartford Insurance Company of the Midwest, corporations duly organized under the laws of the State of Indiana; and Hartford Insurance Company of the Southeast, a corporation duly organized under the laws of the State of Florida; having their home office in Hartford, Connecticut, (hereinafter collectively referred to as the "Companies") do hereby make, constitute and appoint, up to the amount of unlimited:

Rick F. Prentice, William J. Prentice, Anna Sweeten, Richard S. Svec, Suman K. Toor
of
San Jose, CA

their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, to sign its name as surety(ies) only as delineated above by ☑, and to execute, seal and acknowledge any and all bonds, undertakings, contracts and other written instruments in the nature thereof, on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

In Witness Whereof, and as authorized by a Resolution of the Board of Directors of the Companies on September 12th, 2000, the Companies have caused these presents to be signed by its Assistant Vice President and its corporate seals to be hereto affixed, duly attested by its Assistant Secretary. Further, pursuant to Resolution of the Board of Directors of the Companies, the Companies hereby unambiguously affirm that they are and will be bound by any mechanically applied signatures applied to this Power of Attorney.

Paul A. Bergenholz, Assistant Secretary

John P. Hyland, Assistant Vice President

STATE OF CONNECTICUT } ss. Hartford
COUNTY OF HARTFORD

On this 10th day of September, 2000, before me personally came John P. Hyland, to me known, who being by me duly sworn, did depose and say: that he resides in the County of Hartford, State of Connecticut; that he is the Assistant Vice President of the Companies, the corporations described in and which executed the above instrument; that he knows the seals of the said corporations; that the seals affixed to the said instrument are such corporate seals; that they were so affixed by authority of the Boards of Directors of said corporations and that he signed his name thereto by like authority.

Jean H. Wozniak
Notary Public
My Commission Expires June 30, 2004

I, the undersigned, Assistant Vice President of the Companies, DO HEREBY CERTIFY that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which is still in full force effective as of AUGUST 16, 2004.

Signed and sealed at the City of Hartford.

Colleen Mastroianni, Assistant Vice President
State of California
County of Sonoma} ss.

On August 20, 2004 before me, Suzette Ransom, Notary Public,
personally appeared Walt Johnson

Name(s) of Signer(s)

☑ personally known to me
☐ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that he/she executed the same in his/her authorized capacity(ies), and that by his/her signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal.

Suzette Ransom
Signature of Notary Public

Place Notary Seal Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document
Title or Type of Document: ____________________________

Document Date: ____________________________ Number of Pages: __________

Signer(s) Other Than Named Above: ____________________________

Capacity(ies) Claimed by Signer
Signer's Name: ____________________________

☐ Individual
☐ Corporate Officer — Title(s): ____________________________
☐ Partner — ☐ Limited ☐ General
☐ Attorney in Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: ____________________________

Signer is Representing: ____________________________
CERTIFICATE OF INSURANCE

Aon Risk Services, Inc. of Northern California
99 Almaden Blvd., Suite #400
San Jose CA 95113
Fax (877) 528 1556 Phone (408) 288 8000

K.G. Walters Construction Co., Inc.
P.O. Box 4358
Santa Rosa, CA 95402

PRODUCER

RECEIVED

AUG 23 2004

CERTIFICATE HOLDER

Washoe County Dept. of Water Resources
4930 Energy Way
Reno, NV 89502

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT. NO NEW INSURANCE WILL BE EFFECTIVE UNTIL THE NOTICE IS RECEIVED.

AUTHORIZED REPRESENTATIVE

ACORD 25-S (7/87)
POLICY NUMBER: TCP 1056788868

COMMERCIAL GENERAL LIABILITY

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

ADDITIONAL INSURED - OWNERS, LESSEES OR CONTRACTORS (FORM B)

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

Name of Person or Organization: KGW11/6056

Washoe County Dept. of Water Resources, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants

Re: BID, Cold Springs Water Reclamation Facility Expansion

(If no entry appears above, information required to complete this endorsement will be shown in the Declarations as applicable to this endorsement.)

WHO IS AN INSURED (Section II) is amended to include as an insured the person or organization shown in the Schedule, but only with respect to liability arising out of "your work" for that insured by or for you.

Such insurance as is afforded by the General Liability policy is primary insurance and no other insurance of the additional insured will be called upon to contribute to a loss.

Carrier: American Casualty Co. of Reading, PA (CNA)

Named Insured: K.G. Walters Construction Co., Inc.

Policy No.: TCP 1056788868

Policy Term: 10/1/2003 to 10/1/2004

CG 20 10 11 85 Copyright, Insurance Services Office, Inc., 1984
THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

AMENDMENT – AGGREGATE LIMITS OF INSURANCE (PER PROJECT)

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART.

<table>
<thead>
<tr>
<th>Name of Person or Organization:</th>
<th>Schedule:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washoe County Dept. of Water Resources, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants</td>
<td>BID, Cold Springs Water Reclamation Facility Expansion</td>
</tr>
</tbody>
</table>

The General Aggregate Limit under LIMITS OF INSURANCE (SECTION III) applies separately to each of your projects away from premises owned by or rented to you.
WAIVER OF OUR RIGHT TO RECOVER FROM OTHERS
ENDORSEMENT — CALIFORNIA

This endorsement changes the policy to which it is attached effective on the inception date of the policy unless a different date is indicated below.
(The following “attaching clause” need be completed only when this endorsement is issued subsequent to preparation of the policy.)

This endorsement, effective on 1/1/2004 at 12:01 A.M. standard time, forms a part of
Policy No. 176066604
of the State Compensation Ins Fund
issued to K.G. Walters Construction Co., Inc.

We have the right to recover our payments from anyone liable for an injury covered by this policy. We will not enforce our right against the person or organization named in the Schedule. (This agreement applies only to the extent that you perform work under a written contract that requires you to obtain this agreement from us.)

You must maintain payroll records accurately segregating the remuneration of your employees while engaged in the work described in the Schedule.

SCHEDULE

Person or Organization: Washoe County Dept. of Water Resources, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants

Job Description BID, Cold Springs Water Reclamation Facility Expansion
ADDITIONAL INSURED

This endorsement modifies insurance provided under the following:

BUSINESS AUTO COVERAGE FORM

Name of Organization:
Washoe County Dept. of Water Resources, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants

RE: BID, Cold Springs Water Reclamation Facility Expansion

It is agreed that the "Who Is An Insured" provision is amended to include as an insured the person or organization designated below as an additional insured, subject to the following provisions:

1. The insurance applies only with respect to any liability arising out of the operation of covered autos on the additional insured premises described below:

2. The Named Insured is authorized to act for such additional insured in all matters pertaining to this insurance, including receipt of notice of cancellation;

3. Return premium, if any, shall be paid to the Named Insured;

4. Nothing contained herein shall affect any right of recovery as a claimant which the additional insured would have if not designated as such.

Carrier: American Casualty Co. of Reading, PA (CNA)
Named Insured: K.G. Walters Construction Co., Inc.
Policy No.: BUA1056788871
Policy Term: 10/1/2003 to 10/1/2004

Copyright, Insurance Services Office, Inc., 1984
THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

WAIVER OF TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

SCHEDULE

Name of Person or Organization:
Washoe County Dept. of Water Resources, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants

Re: BiD, Cold Springs Water Reclamation Facility Expansion

(If no entry appears above, information required to complete this endorsement will be shown in the Declarations as applicable to this endorsement.)

The TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US Condition (Section IV—COMMERCIAL GENERAL LIABILITY CONDITIONS) is amended by the addition of the following:

We waive any right of recovery we may have against the person or organization shown in the Schedule above because of payments we make for injury or damage arising out of your ongoing operations or "your work" done under a contract with that person or organization and included in the "products-completed operations hazard." This waiver applies only to the person or organization shown in the Schedule above.

Carrier: American Casualty Co. of Reading, PA (CNA)
Named Insured: K.G. Walters Construction Co., Inc.
Policy No.: TCP 1056788868
Policy Term: 10/1/2003 to 10/1/2004
POLICY NUMBER: BUA1056788871

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

WAIVER OF TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS

This endorsement modifies insurance provided under the following:

BUSINESS AUTO COVERAGE FORM
COMMERCIAL BUSINESS AUTO COVERAGE FORM

Schedule

Name of Person or Organization:
Washoe County Dept. of Water Resources, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants

RE: BID, Cold Springs Water Reclamation Facility Expansion

"Any person or organization with whom you agree in writing to waive your right to recover against them. You must agree to this waiver prior to the date of loss."

(If no entry appears above, information required to complete this endorsement will be shown in the declarations as applicable to this endorsement.)

We waive any right of recovery we may have against the person or organization shown in the schedule because of payments we make for injury or damage arising out of "your work" done under a contract with that person or organization. The waiver applies only to the person or organization shown in the schedule.

A. This Endorsement provides only those coverages where a premium is shown in the schedule.

B. The TRANSFER OF RIGHTS RECOVERY AGAINST OTHERS TO US condition does not apply to the person or organization named in the schedule of "accidents" or "losses" occurring after the effective date of the endorsement

Carrier: American Casualty Co. of Reading, PA (CNA)
Named Insured: K.G. Walters Construction Co., Inc.
Policy No.: BUA1056788871
Policy Term: 10/1/2003 to 10/1/2004
ACORD™ CERTIFICATE OF LIABILITY INSURANCE

PRODUCER
AIS, INC.
P.O. BOX 7421
RENO, NV 89510
(775) 324-1707

INSURED
K. G. WALTERS CONSTRUCTION COMPANY
P.O. BOX 4359
SANTA ROSA, CA 95402

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURERS AFFORDING COVERAGE

<table>
<thead>
<tr>
<th>INSURER</th>
<th>ADDRESS</th>
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<tbody>
<tr>
<td>INSURER A:</td>
<td>EMPLOYERS INSURANCE COMPANY OF NEVADA</td>
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<td>INSURER B:</td>
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<td>INSURER C:</td>
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<td>INSURER D:</td>
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<tr>
<td>INSURER E:</td>
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</table>

COVERAGES

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

<table>
<thead>
<tr>
<th>TYPE OF INSURANCE</th>
<th>POLICY NUMBER</th>
<th>POLICY EFFECTIVE DATE (MM/DD/YYYY)</th>
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<td>WORKERS COMPENSATION AND EMPLOYERS' LIABILITY</td>
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<td>COLD SPRINGS WATER RECLAMATION FACILITY EXPANSION</td>
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<tr>
<td>NEVADA HITES ONLY</td>
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</tbody>
</table>

DESCRIPTION OF OPERATIONS/Locations/VEHICLES/EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS

COLD SPRINGS WATER RECLAMATION FACILITY EXPANSION
NEVADA HITES ONLY

CERTIFICATE HOLDER
WASHOE COUNTY DEPARTMENT OF WATER RESOURCES
4930 ENERGY WAY
RENO, NV 89502

ACORD 25-S (7/97)
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<tbody>
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<td>Definitions ................................</td>
<td>Schedule of Values ....................</td>
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<tr>
<td>Computation of Time ...................</td>
<td>Application for Payment ..............</td>
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<tr>
<td>Contract Time ..........................</td>
<td>Payment for Items Delivered But Not Installed</td>
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<td>Damages for Late Completion ..........</td>
<td>Engineer's Recommendation for Payment</td>
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<td>Commencing Work ........................</td>
<td>Completion and Acceptance ............</td>
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<td>Accelerated Work If Required to Meet Schedule</td>
<td>Owner's Right to Partial Use ........</td>
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<td>Excusable Delay .......................</td>
<td>Contractor's List of Deficiencies .....</td>
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<td>Compensable Delays ....................</td>
<td>Semi-Final Inspection, Substantial Completion</td>
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<td>ARTICLE 12 - INSPECTION, DEFECTIVE WORK, GUARANTEE</td>
<td>Final Inspection, Final Completion</td>
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<td>Defective Work ........................</td>
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<td>Access to Work and Notice ............</td>
<td>Waiver of Claims .....................</td>
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<td>Tests and Inspections ..................</td>
<td>ARTICLE 14 - TERMINATION ............</td>
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<td>Reinspection ...........................</td>
<td>Termination by the Owner for Cause</td>
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<td>Uncovering Work .........................</td>
<td>Suspension by the Owner for Convenience</td>
</tr>
<tr>
<td>Correction of Defective Work ..........</td>
<td>Termination by the Owner for Convenience</td>
</tr>
<tr>
<td>Acceptance or Use of Defective Work</td>
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DOCUMENT NUMBER 00700
GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1 - DEFINITIONS

1.1 The term "Contract" refers to a single identified portion of the construction which may be the whole or a part of the Project. The Project is the total construction and consists of one or more Contracts performed by the same or separate contractors or by the Owner. A single set of drawings, specifications and contract conditions may include more than one Contract; when combined with the Agreement for an individual Contract they become the Contract Documents for that Contract. The construction performed under a set of Contract Documents is the Work required by an individual Contract.

1.2 The "Contract Documents" consist of the Agreement, General and Supplementary Conditions, Drawings, Specifications, Addenda issued prior to executing the Agreement and modifications issued after executing the Agreement.

1.3 The term "Contract Price" refers to the total monies payable to the Contractor for completion of the Work in accordance with the Contract Documents.

1.4 The term "Design Engineer" refers to the firm that prepared the Contract Documents - Kennedy/Jenks Consultants - and includes all of their officers, directors, shareholders, employees and consultants.

1.5 The term "Drawings" refers to the graphic and pictorial portion of the Contract Documents, showing the design, location, dimensions, details, scope and character of the Work. Drawings may include plans, elevations, sections, schedules, details and diagrams.

   The term Plans, Plan, Drawing and similar terms shall have the same meaning as the term "Drawings."

1.6 The term "Engineer" refers to the person or entity designated by the Owner to provide administration of the Contract.

1.7 The term "Notice to Proceed" refers to a written notice by the Owner to the Contractor authorizing it to proceed with the Work and establishing the date of commencement from which the Contract Time is measured.

1.8 The term "Owner" is the person or entity referred to in the Agreement and includes all of its officers, employees, and consultants.

1.9 The term "Work" means the entire construction required by the Contract Documents completed or in progress and includes all labor, materials, equipment and services necessary to fulfill the Contractor's obligations. The Work does not include the Contractor's tools, equipment, scaffolding, shoring, barricades, guardrails or any other temporary construction or safety devices employed by the Contractor to complete the Work.

1.10 Definitions of other terms are included at the beginning of each Article or in Division I Section 01010.

ARTICLE 2 - CONTRACT DOCUMENTS

Contract Relationships

2.1 The Contract Documents constitute the entire Agreement between the Owner and the Contractor for the Work and supersede prior agreements written or oral.

2.2 The Contract Documents shall not be construed to create a duty of any kind (1) on behalf of the Design Engineer or the Engineer and toward the Contractor, any subcontractor, worker, or any other party, or (2) on behalf of the Owner and toward any subcontractor, worker, or any other party.

2.3 Provisions in referenced standards, specifications, manuals, publications, installation instructions, operation and maintenance instructions or codes shall not change the duties or responsibilities between any of the parties involved in this work from those described in these General Conditions.

Correlation, Intent

2.4 It is the intent of the Contract Documents to include everything necessary for the proper execution of the Work as a complete functioning facility that serves the intended purpose. The Contractor shall provide all labor, material, equipment and services required by the Contract Documents or that may
reasonably be inferred from the Contract Documents as being required to produce the intended result.

2.5 The Contract Documents are complementary. What is required by one shall be as binding as if required by all. Organization of the Specifications into sections and the arrangement of the Drawings on separate sheets for Mechanical, Electrical, etc. shall not control the Contractor in dividing the Work among subcontractors or among trades.

Order of Precedence

2.6 In case of conflict between different parts of the Contract Documents, the order of precedence shall be as follows:

.1 Supplementary Conditions take precedence over the General Conditions and the Specifications including Division 1;
.2 General Conditions take precedence over the Specifications including Division 1;
.3 Provisions in Division 1 General Requirements apply to all sections of the Specifications.
.4 Specifications take precedence over the Drawings;
.5 Stated dimensions take precedence over scaled dimensions;
.6 Larger scale drawings take precedence over smaller scale drawings;
.7 Detailed drawings take precedence over general or typical drawings;
.8 Specific notes on the Drawings take precedence over schedules; and
.9 Notes, descriptions or schedules take precedence over graphic representations on drawings.
.10 Higher quality takes precedence over lower quality.
.11 Greater number, amount or size takes precedence over lesser number, amount or size.

2.7 The Contractor will be furnished 10 complete copies of the Drawings and the Project Manual and may obtain additional copies at their cost of reproduction.

Use of Contract Documents

2.8 The Drawings, Specifications and other documents prepared by the Design Engineer, are instruments of service to which the Design Engineer retains legal title, including copyright rights. These instruments of service shall not be used on other projects or for subsequent changes to this project without the written permission of the Design Engineer.

ARTICLE 3 - LAND, EXISTING CONDITIONS, LAYOUTS

Land

3.1 The Owner shall furnish access to the land on which the Work is to be performed including rights-of-way and easements for access. The Contractor shall confine its operations to the land furnished or to that portion of the land indicated on the Drawings. The Contractor shall provide all other land that it may require.

Existing Conditions

3.2 Execution of the Agreement by the Contractor is a representation that the Contractor has visited the site and has become familiar with existing and local conditions which may affect the Work and has included all costs associated therewith in its Bid.

Subsurface Soil Conditions

3.3 If information on subsurface soil conditions was obtained for design purposes, the Contractor may rely on the boring logs as a representation of soils that existed at the location of the boring at the time the borings were made but may not rely on the interpretations or opinions contained in the report nor on the completeness or adequacy of the information for the Contractor's construction purposes.

Existing Utilities and Underground Facilities

3.4 Information shown with respect to existing concealed or underground utilities and underground facilities is based on data provided by the utility or facility owners or by others. The Contractor may rely on the information shown in the Contract Documents for purposes of establishing the Scope of Work included in the Contract Price but the Owner and the Design Engineer are not responsible for the adequacy or completeness of such information for the Contractor's construction purposes.

Existing Structures

3.5 Information on existing structures and facilities including concealed utilities was obtained from such records as were available from facility owners and not from exhaustive field investigations. The Contractor may rely on technical data for existing structures and facilities including concealed utilities when such data are shown in the Contract Documents but not on the completeness or adequacy of such data for the Contractor's construction purposes.
Contractor Responsible for Damage

3.6 The Contractor shall be responsible for:
.1 verifying the existence and location of all utilities
and underground facilities, including the use of potholing,
hand excavations and hand demolition;
.2 coordinating work with utility and facility owners;
.3 protection of concealed and underground utilities
and underground facilities from damage;
.4 the repair or replacement of utilities or
underground facilities damaged by the Contractor's
failure to exercise reasonable care; and
.5 damage to others due to loss of utility service
resulting from the Contractor's operations.

Differing Conditions

3.7 If the Contractor encounters: (1) subsurface or
otherwise concealed physical conditions which differ
materially from those indicated in the Contract
Documents or (2) unknown physical conditions of an
unusual nature, which differ materially from those
ordinarily encountered and generally recognized as
inherent in work of the character covered by these
Contract Documents, (3) material that the Contractor
believes may be hazardous waste as defined by law,
the Contractor shall immediately report them to the Engineer.
If the Engineer determines that conditions encountered
are materially different from those indicated in the
Contract Documents or ordinarily encountered in work of
the character required and that the differing conditions
cause a change in the Contractor's cost or time, it will
recommend an equitable adjustment in Contract Price
and/or Time. The Contractor's failure to notify the Owner
of differing conditions that cause a reduction in the
Contractor's cost or time shall not affect the Owner's right
to make a Claim for adjustment in Contract Price and/or
Time. If either the Contractor or the Owner disagrees
with the Engineer's recommendation, they may make a
Claim under Article 10.

Contractor Responsible for Safety Precautions

3.8 The Contractor shall take all precautions required
to protect workers and others from known and unknown
or concealed hazards including verifying the location of
concealed and underground utilities and underground
facilities with utility and facility owners, potholing, hand
excavation and hand demolition and shall not rely on the
adequacy, accuracy or completeness of information
provided in the Contract Documents or elsewhere by the
Owner, the Engineer or the Design Engineer. The
Contractor shall be solely responsible for and take all
responsibility for safety in, on, or about the site.

Reference Points, Layout

3.9 The Owner shall provide reference points to
establish property corners, a baseline and an elevation.
The Contractor shall protect reference points provided
by the Owner and shall reset any that are damaged. The
Contractor shall hire a surveyor licensed in the state
where the project is being built to reset and document
baseline reference points, elevation bench marks and
property corners that are damaged.

3.10 The Contractor shall layout the Work from the
reference points provided and shall be responsible for
accurate location, alignment, elevation and level of the
completed Work.

ARTICLE 4 - BONDS AND INSURANCE

Performance and Payment Bonds

4.1 The Contractor shall furnish Performance and
Payment Bonds, each in an amount equal to the
Contract Price as security for the faithful performance
and payment of the Contractor's obligations under the
Contract Documents. The Payment Bond shall remain
in effect for at least two (2) years after final acceptance.
The Performance Bond shall remain in force the greater
of: (a) four (4) years after final completion and final
acceptance of all work, or (b) until the expiration of all
Warranties and Guarantees as required by the Contract
Documents. All Bonds shall be in the forms prescribed
by law and by the Contract Documents and be executed
by Sureties named in the current list of "Certified
Companies Holding Certificates of Authority as
Acceptable Sureties on Federal Bonds or Certified
Reinsurer Companies Holding Certificates Of Authority
As Acceptable Reinsuring Companies" published in
Circular 570 (most recent amendment) by the Audit
Staff Bureau of Accounts, U.S. Treasury Department
(www.fms.treas.gov/c570/index.html) and is admitted
to issue bonds in the states in which the Project is
located and all Work is performed. If the Surety is
declared bankrupt or becomes insolvent or its right to
do business is terminated by the state where the Work is
located or if it ceases to meet the foregoing listing
requirement, the Contractor shall provide another Bond
meeting the stated requirements. All Bonds signed by
an agent must be accompanied by a certified copy of the
agent's authority to act.

4.2 Sureties shall specifically waive all rights of
notice of and consent to change, extension of time,
alteration or addition to the terms of the Contract. The
Contractor shall be responsible for notifying Sureties of
all events that may affect them.
Insurance Requirements

4.3 The Contractor shall, at its sole cost, obtain and maintain, in force and effect for the duration of the Contract, including the Guarantee and Warranty periods, insurance of the following types with limits not less than those set forth below, in a company or companies with a Best's rating of no less than A:VII and admitted to issue insurance in the jurisdiction(s) in which all work is to be performed, where the site is located and where any waste is transported or deposited. The Contractor shall require compliance with these Insurance Requirements by its lower tier subcontractors:

.1 Workers' Compensation Insurance, including occupational illness or disease coverage, in accordance with the laws of the nation, state, territory or province having jurisdiction over the Contractor's employees and Employer's Liability Insurance with limits the greater of the statutory requirements, or $1,000,000 per accident and, for bodily injury by disease, $1,000,000 per employee. Coverage shall include all work covered under the U.S. Longshoreman's and Harbor Workers' Compensation Act and Jones Act. The Contractor shall not utilize occupational accident or health insurance policies, or the equivalent, in lieu of statutory Workers' Compensation insurance, or otherwise attempt to opt out of the statutory Workers' Compensation system. This insurance shall contain a waiver of subrogation against the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants.

.2 Comprehensive General Liability Insurance (Occurrence Form) ISO Form CG 00 01 10 93 with a full defense and indemnity, and unless modified in the Supplementary Conditions, shall include:

(a) a minimum combined single limit of liability of $3,000,000 or the limits required by law, whichever is greater for each occurrence for bodily injury and property damage;

(b) a minimum limit of liability of $3,000,000 each person for personal and advertising injury liability;

(c) a minimum limit of liability of $3,000,000 each occurrence for products/completed operations liability. The products/completed operations liability shall be maintained in full force and effect for not less than 10 years following completion of any of the Contractor's work;

(d) a general aggregate limit of not less than $3,000,000, which shall be provided on a per project basis by means of ISO Endorsement CG 25 03 11 85;

(e) an endorsement that names the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants as additional insureds. Such endorsement shall be made upon an ISO Endorsement CG 20 10 11 85, Additional Insured - Owners, Lessees or Contractor (Form B) and shall state "insurance is primary and all other insurance shall be noncontributory" and shall waive all rights of subrogation against the additional insureds;

(f) XCU coverage for claims arising from explosion, collapse and underground damage;

(g) Pollution Impairment Liability coverage of not less than $1,000,000;

(h) Contractual liability coverage for all oral and written contracts including the indemnity provisions contained herein

(i) Deductibles shall not exceed $5,000 per occurrence and shall be the sole responsibility of the Contractor;

(j) Coverage for Cross Liability and coverage for Severability of Interest shall be included;

(k) Claims made policies are not acceptable;

(l) Coverage for Work performed on or within 50 feet of a railroad, by deletion of any limitation or exclusion of coverage on or within 50 feet of a railroad or by a Railroad Protective Liability policy which complies with Article 4.3.2 (a), (d), (e), and (h)-(k).

.3 Automobile Liability Insurance covering use of all owned, non-owned and hired automobiles with a minimum combined single limit of liability for bodily injury and property damage of $3,000,000 per occurrence, and shall include:

(a) An endorsement that names the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants as additional insureds, states such "insurance is primary and all other insurance shall be noncontributory", and waives all rights of subrogation against the additional insureds;

(b) Coverage for Cross Liability and coverage for Severability of Interest;

.4 Property Insurance shall be on an all-risk policy form and shall include:

(a) A minimum limit of liability in the amount of the initial Contract Price as well as subsequent modifications thereto for the entire Work at the site on a replacement cost basis without voluntary deductibles;

(b) The interests of the Owner, the Contractor, the Engineer, and the Design Engineer and each of their officers, employees, agents, consultants, and all tiers of subcontractors, all of whom shall be listed as insureds or additional insureds and the policy shall, by endorsement, waive all rights of subrogation against the insureds and additional insureds and the endorsement shall state: "Subrogation: This insurance shall not be
invaluated should the named Insured waive in writing prior to a loss, any right of recovery against any person for loss occurring to the property described.

(c) Coverage for the Completed Value. If the Owner is damaged by the failure of the Contractor to maintain such insurance, the Contractor shall bear all reasonable costs properly attributable thereto;

(d) Coverage against the perils of fire and extended coverage and all physical loss or damage including, without limitation or duplication of coverage:

(i) lightning, windstorm, hail, smoke, explosion, riot, riot attending a strike, civil commotion, aircraft and vehicles;

(ii) theft, vandalism, malicious mischief, and water damage;

(iii) collapse, flood including tidal waves or overflow from bodies of water, landslide, water pressure or earth movement and earthquake;

(iv) removal of debris resulting from an insured loss and demolition occasioned by enforcement of any applicable legal requirements;

(v) falsework, temporary buildings and safety devices used by the Contractor to perform the Work;

(vi) portions of the Work stored on and off the site and in transit when such portions of the Work are included in an Application for Payment (including Inland Marine coverage and Installation and Equipment Floater coverage as applicable);

(vii) and shall cover compensation for the services of the Design Engineer and the Engineer required as a result of the insured loss.

(viii) flood and tidal wave insurance coverage shall be for the maximum percentage of the Contract Price permitted by law.

(e) Remaining in full force and effect until the Final Payment has been made to the Contractor. The property insurance policy shall be endorsed to allow for partial use or occupancy by the Owner without permitting a cancellation or lapse of insurance coverage;

(f) Deductibles shall not exceed $5,000 per occurrence with a deductible aggregate of $5,000. The Contractor shall pay for deductible losses at no cost to any other insured or additional insured.

5.5 Boiler and Machinery Insurance shall be provided as required by the Supplementary Conditions or by law.

Certificates of Insurance

4.4 Prior to beginning any Work, the Contractor shall file with the Owner, Design Engineer and Engineer, Certificates of Insurance in a form satisfactory to Owner (ACCORD form) along with a copy of all endorsements as required in Article 4.3. The certificates shall name each additional insured required by these General Conditions, shall state "insurance is primary and all other insurance shall be noncontributory", shall waive all rights of subrogation against the additional insureds; and shall also contain a provision that the Owner, Design Engineer and Engineer shall be notified in writing 30 days before the policies may be canceled or allowed to expire or any reduction in coverage. An additional certificate shall be submitted with the final Application for Payment showing required continuation of coverage beyond the Final Payment.

Property Insurance: Adjustment of Loss

4.5 A loss insured under the Contractor's property insurance shall be adjusted with the Contractor and made payable to the Contractor as fiduciary for the insured, as their interests may appear subject to the requirements of any applicable mortgage clause. The Contractor shall deposit the insurance proceeds in a separate account, and shall distribute payment to the parties in proportion to their cost for repairing or replacing the damaged Work. The Contractor shall provide a complete audited accounting of the distribution of insurance proceeds to all parties of interest.

ARTICLE 5 - CONTRACTOR

5.1 The Contractor shall be skilled in the type of work required by the Contract Documents and shall be licensed in accordance with applicable law. The Contractor shall perform at least ten percent of the dollar value of the Work using personnel on its own payroll.

Supervision

5.2 The Contractor shall supervise and direct the Work using its best skill and attention. The Contractor shall employ a competent superintendent to represent the Contractor at the site at all times work is being performed. The Superintendent shall not be replaced without reasonable cause and notice to the Engineer. Communications given to the Superintendent shall be as binding as if given to the Contractor.

Contractor Responsible for Means and Methods

5.3 The Contractor shall be solely and completely responsible for and have control over construction means, methods, techniques, sequences, procedures and safety and for coordinating all portions of the Work under the Contract Documents. The Owner, the
Engineer, and the Design Engineer and each of their officers, employees, agents and consultants shall not be responsible for any construction means, methods, techniques, sequences, nor for safety in, on or about the site, nor for coordinating any part of the Work.

Labor, Material and Equipment

5.4 The Contractor shall provide and pay for labor, material, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, communications, and other facilities and services necessary for the proper execution and completion of the Work.

5.5 The Contractor warrants to the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants that materials and equipment furnished under the Contract will be of good quality and new unless otherwise specified, that the Work will be free from defects, that all material, equipment, hardware, software and firmware products provided to the Project will be "Year 2000 Compliant" defined in Article 8.8, and that the Work will conform with the requirements of the Contract Documents. If required by the Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. Work not conforming to these requirements, including Proposed Equivalents not Favorably Reviewed, may be considered defective. The Contractor's warranty excludes remedy for damage caused by the Owner's abuse, modification, improper maintenance, improper operation, or normal wear.

5.6 The Contractor shall enforce strict discipline and good order among persons performing the Work. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

5.7 The Contractor shall be responsible to the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants for the acts and omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons performing portions of the Work under a contract with the Contractor.

Subcontractors

5.8 Unless listing subcontractors at the time of bidding is required by the bidding documents, the Contractor shall furnish a list of all subcontractors whose work amounts to one-half percent or more of the Contract Price prior to beginning construction. The Contractor shall not contract with any subcontractor to whom the Owner or the Engineer has made reasonable and timely objection.

5.9 Contracts between the Contractor and subcontractors shall (1) require each subcontractor to be bound to the Contractor by the terms of these Contract Documents, and to assume toward the Contractor, the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants all the obligations and responsibilities including insurance requirements which the Contractor, by these Contract Documents, assumes toward the Owner, the Design Engineer and the Engineer, and (2) at the Owner's option, provide for the assignment of subcontracts to the Owner in the event of Termination of the Contract.

Taxes, Permits, Fees and Notices

5.10 The Contractor shall pay sales, consumer, use, and other similar taxes which are legally enacted when bids are received. The Contractor shall secure and pay for the building permit (less the Plan Review fee) and other permits and governmental fees, licenses and government required inspections necessary for proper execution and completion of the Work including utility connection fees. The Owner will submit the Drawings, Specifications and other required data to the Building Official prior to bidding and will pay for the Plan Review fee. The Owner will pay capital cost assessments such as plant investment fees required by utility owners.

5.11 The Contractor shall give all notices and shall comply with all laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on furnishing and performing the Work.

Patents

5.12 The Contractor shall include in its bid and shall pay royalties and license fees required for the use of all patents. The Contractor shall defend suits or claims for infringement of patent rights and shall hold the Owner, the Engineer, and the Design Engineer and each of their officers, employees, agents and consultants harmless from loss on the account thereof.

Documents at the Site, Record Drawings

5.13 The Contractor shall keep a complete set of Contract Documents including all modifications and all favorably reviewed submittals at the site. The Contractor shall prepare Record Drawings by neatly adding the following information in ink at least once a week to a set of Contract Drawings: (1) references to Contract modifications including Responses to Request For Information, minor changes and Change Orders;
(2) as-built work that differs from work shown on the Contract Drawings; and (3) the dimensioned, as-installed location of major underground and concealed utilities, conduits, piping, tanks, facilities and similar items. Record Drawings shall be made on a clean copy of the Contract Drawings furnished under General Conditions paragraph 2.7 and not used for any other purposes. The Contractor shall make Record Drawings available to the Engineer to verify progress. The Contractor shall submit and obtain favorable review of the Record Drawings prior to Final Acceptance.

**Review of Contract Documents and Field Conditions**

5.14 Before starting work, the Contractor shall carefully study and compare the Contract Documents with each other and with existing site conditions and field measurements. The Contractor shall immediately report any discovered deficiencies including code violations to the Engineer, in writing. The Contractor is not responsible for finding all deficiencies but will be held responsible for construction required to correct deficiencies or code violations that the Contractor had knowledge of or should reasonably have had knowledge of and did not report to the Engineer in writing.

**Contractor's Construction Schedule**

5.15 Within 10 days after the date in the Notice to Proceed, Contractor shall submit a temporary construction schedule covering the first 60 days of the Contract Time. The submittal shall be graphic and in electronic form (floppy discs or CD-ROM).

5.16 Within 30 days after beginning construction, the Contractor shall prepare and submit for the Owner's and the Engineer's information a construction schedule for the Work. Unless a specific type of schedule is specified in Division One, the form of schedule may be selected by the Contractor but the schedule shall show the beginning and ending date for each major construction task by each trade and the interdependencies between tasks, and shall identify the critical sequence of tasks (or "Critical Path") that determines the shortest time required to complete the Work. The schedule shall reflect input from the Contractor's subcontractors and suppliers, shall include an allowance for normal unfavorable weather and enough float time to accomplish all clarifications, requests for information or changes required in the Contract Documents, and shall not exceed time limits specified in the Contract Documents. If the Contractor's schedule shows a shorter construction period than provided in the Contract Documents, the Contractor's schedule shall be a Critical Path Method (CPM) type schedule, shall be prepared in sufficient detail to demonstrate the feasibility of early completion and shall be submitted within 30 days after beginning construction. This CPM schedule shall show all required submittals and dates for ordering, shipping and receiving critical materials and equipment. Contractor's submittals shall be submitted with sufficient time to permit 30 days for a response and not impact Contractor's schedule. The submittals shall be graphic and in electronic format (floppy discs or CD-ROM).

5.17 It is agreed that the Contract Price includes the Contractor's office and field overhead, profit and related charges for the full Contract Time. The Contractor may, at its option, complete the Work in a shorter period than the Contract Time but the Contractor may not make a claim for extended overhead or other charges for: (1) delays that extended completion beyond the date planned by the Contractor but not beyond the Contract Time, and (2) delays contemplated by the Contractor and the Owner. All float in the schedule shall first be for the benefit of the Owner, the Engineer, the Design Engineer and then for the benefit of the Contractor. To the fullest extent permitted by law, the Contractor on behalf of itself and its subcontractors, waive any and all claims for damages attributable to delays, interference, or acceleration caused by the Owner, the Engineer, the Design Engineer and each of their officers, employees, agents and consultants and the Contractor and its subcontractors shall be entitled to an extension of the Contract Time as their exclusive remedy.

5.18 The construction schedule shall provide for expeditious and practicable execution of the Work and shall be revised and submitted monthly unless excused by the Engineer in writing. The Contractor shall conform to the most recent schedule.

5.19 The Contractor shall prepare and keep current, for the Engineer's information, a schedule of submittals which is coordinated with the Contractor's construction schedule and allows 30 days for the Engineer's review of each submittal and 30 days for review of each resubmittal.

**Safety of Persons and Protection of Property**

5.20 The Contractor shall be solely and exclusively responsible for construction safety means and methods and for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of this Contract.

5.21 The Contractor shall take all necessary precautions for safety of, and shall provide the
necessary protection to prevent damage, injury or loss:

1. employees on the Work and other persons who may be affected thereby;
2. the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's subcontracts or sub-subcontractors; and
3. other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities not designated for removal, relocation or replacement in the course of construction.

5.22 The Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

5.23 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, necessary fences and other safeguards for safety and protection of persons and property on and off the site and shall: (1) post danger signs and other warnings against hazards, (2) promulgate safety regulations, and (3) notify owners and users of adjacent sites and utilities when the Contractor's operations may affect them.

5.24 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry out such activities under supervision of properly qualified personnel.

5.25 The Contractor shall promptly remedy damage and loss to property that the Contractor is required to protect caused in whole or in part by the Contractor, a subcontractor, a sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable. The Contractor shall not be responsible for damage or loss resulting solely from the acts or omissions of the Owner or the Engineer or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under the Indemnification clause in this Article 5.

5.26 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's Superintendent unless otherwise designated by the Contractor in writing to the Owner and Engineer.

5.27 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs required in connection with the Work and shall send copies of all accident, injury or work-related illness reports and of all notices of unsafe conditions to the Engineer.

5.28 The Contractor shall not load or permit heavy weights to be placed on any part of the construction or site so as to endanger its safety.

Hazardous Materials

5.29 If the Contractor encounters material on the site which it reasonably believes may contain asbestos, polychlorinated biphenyl (PCB) or other hazardous material, the Contractor shall stop work in the affected area and shall notify the Owner in writing. The Owner shall have the suspected material tested and if found to contain asbestos, PCB or other hazardous material, the Owner shall have the material removed or rendered harmless. Work in the affected area may be resumed when the Owner gives written notice that the material containing asbestos, PCB or other hazardous material has been removed or made harmless. If halting work in the affected area impacts the Contractor's critical path for construction, the delay will be regarded as an Excusable Delay and the Contract Time will be extended.

Owner's Indemnification for Hazardous Materials

5.30 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Engineer, Design Engineer, and each of their consultants, agents, employees, officers, and shareholders from and against all claims, damages, losses and expenses, including, but not limited to, attorney's fees, arising out of or resulting from work in areas affected by asbestos, polychlorinated biphenyl (PCB) or other hazardous material, the presence and location of which has not been identified by the Owner in writing.

Emergencies

5.31 In an emergency affecting safety of persons or property, the Contractor shall act as required to prevent threatened damage, injury or loss without instruction or authorization from the Owner or Engineer. Additional compensation or extension of time claimed by the Contractor on account of such an emergency shall be determined as provided under Article 10.
Indemnification

5.32 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, the Engineer and the Design Engineer and each of their agents, consultants, officers, employees, and shareholders from and against all claims, damages, losses and expenses, including but not limited to attorney's fees, caused in whole or in part, or arising out of, connected with, or resulting from the performance of the Work, regardless of whether or not such liability, claim, damage, loss or expense was caused in part by any negligent act or omissions, whether active or passive, by a party indemnified hereunder. The Contractor stipulates that this provision has been negotiated in accordance with applicable law to be fully enforceable.

5.33 The obligation of the Contractor under this indemnity and hold harmless agreement shall not apply to liability for damages arising from the sole negligence or willful misconduct of the Owner, the Engineer, or the Design Engineer or their agents, consultants, employees, officers, shareholders or independent contractors (other than the Contractor).

5.34 The Contractor's liability to the Owner, Engineer and Design Engineer under this Indemnification Clause shall not be limited by any legal limitation on the amount or type of damages, compensation or benefits payable under workers' compensation acts, disability benefit acts or other employee benefit acts.

5.35 The Contractor's liability insurance shall provide coverage for the Contractor's obligations under this Indemnification Clause in accordance with paragraph 4.3.

ARTICLE 6 - OWNER

Owner's Right to Perform Work and Award Separate Contracts

6.1 The Owner reserves the right to perform construction within, related to or adjacent to the Work as a separate activity using its own workers or by contracts with separate contractors under contract conditions similar to those in Article 4 with respect to insurance and subrogation. The Owner shall provide coordination of these separate activities with the Work of the Contractor.

6.2 The Contractor shall cooperate with the Owner's separate contractors and workers and shall afford them access to their work areas and space to store materials, tools and equipment. The Contractor shall adjust its construction schedule to reflect agreed upon interfaces with the Owner's separate activities.

Mutual Responsibility

6.3 If part of the Contractor's work depends on or must interface with work performed by the Owner as a separate activity, the Contractor shall (1) cooperate with the Owner's coordination of the work efforts, (2) inspect work provided by the Owner's separate activities for compatibility with work provided or intended to be provided by the separate contractor, and (3) report to the Owner and the Engineer, prior to proceeding with work that may be affected, any deficiencies in work planned or executed by the Owner that would render it incompatible with work planned or completed by the separate contractor.

6.4 If the Contractor is caused delay or additional cost because of the Owner's separate activities, it may make a Claim as provided under Article 10.

Owner's Right to Stop the Work

6.5 If the Contractor fails to correct defective work or continues to perform defective work, the Owner may issue a signed order directing the Contractor to stop the Work or a portion of the Work until the defective work has been corrected. This right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

Owner's Right to Carry Out The Work or Correct Defective Work During Construction

6.6 If the Contractor fails to remove and replace or correct Defective Work, or if the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails to cure the defect, fault or neglect within 7 days after receipt of written notice from the Owner, the Owner may issue a second notice warning the Contractor that if it does not correct the defect, fault or neglect within the second 7-day period the Owner will, without prejudice to other remedies the Owner may have, correct such deficiencies. In which case, the Owner will deduct the cost of correcting such deficiencies, including compensation for any additional engineering services required, from payments due the Contractor. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. The Owner's right to correct Defective Work during the Guarantee Period is covered in Article 12.
ARTICLE 7 - ADMINISTRATION OF THE CONTRACT

7.1 At the Owner's option, either the Owner or the Engineer designated by the Owner will provide administration of the Contract and will be the Owner's representative (1) during construction, (2) until final payment is due and (3) with the Owner's concurrence, from time to time during the Guarantee Period. If an engineer other than the Design Engineer is appointed to be the Engineer to administer the Contract during construction, the duties and responsibilities of the Engineer and the Design Engineer during construction will be defined in the Supplementary Conditions, in Division One of the Specifications or in a modification to the Contract.

7.2 The Engineer may visit the site at intervals appropriate to the stage of construction to become generally familiar with the progress and quality of the completed Work and to determine in general if the Work is being performed in accordance with the Contract Documents. However, the Engineer will not be required to make exhaustive or continuous on-site inspections to check quality or quantity of the Work. The Contractor shall not rely upon the Engineer's site visits nor raise as a defense to any claims of defective work, that the Engineer visited the site or observed the site.

7.3 The Engineer shall not have control over or charge of and shall not be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's responsibility as provided in Article 5. The Engineer shall not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents.

7.4 The Engineer shall not have the authority to authorize extra work or to change the Contract Time or Price. The Engineer shall not have the authority to stop the Work. The Engineer's duties, responsibilities and limitations of authority are set forth in the Agreement between the Owner and the Engineer and shall not be modified by any action or inaction of any parties and can only be changed by a fully executed Amendment to the Agreement between the Owner and the Engineer.

7.5 The Engineer will have authority to reject Defective Work. The Engineer will have authority to require additional inspection or testing of the Work whether or not such Work is fabricated, installed or completed. Neither this authority of the Engineer nor a decision not to exercise such authority shall give rise to a duty or responsibility of the Engineer to the Contractor, subcontractors, material and equipment suppliers, their agents or employees, or other persons performing portions of the Work.

7.6 The Owner may arrange for the Engineer to provide a full-time on-site Resident Engineer with additional staff as appropriate. The duties, responsibilities and limitations of authority of the Resident Engineer and his staff shall be the same as defined for the Engineer in the Agreement between the Owner and the Engineer.

Communications

7.7 Communications between the Owner or the Design Engineer and the Contractor shall be through the Engineer. Communications between the Contractor and the Design Engineer shall be through the Engineer, and communications between the Contractor and the Design Engineer's consultants shall be through the Engineer and the Design Engineer. Communications between the Engineer and the subcontractors shall be through the Contractor.

Requests for Information and Responses

7.8 The Engineer will endeavor to issue Responses to Requests for Information within 30 days of the date a Request for Information is received by the Engineer unless the Engineer requests more information from the Contractor in which case the Response will be issued 20 days after receipt of the additional information. The Contractor shall use the Request for Information form, attached as Exhibit GC-1. The Engineer's Response to a Request for Information shall not authorize a change in Contract Time or Price. If the Contractor disagrees with the Engineer's interpretation of the Contract Documents, it shall notify the Engineer in writing in accordance with Article 9. The Engineer shall not be required to answer Requests for Information when the information is contained in the Contract Documents or when the Request for Information form is incomplete or not used.

ARTICLE 8 - SUBMITTALS

Definitions

8.1 Definition of Terms:

1 "Shop Drawings" are drawings, diagrams, schedules and other data custom prepared by the Contractor or one of its subcontractors or suppliers to illustrate some portion of the Work.

2 "Product Data" are catalogue pages, brochures, schedules, performance charts, diagrams, instructions
and other information which have been highlighted or marked and certified (if required in the Technical Specifications) by the Contractor to indicate the specific items, including options, that are being submitted for some portion of the work.

3 A "Proposed Equivalent" is an item proposed for use by the Contractor in lieu of the first specified item and warranted by the Contractor as being at least equal in quality, utility, function and appearance to the first specified item. The Contractor shall assume all costs and be fully and solely responsible for the Proposed Equivalent.

4 "Favorable Review" by the Engineer means that based on information submitted by the Contractor and in consideration of the Contractor's warranty required by General Conditions paragraph 8.8 the Contractor may provide the Favorably Reviewed item or work subject to the limitations in General Conditions Article 8, the General Requirements of Division 1, and the Engineer's review comments.

5 The term "first specified item" or "first named maker" refers to the first product identified in the Specifications by a model number or trade name and/or by a maker's name for a specified item.

Specified Items, Proposed Equivalents ("Or Equal")

8.2 When the first specified item is followed by a second maker's name and "or equal," the Contractor may submit Proposed Equivalent items for the Engineer's review. Proposed Equivalent items that are in the Engineer's judgment equal to the first specified item in quality, utility, and appearance, will be Favorably Reviewed. Where a product description and first maker's name is followed by "or equal" with no second maker's name, it means the specifier knows of no equivalent product and the Contractor may submit Proposed Equivalent products by other makers for review. Where the term "or equal" is omitted, it means that the named item is required to meet the Owner's needs; no products or makers other than those specified will be considered.

8.3 Proposed Equivalent items must be submitted as required for Product Data submittals on the form attached as Exhibit GC-3 and shall include adequate technical information to fully describe the function and quality of the item. Submittals of Proposed Equivalent items that are not made within 35 days of the Notice to Proceed will be rejected unless the Engineer has agreed in writing to a later submittal date and the Contractor agrees to comply with all conditions of the Engineer for the late submittal. If the Contractor's second attempt to obtain Favorable Review of a Proposed Equivalent item is unsuccessful, the Contractor shall submit the first specified item.

8.4 Inclusion of a second maker's name indicates the maker is acceptable but does not necessarily indicate the maker offers a standard product equal to the first specified item.

1. Items by the second named maker are subject to the same conditions of review and compatibility as other Proposed Equivalent items.

2 Inclusion of a maker's name and/or model number after a specification description is not a representation that the maker will furnish an item meeting the Contract requirements at bid time or at time of need. It is the Contractor's sole responsibility to furnish items meeting the Contract requirements.

8.5 Where items are specified with a description followed by a maker's name and trade name or model number, the item shall be provided with all of the custom modifications, special features, accessories and options described even though such things may not normally be included by the maker or provider as part of the model specified. Where there is a conflict between the written description of an item and maker's trade name and/or model number, the written description shall take precedence.

8.6 The design is based on first specified items including all described custom modifications, special features, accessories and options as made by the first named maker. The Contractor shall be responsible for all cost including redesign required to accommodate a Proposed Equivalent item including items by the second named maker.

8.7 The Engineer's review of Proposed Equivalent items is based solely on information provided by the Contractor and on the Contractor's warranty that the proposed item is at least equal in quality, utility, function and appearance to the first specified item. Favorable Review of a Proposed Equivalent item has the same meaning and is subject to the same limitations that apply to the Favorable Review of Product Data and Shop Drawings described in this Article.

Shop Drawings, Product Data, Samples and Proposed Equivalents

Intent of Contractor's Review

8.8 The Contractor shall make required submittals including Shop Drawings, Product Data, Samples and Proposed Equivalent items in time to allow for the Engineer's review and resubmittal, if required, without causing delay to the Work. The Contractor and appropriate subcontractor shall review, stamp, date and sign submittals before sending them to the Engineer. By
making such a submittal, the Contractor makes the following warranty and shall include that warranty statement on its letter of transmittal.

"The Contractor warrants:

1. Work or items submitted are complete, accurate and meet the requirements of the Contract Documents, or else any deviations are identified and described in a separate letter accompanying the submittal form, Exhibit GC-2.
2. Work or items submitted have been coordinated with and meet the requirements of other submittals, field conditions and the Work as a whole and quantities and dimensions are correct.
3. Proposed Equivalent items are at least equal in quality, utility and appearance to the first specified item, or else any deviations are identified in a separate letter accompanying the submittal form, Exhibit GC-3.
4. Adjustments to other work required to accommodate Proposed Equivalent items including second named items have been delineated on the submittal and will be made at the Contractor's expense.
5. This submittal includes all items needed for a particular specification section or assembly for which submittals are required.
6. And represents that all material, equipment, hardware, software and firmware product provided to the Project will be "Year 2000 Compliant". Year 2000 Compliant products will perform without error, loss of data or loss of functionality arising from any failure to process, calculate, compare or sequence date data accurately. In addition, Year 2000 Compliant products and/or services will not cause any associated products or systems in which they may be used to fail in any of the ways described above. This Year 2000 Compliant Warranty will remain in effect through January 1, 2034, not withstanding any other warranty period specified in the Contract Documents."

Intent and Limitations on Engineer's Review

8.9 The Engineer's review of the Contractor's submittals is done solely for the Engineer's and Owner's benefit. The Contractor agrees that the Engineer has no duty to the Contractor or any of its subcontractors or suppliers for the accuracy, completeness or adequacy of the Engineer's review of its submittals.

8.10 The Engineer's review of submittals is for compliance with the design intent and requirements of the Contract Documents and is based solely on information provided by the Contractor and on the Contractor's warranty that the work or items submitted meet the requirements of the Contract Documents, and the Work as a whole. If later information reveals that work or items submitted or furnished do not meet the requirements of the Contract Documents or the Work as a whole, the Engineer's Favorable Review shall be void and the items or work shall be considered Defective. The Engineer's Favorable Review shall not include an examination of methods or means of construction or required safety precautions. The Engineer's Favorable Review: (1) shall not include a review of quantities or dimensions, (2) shall not relieve the Contractor from responsibility for errors or omissions in submittals, (3) shall not relieve the Contractor from responsibility for complying with the requirements of the Contract Documents, (4) shall not constitute a Change Order, and (5) shall not constitute final acceptance of a product, item or portion of the Work.

8.11 The Engineer's Favorable Review of submittals shall not relieve the Contractor from responsibility for deviations from the requirements of the Contract Documents unless the deviations are specifically called to the Engineer's attention in a separate letter accompanying the submittal form, Exhibit GC-2, and the Engineer favorably reviews the specific deviations in writing.

8.12 The Engineer's Favorable Review of a resubmittal does not include a review of changes made by the Contractor to a previous submittal that were not requested by the Engineer unless the Contractor specifically calls the Engineer's attention to the non-requested changes, in a separate letter accompanying the resubmittal of form Exhibit GC-2.

8.13 Where performance type specifications are used or where pre-engineered or Contractor designed systems, elements, equipment or components are called for, the Owner, the Design Engineer and the Engineer shall have the right to rely on the Contractor's design. Favorable Review of the Contractor's design submittal shall be limited to acknowledgment that the design was prepared with the intent of meeting the specified performance criteria, but the Engineer's review shall not constitute a review of the design itself, of the designer's calculations, or of the effectiveness of the design in actually satisfying the specified criteria.

8.14 The Contractor shall allow 30 days for the Engineer's review of each submittal and 30 days for each resubmittal unless a different period is specified by the Engineer in writing. If the Engineer requests
additional information or clarification of a submittal, the
30 days shall be measured from the date the additional
information or clarification is received. If the Contractor
requires more than two submittals to obtain the Engineer's
Favorable Review, the Contractor shall compensate the
Owner for the cost of the Engineer's additional review
time. The Contractor shall not perform work for which
reviewed submittals are required without obtaining
Favorable Review of submittals.

8.15 Submittals required for the Owner's or Engineer's
information and on which the Engineer shall not be
expected to take responsive action are identified in the
Contract Documents.

ARTICLE 9 - CHANGES IN THE WORK

Changes

9.1 The Owner may order changes in the Work after
executing the Agreement by issuing a written Change
Order or Work Directive Change.

9.2 The Contractor expressly agrees that it shall not
consider any order, instruction, Clarification, Response to
a Request for Information or any other communication
either written or oral given intentionally or
unintentionally by the Engineer, Owner or any other
person as authorization or direction to do work that would
cause a change in Contract Time or Price unless it is a
Change Order or Work Directive Change signed by the
Owner.

Requests for Quotation

9.3 If a change involving Contract Price or Time is
being considered, the Engineer will issue a Request for
Quotation describing the proposed change. The
Contractor shall submit a quotation promptly so not to
delay or interfere with the progress of the Work, in
accordance with the requirements for determining the cost
of changes described in this Article.

Change Orders

9.4 If the Owner and the Contractor agree on the
change in Price and Time for a proposed change, a
Change Order will be issued and signed by the Engineer,
Contractor and the Owner. An executed Change Order
shall be conclusive and final settlement of the change in
Contract Time and Price for the work covered by the
Change Order including the effect of the change on all
other portions of the work completed or not and shall
include compensation for all related claims for disruption,
impact, delay or extended overhead, if any, that may
result from the change. Implied in every Change Order,
unless expressly reserved by the Owner or Contractor,
is a waiver of all known and unknown claims arising
out of the Change Order, including a waiver of Section
1542 of the California Civil Code as well as under any
other state or federal statute or common law principle of
similar effect which provides as follows:

"GENERAL RELEASE CLAIMS EXTINGUISHED.

A general release does not extend to claims which the
creditor does not know or suspect to exist in his favor at
the time of executing the release, which, if known by
him, must have materially affected his settlement with
the debtor."

9.5 The Owner reserves the right to have changed
work performed by a separate contractor or its own
workers if the Contractor and the Owner cannot agree
on the change in Price and Time required.

Work Directive Change

9.6 If the Owner and the Contractor have not agreed
on the change in Price or Time required for a proposed
change, or if time does not permit preparation of a
quotation, the Owner may direct the Contractor to
proceed with the work on a cost accounting basis by
issuing a Work Directive Change.

9.7 All Work Directive Changes must be signed by
the Owner and will state the maximum sum the Owner
is obligated to pay.

.1 If the Contractor has agreed to do the work on a
cost accounting basis and to complete the work for an
amount not to exceed the stated maximum sum, the
Contractor shall sign the Work Directive Change.

.2 If the Contractor cannot agree to a maximum
sum to complete the work, the Contractor shall not sign
the Work Directive Change. In that case the maximum
sum shall limit the amount the Owner is obligated to
pay to the Contractor but shall not obligate the
Contractor to complete the work for that sum.

9.8 When the Owner and the Contractor agree on
the change in Price and Time for a Work Directive
Change, the Work Directive Change shall be converted
into a Change Order.

Information, Interpretations and Minor Changes

9.9 The Engineer has the authority to order minor
changes in the Work including interpretations which are
consistent with the intent of the Contract Documents.
The Engineer does not have authority to order any changes which involve:

.1 a change in Contract Price, or
.2 a change in the Contract Time, or
.3 means, methods, techniques or sequence of Work, or
.4 safety in, on or about the site.

If the Contractor considers that any minor changes so ordered causes a change in Contract Price or Time, the Contractor shall notify the Engineer in writing within 15 days of receipt of the order and shall not proceed with the work except in the case of an emergency endangering persons or property.

9.10 If, after reviewing the Contractor's objection to a minor change, the Engineer determines the work is required by the Contract Documents and does not involve a change in Price or Time, the Owner may direct the Contractor, in writing, to proceed with the work. If so directed, the Contractor may (1) accept the Engineer's determination and proceed with the work or (2) give the Engineer written notice 5 days in advance of beginning work stating that it intends to make a claim under Article 10 and will document costs in accordance with paragraphs 9.11 through 9.14.

Determining Cost of Changes

9.11 The Contractor's quotations of cost on proposed changes and cost reported for work performed on a cost accounting basis shall be determined as the sum of the following:

.1 costs of labor including foremen engaged on the work but not of the Superintendent, field engineer, project manager, and other supervisory or support personnel except as provided in paragraph 9.11.5. Labor costs shall include the cost of social security, old age and unemployment insurance, fringe benefits required by labor agreements and workers' or workmen's compensation insurance;
.2 costs of materials, supplies and equipment, including cost of transportation, incorporated in the Work;
.3 rental costs of machinery and equipment, exclusive of portable power or hand tools, supplied by the Contractor or rented from others;
.4 costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the change;
.5 the increased or decreased cost of the Contractor's supervision and field office personnel but only if the change affects the "critical path" of construction activities and requires a change in Contract Time;

.6 the cost of any tier of subcontractors' work computed as required for the Contractor's work. The mark-up charged by a subcontractor for overhead and profit shall be subject to negotiation and shall not exceed 15% for work performed directly by the subcontractor and 5% for work performed by a subcontractor one tier below it, and

.7 for work performed by the Contractor, the mark-up for overhead, profit and all other costs shall be subject to negotiation and shall be the lesser of 15% for work performed directly by the Contractor and 5% for work performed by a subcontractor or the markup included in escrowed bid documents.

Work shall be done making the most effective use of labor; materials shall be purchased at the lowest available price and all discounts shall be passed on to the Owner; equipment shall be rented at the most favorable rate available for the term of use required.

9.12 When both additions and deletion are related and pertain to the same work item and are included in the same Change Order, the mark-up for overhead and profit shall be computed on the net increase, if any. No deductions for overhead and profit will be made on deductive changes except for deductive changes that materially change the scope of the work or deductive changes issued pursuant to the Owner's right to correct defective work, the Owner's right to remedy the Contractor's default or neglect or the Owner's right to terminate the Contract for cause.

9.13 The Contractor shall keep the Engineer informed as to when and where work is being performed on a cost accounting basis and shall submit complete auditable records of the cost of such work including daily time sheets signed by the Engineer.

9.14 Any work for which the Contractor may wish to make a claim shall be done in accordance with these requirements for work done on a cost accounting basis.

Change in Contract Time Due to Changes in the Work

9.15 If the work required by a Change Order affects the "Critical Path" of construction tasks and is the sole, unavoidable cause for changing the length of time required to complete the Work, the Contract Time will be adjusted accordingly.
ARTICLE 10 - CLAIMS AND DISPUTES

Claims

10.1 A Claim is a written demand by one of the parties to the Contract for an interpretation of Contract terms or an adjustment in Contract conditions including Price or Time and may involve questions of performance under the Contract including acceptability of work, progress of work, the extent to which work has been completed, whether work is included in the Contract, and other matters in question between the Owner and the Contractor.

Engineer's Decisions

10.2 Claims shall be made in writing and shall include complete documentation including:

1. The Contractor's certification, by its owner or an officer, under penalty of perjury, that (a) the claim is made in good faith, (b) supporting data are accurate and complete to the best of the Contractor's and subcontractor’s knowledge and belief, and (c) the amount requested accurately reflects the Contract adjustment for which the Contractor believes the Owner is liable.

2. Full disclosure of facts and detailed reasons supporting the Claim and citing relevant provisions in the Contract Documents.

3. Complete documented cost of doing the work for which it is making a Claim and such cost shall be computed in accordance with General Conditions paragraphs 9.11 through 9.14.

The Engineer, as an arbiter of disputes, will make an initial decision on all Claims made prior to the date the final payment is due including Claims alleging an error or omission by the Engineer. The Engineer's decision will be in writing, will be consistent with the intent of the Contract Documents and will cite the basis on which it is made. The Engineer will endeavor to make decisions that are impartial and will not be liable for results of decisions made in good faith. The Engineer's decision is a condition precedent to a demand by either party that a Claim be settled by litigation, or if agreed to in advance by both parties or if required by law, be settled by mediation or arbitration.

Time Limits for Submitting and Deciding Claims

10.3 The Contractor shall give written notice 5 days prior to beginning any work for which it intends to make a Claim in an increase in Contract Time or Price and expressly waives any right to make a Claim if the required notice is not given. All other Claims must be made within 14 days of the time the condition giving rise to the Claim becomes known to the claimant. The Engineer, as an arbiter of disputes, will issue a written decision on the Claim within 30 days after receipt of the Claim unless additional information is requested from the claimant or the claimant amends the Claim and then a decision will be issued within 30 days after receipt of additional information, or an amended Claim.

10.4 A demand to appeal the Engineer's decision and settle a Claim by litigation, mediation or arbitration can only be made after the Engineer has made a written determination, or in the absence of a determination, 7 days after the Engineer's determination became due. If no demand to settle a Claim by litigation, mediation or arbitration is made within 15 days after the Engineer's written decision was issued, the Engineer's decision shall become final and binding on the Owner and the Contractor and if a change in Contract Time or Price is involved, a Change Order shall be signed by both parties.

10.5 Provisions of law notwithstanding, the Owner and Contractor hereby agree that neither the Engineer, the Design Engineer, nor any other third party shall, without its specific written consent, be required to participate as a party in any litigation, arbitration or mediation proceedings between the Contractor and the Owner initiated to resolve disputes under the Contract Documents.

Mediation

10.6 If any dispute, controversy, or Claim (hereinafter referred to as a dispute) arises out of or relates to this Contract, or breach thereof, and if the dispute cannot be settled through direct discussions, then the parties first agree to try to settle the dispute by mediation before resorting to litigation or some other dispute resolution procedure. The mediator shall be an attorney experienced in mediating construction disputes and shall be chosen by agreement of the parties, but if no agreement then appointed by the Presiding Judge of the Superior Court in the jurisdiction of the site. Each party shall bear its own costs and expenses of the mediation, including attorney's fees. The fees and costs of the mediator shall be borne equally by the parties.

Work Continued During Disputes

10.7 The Contractor shall continue to work in conformance with the requirements of the Contract Documents and the progress schedule during any dispute and when waiting for decisions on Claims by the Engineer or for resolution of Claims by litigation, mediation or arbitration, unless otherwise directed in writing by the Engineer or Owner.
ARTICLE 11 - CONTRACT TIME AND DELAYS

Definitions

11.1 Definitions of Terms:

1 "Contract Time" is the period of time including authorized adjustments allowed for completion of the Work and is measured from the date of commencement in the Notice to Proceed to the date of Final Completion.

2 "Day" is a calendar day beginning and ending at midnight.

3 "Unusual Weather" is defined as when either the number of Wet Days or the number of Freezing Days exceeds the most recent published mean number of Wet or Freezing Days for the period of record, for the same month and for the weather observing station closest to the project site as reported in "Comparative Climatic Data" published by the National Oceanic and Atmospheric Administration, Asheville, NC 28801. "Wet Days" are defined as days that have at least 0.01 inch of rainfall unless modified in the Supplementary Conditions. "Freezing Days" are defined as days with a minimum temperature of 32 degrees F or lower.

Computation of Time

11.2 Any period of time referred to in the Contract Documents measured in days shall mean consecutive calendar days and shall exclude the first and include the last day. If the last day falls on a Saturday, Sunday or legal holiday, it shall be omitted from the calculation.

Contract Time

11.3 Time limits stated in the Agreement are the essence of the Contract. The Contractor confirms that the Contract Time is a reasonable period for performing the Work and includes enough float time to allow for normal unfavorable weather and other reasonably anticipated delays.

Damages for Late Completion

11.4 Liquidated damages if applicable are stipulated in the Agreement. If liquidated damages are not stipulated, the Contractor will be assessed actual damages suffered by the Owner as a result of completion after the Contract Time.

Commencing Work

11.5 The Contractor shall not commence work (1) prior to the date in the Notice to Proceed, (2) prior to giving the Engineer 5 days written notice and (3) prior to the effective date of insurance coverage required under Article 4.

Accelerated Work If Required to Meet Schedule

11.6 The Contractor shall proceed expeditiously with adequate forces and shall achieve Final Completion within the Contract Time. If the Contractor's performance falls behind schedule, the Contractor shall accelerate the work as required to get back on schedule at no additional cost to the Owner. Accelerated work shall include air or express delivery of materials and equipment, increasing the number of workers, working overtime, working Saturdays, Sundays, and holidays and working additional shifts. The Contractor shall pay the Owner for any extra cost of inspection made necessary by accelerated work required under this provision.

Excusable Delay

11.7 "Excusable Delay" means unforeseeable delay beyond the Contractor's or Owner's control and not resulting from the Contractor's fault or negligence. Excusable Delay includes labor disputes, fire, Unusual Weather, unavoidable casualties and unusual delays in transportation. The Contractor may make a Claim under Article 10 for an extension of Contract Time due to an Excusable Delay if it can show that the Excusable Delay is the sole and unavoidable cause increasing the time actually needed to complete the Work. The Contractor shall not be entitled to an increase in Contract Price due to an Excusable Delay.

Compensable Delays

11.8 The Contractor may make a Claim under Article 10 for extension of Contract Time due to delays that are not due to the fault or neglect of the Contractor and which could not have been reasonably anticipated, including delays: (1) caused by the Owner or Engineer or by the Owner's separate contractors or workers, (2) resulting from the Owner's failure to provide access to lands or rights-of-way on which the Work is to be performed, or (3) due to suspension of the Work ordered by the Owner. In making such a Claim, the Contractor must demonstrate that the delay was the sole and unavoidable cause for increasing the length of time required to complete the Work. For purposes of settlement of Claims under this paragraph, the Contractor's cost shall be determined in accordance with paragraph 9.11 except that no mark-up for profit will be allowed and therefore, the maximum percentage mark-ups allowed under subparagraphs 9.11.6 and 9.11.7 shall be reduced by one-third.
11.9 Changes in Contract Time associated with changes ordered by the Owner are covered under Article 9.

11.10 An executed Change Order covering changes ordered by the Owner under Article 9 or the resolution of Claims made under Article 10 shall be the final and conclusive settlement of the change in Contract Time and Price for the Work or Claim covered by the Change Order including all related costs in accordance with Article 9.4.

ARTICLE 12 - INSPECTION, DEFECTIVE WORK, GUARANTEE

Defective Work

12.1 Defective Work is work that (1) is unsatisfactory, faulty, deficient, or leaks, breaks, fails or does not conform to the Contract Documents; or (2) does not meet the requirements of reference standards, tests or approvals specifically referred to in the Contract Documents; or (3) has been damaged prior to final acceptance; or (4) does not meet applicable industry or trade standards; or (5) a submittal is required and Favorable Review has not been obtained.

Access to Work and Notice

12.2 The Contractor shall provide the Owner, the Engineer and each of their representatives safe access to every part of the Work at all times work is in progress for observation, inspecting and testing. The Contractor shall give 2 days notice of work being ready for required inspection, test or approval or of intent to cover work up.

Tests and Inspections

12.3 Unless otherwise specified, the Contractor shall arrange and pay for tests, inspections and approvals required by laws, ordinances, rules, regulations, orders of public authorities having jurisdiction or by the Contract Documents. All such tests, inspections and approvals shall be performed by an independent testing laboratory or inspection agency acceptable to the Engineer or to the appropriate public authority. Samples to be tested and items of work to be inspected will be selected by the Engineer or the public authority requiring the test or inspection. Test reports, inspection reports and certificates shall be submitted directly to the Engineer by the performing laboratory or agency. The Contractor shall notify the Engineer at least 2 days prior to all tests and inspections to permit observation by the Engineer.

Reinspection

12.4 If the Engineer determines that portions of the Work require additional testing or retesting, the Contractor shall provide material to be tested, safe access to test locations, power, light and other services. The cost of retesting shall be paid for by the Owner, but if the additional tests or retesting indicate that said portion of the Work is Defective, the Contractor shall pay the Owner all costs associated with additional testing or retesting including the cost of the Engineer's additional service.

Uncovering Work

12.5 If work is covered or concealed without giving the Engineer 2 days notice to permit observation, it shall be uncovered or exposed at the Contractor's expense to permit observation if so requested.

12.6 If the Engineer wishes to have work uncovered for observation after having been given the required notice to observe it, the Contractor shall uncover the work on a cost accounting basis. If the work is found to be in accordance with the Contract Documents, the Owner shall pay the cost of uncovering and replacing the work. If the work is found to be Defective, the Contractor shall pay the cost of uncovering and correcting the work and the cost of required additional engineering and testing service.

Correction of Defective Work

12.7 The Contractor shall promptly correct or replace: (1) work rejected by the Engineer as being Defective, and (2) work that is Defective whether or not rejected by the Engineer. The Contractor shall correct Defective Work prior to installing subsequent related or connected Work. The Contractor's obligation to correct Defective Work applies to latent as well as patent defects and whether or not the work is fabricated, installed or completed and whether observed before or after Substantial Completion. The Contractor shall bear the cost of correcting Defective Work including consequential costs, engineering services and attorneys' fees made necessary thereby.

Acceptance or Use of Defective Work

12.8 The Owner may elect to accept Defective Work in which case a deductive Change Order shall be signed by the Contractor reflecting the decreased value of the Work. If final payment has been made, the Contractor shall pay to the Owner a sum reflecting the decreased value of the Work.
12.9 The Owner may use Defective Work without negating its rejection or decreasing the Guarantee Period which shall commence when the work is finally corrected or replaced and accepted. When all or part of the Work is being used by the Owner, the Contractor shall schedule correction or replacement of Defective Work at the Owner's convenience.

Tests and Inspections Do Not Reduce Contractor's Responsibility for Performance

12.10 Observations by the Engineer or tests, inspections or approvals by others shall not relieve the Contractor from its obligation to perform the Work in accordance with the Contract Documents.

Guarantee Period

12.11 Within 7 days of receipt of written notice from the Owner, the Contractor shall correct or replace work found Defective within one year after the date of Final Completion of the Work and Acceptance by the Owner or such longer period as covered by any Special Guarantee required by the Contract Documents or by law. For work first performed or first made acceptable after the date of Final Completion, the one-year or longer Guarantee Period shall commence to run at the time the Work is completed or made acceptable.

Owner's Right to Correct Defective Work During Guarantee Period

12.12 If the Contractor fails to correct Defective Work within 7 days of receiving notice to do so, the Owner may correct the Work and recover the cost of correction from the Contractor. If the Defective Work creates an emergency where delay would cause unsafe conditions or serious risk of loss or damage, the Owner may proceed to correct the Defective Work without giving the Contractor notice.

12.13 If the Owner corrects Defective Work under this paragraph, the Contractor shall pay the Owner all direct, indirect and consequential cost and all required engineering services and attorney's fees.

12.14 The Contractor shall be responsible for the cost of removing and replacing work provided by the Owner when such removal and/or replacement is necessary to permit correction of Defective Work for which the Contractor is responsible.

Contractor's Liability for Defective Work Not Limited by Guarantee

12.15 Nothing contained in this Article 12 nor in any Special Guarantee required under Division 1 General Requirements shall be construed to limit the period of the Contractor's obligations under the Contract Documents or under law. Establishment of a time period for the Contractor's specific obligation to correct work places no limit on the time within which the Contractor's obligation to comply with the Contract Documents may be enforced nor on the period during which the Contractor may be held liable for the effect of Defective Work.

12.16 Nothing contained in this Article 12 nor in any Special Guarantee required under Division 1 General Requirements shall be construed to limit the Contractor's, subcontractor's, material or equipment supplier's liability for damages sustained as a result of latent or patent defects in equipment or materials furnished or caused by the negligence of the Contractor or his subcontractors or suppliers. The guarantees contained in this Article 12 shall not be a waiver of nor shall they reduce any guarantee or warrante offered by the suppliers of materials or equipment furnished under this Contract nor shall they reduce any responsibilities imposed on manufacturers or suppliers of such equipment under law.

ARTICLE 13 - PAYMENT AND COMPLETION

Schedule of Values

13.1 At least 20 days prior to the first Application for Payment Date, the Contractor shall submit a Schedule of Values, in a form acceptable to the Engineer, allocating the Contract Price to various trades, types of work, pieces of equipment, and major tasks to assist the Engineer in evaluating the percentage completion for each part of the Work. The Contractor's overhead and profit shall be uniformly pro-rated over all items in the Schedule of Values. The Schedule of Values shall represent the actual cost of each segment of the work and shall not allocate higher costs, overhead or profit to work items scheduled for early completion. If the Engineer objects to the allocation of cost or the level of detail provided, the Contractor shall revise and resubmit the Schedule of Values.

Application for Payment

13.2 The period covered by each Application for Payment shall be one calendar month. Payment shall be based on work completed as of the Application for Payment Date which shall be the last day of the month.
unless otherwise stated in the Agreement. Within 7 days after each Application for Payment Date, the Contractor shall meet with the Engineer to review the line item amounts proposed by the Contractor for payment. When the amounts proposed are acceptable to the Engineer, the Contractor shall prepare and submit within 3 days, the Application for Payment form, attached as Exhibit GC-4, and Conditional Lien Releases from the Contractor, each subcontractor, supplier and materialman whose work is included in the Application. The Contractor shall sign and certify on the Application for Payment, subject to penalty of perjury, the following: "The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief, the Work covered by this Application for Payment has been completed in accordance with the Contract Documents and that all Work for which previous payments have been received is free and clear of liens, claims, security interests or encumbrances of any kind. The Contractor further warrants that title to all Work covered by this Application for Payment will pass to the Owner no later than the time of payment."

Payment for Items Delivered But Not Installed

13.3 If recommended by the Engineer, Applications for Payment may include the percentage of value stipulated in the Agreement for major equipment and custom fabricated items that have been delivered, stored and protected at the site providing proof is furnished that title will pass to the Owner upon payment. Payment will not be made for material stored at the site that is not custom fabricated. Payment will not be made for items stored off the site. Payment will not be made for stored or installed items that are not protected from physical, environmental or other damage. Payment for successful submittal of Shop Drawings or Product Data will be made only when specifically provided for in Division 1.

Engineer's Recommendation for Payment

13.4 Within 7 days after receipt of the Contractor's Application for Payment, the Engineer will either issue a Recommendation for Payment for such amount as the Engineer determines is due or will notify the Contractor and the Owner of reasons for withholding recommendation. The Engineer's recommendation will not be an evaluation or interpretation based upon legal theories or principles but will be based upon sound engineering judgment. The Owner will seek independent legal services, if necessary to assist it in determining if withholdings are appropriate. Retainage to be withheld by the Owner is stipulated in the Agreement.

13.5 The Engineer's Recommendation for Payment will constitute a representation that to the Engineer's best knowledge, information and belief the Work has progressed to the point indicated and is generally in conformance with the Contract Documents but is subject to re-evaluation during subsequent site visits and upon final completion. The Engineer's Recommendation for Payment shall not be taken as a representation that the Engineer has (1) made exhaustive or continuous onsite inspections to check the quality of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Price, or (5) offered its legal opinion in any respect.

13.6 If, in the Engineer's opinion, the representations in paragraph 13.5 cannot be made or if the Engineer has knowledge of any of the faults listed below, then the Engineer may decline to issue a Recommendation for Payment or may recommend a reduced amount of payment or may rescind previously issued Recommendation for Payment. Faults for which payment may be withheld, reduced or rescinded include:

.1 Defective Work not corrected;
.2 Third party claims filed or reasonable evidence indicating probable filing of such claims;
.3 Failure of the Contractor to make payments properly to subcontractors or suppliers for labor, materials or equipment;
.4 Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;
.5 Damage to property, the Work, the Owner, another contractor or a third party;
.6 Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
.7 Work performed for which submittals are required prior to obtaining Favorable Review of submittals;
.8 Persistent failure to carry out the Work in accordance with the Contract Documents;
.9 Failure to submit a construction schedule or to update the construction schedule in accordance with General Conditions paragraph 5.18;
.10 Failure to update Record Drawings weekly;
.11 Failure to reinstate required insurance that has been allowed to lapse; or
.12 Non-payment of money owed to the Owner for the extra cost of inspection or engineering services provided for in the General Conditions.

Completion and Acceptance

13.7 Definitions

.1 "Substantial Completion" means the Work has progressed to the point that: (1) the Work is ready for beneficial use and occupancy by the Owner for the intended purpose, (2) all fire and life safety work has been completed, inspected and accepted, (3) all mechanical and process systems and equipment are complete and have been put in automatic operation, (4) the total value of uncompleted work is less than one-half of one percent of the Contract Price and (5) completing the Work will not significantly interfere with the Owner's convenience, use or cost of operation.

.2 "Semi-Final Inspection" determines if the Work is Substantially Complete.

.3 "Final Inspection" determines if the Work has reached Final Completion.

.4 "Final Completion" indicates that the Work has been fully completed in accordance with the Contract Documents and is ready for acceptance and final payment by the Owner.

.5 "The Final Punch List" contains items that remain uncompleted after Substantial Completion but that must be completed prior to Final Completion.

Owner's Right to Partial Use

13.8 When provided for in the Contract Documents or agreed to in writing by the Owner and the Contractor, the Owner may notify the Contractor and begin using a portion of the Work even though it is not Substantially Complete. The Contractor, the Owner and the Engineer shall agree on and document responsibilities for security, operation, safety, maintenance, utilities, insurance, warranties and guarantees for that portion of the Work being used by the Owner. The Owner, the Contractor and the Engineer shall inspect such portion of the Work and shall prepare a list of work to be completed or corrected before final acceptance. The Owner's use of any portion of the Work shall not constitute final acceptance of that portion of the Work prior to Final Completion and acceptance of the Work as a whole. The Owner shall allow the Contractor reasonable access to complete or correct work in areas being used by the Owner. Partial beneficial occupancy shall not relieve the Contractor of Liquidated Damages unless the Contract Documents expressly provide for and identify the portion of Work that may be considered Substantially Complete before the remaining portions of the Work.

Contractor's List of Deficiencies

13.9 When the Contractor considers the Work nearly complete, the Contractor shall review the Contract Documents, inspect the Work and prepare a list of deficiencies (Punch List). The Contractor shall complete or correct the items on the Punch List until, in the Contractor's opinion, the Work is Substantially Complete and ready for occupancy and use by the Owner. The Contractor shall then deliver the Punch List to the Engineer and notify the Engineer in writing that the Contractor believes the Work is Substantially Complete and ready for a Semi-Final Inspection.

Semi-Final Inspection, Substantial Completion

13.10 When the Work is ready and the Contractor so notifies the Engineer in writing, the Engineer will make a Semi-Final Inspection and may add additional items to the Contractor's Punch List. As a result of this inspection, the Engineer may determine that (1) the Work is not sufficiently complete to warrant a Semi-Final Inspection, additions to the Contractor's Punch List, or the preparation of a Final Punch List, (2) the Work is sufficiently complete for the Engineer to prepare a Final Punch List but certain incomplete or Defective Work prohibits use of the Work for its intended purpose and therefore, the Work is not Substantially Complete, or (3) that the Work is Substantially Complete and usable for its intended purpose and the Engineer can prepare a Final Punch list. In preceding cases 1 and 2, the Contractor shall continue the Work and call for a second Semi-Final Inspection when the Work is ready. In case (3), the Engineer will prepare a Final Punch List and a notice of Substantial Completion which shall establish the date of Substantial Completion and shall state the time agreed to by the Owner and the Contractor (not to exceed 30 days) in which the Contractor shall complete all work ready for Final Inspection. The date of Substantial Completion shall be revised if necessary such that it is no more than 30 days prior to the actual date of Final Completion. The Engineer shall attach a copy of the Final Punch List to the notice of Substantial Completion. If the Contractor does not achieve Substantial Completion on the second attempt, it shall reimburse the Owner the cost of the Engineer's services for additional inspections.
Final Inspection, Final Completion

13.11 When the Contractor has completed or corrected all the items on the Engineer's Final Punch List and has made all required final submittals, the Contractor shall give the Engineer written notice that the Work is ready for Final Inspection and acceptance and upon receipt of a final Application for Payment, the Engineer shall make a Final Inspection. If the Engineer finds the Work is not fully complete, it shall notify the Contractor of items still requiring completion or correction. The Contractor shall immediately correct these deficiencies and call for a reinspection. When the Engineer finds to the best of the Engineer's knowledge, information and belief, and on the basis of the Engineer's observations and inspections, the Work is acceptable and fully complete in accordance with the Contract Documents, and when all final submittals have been made, the Engineer will recommend that the Owner issue and file a Notice of Completion, designating Final Completion, make Final Payment and Accept the Work in accordance with the terms and conditions of the Contract Documents.

13.12 Neither the Engineer's failure to include an item on the Final Punch List, nor making of the Semi-Final or the Final Inspection, nor recommendation of final acceptance shall alter the Contractor's responsibility to complete all Work in accordance with the Contract Documents.

Final Payment

13.13 Within 10 days after the Contractor has delivered to the Owner a complete release of all liens arising out of this Contract or receipts in full covering all labor, materials and equipment for which a lien could be filed, or a bond satisfactory to the Owner to defend and indemnify the Owner against such liens, the Owner shall accept the Work and file a Notice of Completion. Final Payment shall not become due until 60 days after the Owner files a Notice of Completion and there being no liens or stop notices filed. If any lien or stop notice remains unsatisfied, the Contractor shall immediately take all steps necessary to remove all liens or stop notices before Final Payment is made. If any liens are filed or exist after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such liens, including all costs and reasonable attorneys' fees.

Waiver of Claims

13.14 The making of Final Payment shall constitute a waiver of claims by the Owner except those arising from:

1. Liens, claims, security interests or encumbrances arising out of the Contract and unsettled;
2. Failure of the Work to comply with the requirements of the Contract Documents; or
3. Terms of the one-year guarantee period and special warranties required by the Contract Documents.
4. Any of the Contractor's continuing obligations under the Contract Documents.

13.15 Acceptance of Final Payment by the Contractor, a subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 14 - TERMINATION

Termination by the Owner for Cause

14.1 The Owner may terminate the Contract if the Contractor:
1. Persistently fails to provide enough workers or materials to properly pursue the Work as required to complete the Work within the Contract Time;
2. Persistently fails to perform the Work in accordance with the Contract Documents including, but not limited to providing monthly updates to the schedule of Work and monthly updates to Record Drawings, or to correct or replace Defective Work when directed to do so;
3. Fails to make payment to subcontractors or material suppliers;
4. Becomes insolvent, commences any form of voluntary bankruptcy proceedings, has any petition or action filed against it under any bankruptcy code or law, makes a general assignment for the benefit of creditors, or if a trustee, receiver or agent is appointed under law to take charge of Contractor's property or operations for the benefit of creditors;
5. Persistently disregards laws, regulations, rules or orders of public bodies having jurisdiction or persistently disregards the authority of the Engineer or Owner;
6. Fails to retain a valid Contractor's license of the required class in the applicable jurisdiction; or
7. Otherwise commits a material breach of the Contract.

14.2 When any of the above reasons exist and without prejudice to any other rights or remedies the Owner may have, and after giving the Contractor and the Contractor's Surety 7 days written notice, the Owner
may terminate the employment of the Contractor and, subject to any prior rights of the Surety, the Owner may:

.1 Take possession of the site and of all material, tools and construction equipment on the site owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to paragraph 5.9; and

.3 Complete the Work by any reasonable method the Owner may select.

14.3 When the Owner terminates the Contract for cause, the Contractor shall not be entitled to further payment until the Work has been completed.

14.4 If the cost of completing the Work, including additional engineering services, attorney's fees and administrative expenses made necessary thereby, exceeds the unpaid Contract Price, the Contractor shall pay the difference to the Owner. This obligation for payment shall be binding after termination of the Contract. If the cost of completing the Work including costs for engineering, legal, and administrative services minus the Contractor's unearned overhead and profit computed in accordance with paragraphs 9.11.6 and 9.11.7, is less than the unpaid Contract Price, the difference and other consequential costs shall be paid to the Contractor.

Suspension by the Owner for Convenience

14.5 The Owner, without cause, may issue written order giving the Contractor 7 days notice to suspend, delay or interrupt the Work in whole or in part for any period of not more than 90 consecutive days. The order shall fix the dates on which the work shall cease and resume.

14.6 If a suspension, delay, or interruption of the Work ordered by the Owner for convenience causes an increase or decrease in the cost of performing the Contract, the Contract Price shall be adjusted as agreed by the Owner and the Contractor or in accordance with the method for determining the cost of changes in Article 9. The Contract Price shall not be adjusted if the Contractor's performance would otherwise have been suspended, delayed or interrupted due to causes for which the Contractor is responsible.

Termination by the Owner for Convenience

14.7 The Owner may terminate the Contract without cause by giving the Contractor 7 days written notice. Such termination shall not prejudice any other right or remedy the Owner may have under the Contract. If the Contract is terminated without cause, the Contractor shall be paid for all work executed as of the date of termination plus reasonable termination expenses including direct, indirect and consequential costs but the Contractor shall not be paid for anticipated profit on work not performed.

Contractor May Stop Work or Terminate

14.8 If, through no act or fault of Contractor, the Work is suspended for a period of more than 90 days by the Owner or under an order of court or other public authority, or the Engineer fails to act on any Application for Payment within 30 days after it is submitted, or the Owner fails for 60 days to pay the Contractor any sum finally determined to be due, the Contractor may, upon 7 days' written notice to the Owner and the Engineer, terminate the Agreement and recover from the Owner payment for all Work performed and any expense sustained plus reasonable termination expenses. In addition and in lieu of terminating the Agreement, if the Engineer has failed to act on an Application for Payment or the Owner has failed to make any payment as aforesaid, the Contractor may, upon 7 days' written notice to the Owner and the Engineer, stop the Work until payment of all amounts then due is received. The provisions of this paragraph shall not relieve the Contractor of the obligations to carry on the Work in accordance with the progress schedule and without delay during disputes and disagreements with the Owner.

ARTICLE 15 - MISCELLANEOUS

Method for Giving Notices

15.1 Written notice shall be considered to have been given if delivered in person to the individual, partner of the partnership or joint venture, or officer of the corporation for whom intended or if sent by registered or certified mail to the address given in the Agreement unless amended by written notice. Notice to the Contractor's superintendent shall be considered notice to the Contractor. Notice to the Resident Engineer shall be considered notice to the Engineer. Notice to the Owner's Project Representative or Manager shall be considered notice to the Owner.

Rights and Remedies

15.2 Duties, obligations, rights and remedies prescribed by the Contract Documents shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed by or available under law.
Failure to Act Not a Waiver of Rights

15.3 Except as expressly provided in the Contract Documents, no action or failure to act by the Owner, Engineer, Design Engineer or Contractor shall constitute a waiver of a right afforded or duty imposed under the Contract. No such action or failure to act shall constitute approval of or acquiescence in failure to perform in accordance with the Contract Documents or any other breach of contract.

Severability of Provisions

15.4 The finding under law that any one or more provisions or any portion of a provision in the Contract Documents is invalid, unenforceable, or illegal shall not impair the validity or enforceability of any other provision or of the Contract Documents as a whole. In the case of invalidity or enforceability of any provision or portion thereof, the provision shall be rewritten and enforced to the maximum extent permitted by law to accomplish as near as possible the intent of the original provision.

Right to Audit

15.5 The Owner shall have the right to audit the Contractor's accounting records and the accounting records of any tier of subcontractor to verify the cost of work done on a cost accounting basis as provided under Article 9.

Governing Law

15.6 The Contract shall be governed by the law of the place where the project is located.

END OF GENERAL CONDITIONS
Request for Information

Originator: ___________________________ Drawing Reference: ___________________________
Requested Date of Response: ___________________________ Specification Section: ___________________________

Written requests for information will not be considered without an accompanying completed copy of this RFI. By submission of this form the Contractor represents it has carefully reviewed the Contract Documents, coordinated the Work with the appropriate subcontractors, reviewed the field conditions and hereby certifies that the information requested cannot be determined from such efforts as required by the Contract Documents.

The Contractor requests the following information in accordance with the requirements of the Contract Documents.

Description of Requested Information
Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

Contractor's Proposed Method of Resolving Issue
Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

Contractor's Proposed Impact on Project
Estimated Contract Cost will be □ increased □ decreased □ unchanged by: ________________
Estimated Contract Time will be □ increased □ decreased □ unchanged by: __________ days.

Attachments
Attach supporting documentation sufficient for Engineer to evaluate Request for Information, including documentation of field conditions. Forms submitted without adequate documentation will be returned without comment for further clarification.

Contractor's signature below signifies acceptance of responsibility for accuracy and completeness of information included in this Request for Information Form.

Authorized Signature: ___________________________ Title: ___________________________ Date: ___________________________

Company: ___________________________
Response

Notations listed below indicate the response to the Contractor's proposed method to resolve the issue. If the Contractor has not proposed a method of resolution, see remarks below. Modification of costs, project schedule or time shall be processed in accordance with the Contract Documents.

- No Exceptions Taken (NET)
- Make Corrections Noted (MCN)
- Amend and Resubmit (A&R)
- Rejected, Resubmit (RR)
- Returned Without Review (NR)

Remarks

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

If Contractor estimates an impact on Project time or price based upon Response, submit Reply within 5 working days of receipt.

Respondent: ____________________________  Signature: ____________________________
Company: ______________________________
Issued for Kennedy/Jenks Consultants by: ______________________________

Contractor's Reply To Response:

Estimated Contract Cost will be □ increased □ decreased □ unchanged by: __________
Estimated Contract Time will be □ increased □ decreased □ unchanged by: _______ Days.

Comments

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

Distribution  RFI  Response  Reply
Owner
Engineer
Contractor
File

General Conditions
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Exhibit GC-1
Response for Information and Response
Submittal No.: XX and Response

From: Company Name
Mailing Address
City, ST Zip
Name

Specification Section: ____________________________

Submittal

A. Certification of Completeness and Accuracy

We certify that we have reviewed this submittal in detail and that the submittal is:

1. Complete and accurate and in complete compliance with the Contract Documents.

2. Compliant with the requirements of "Material and Equipment" in Section 01040, especially the subparagraph titled "Compatibility of Equipment and Material".

3. Compliant with the paragraph titled "Performance Specifications and Contractor Designed Items" in Section 01040.

4. Without any deviations from the Contract Drawings, except the following (describe deviation) which have the following advantages and disadvantages:

   Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

   ____________________________
   ____________________________
   ____________________________

Signed by Subcontractor: ________________ Title: ____________________________ Date: ________________

Signed by Contractor: ________________ Title: ____________________________ Date: ________________

B. Certification of Year 2000 Compliance

We certify that all material, equipment, hardware, software and firmware product submitted is "Year 2000 Compliant". Year 2000 Compliant products perform without error, loss of data or loss of functionality arising from any failure to process, calculate, compare or sequence date data accurately. In addition, Year 2000 Compliant products and/or services will not cause any associated products or systems in which they may be used to fail in any ways described above. We include the manufacturer's Year 2000 Compliance Certification with this submittal.

Signed by Subcontractor: ________________ Title: ____________________________ Date: ________________

Signed by Contractor: ________________ Title: ____________________________ Date: ________________
Response

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A. The action(s) noted above have been taken on the enclosed document(s).

- NET = No Exceptions Taken
- MCN = Make Corrections Noted
- A&R = Amend and Resubmit
- RR = Rejected, Resubmit
- NR = Not Reviewed

Comment(s):

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

B. Corrections or comments made on the shop drawings during this review do not relieve the Contractor from compliance with the requirements of the Drawings and Specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for: confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating its work with that of all other trades, and performing its work in a safe and satisfactory manner.

Distribution Submittal Encl. Response

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Responder: type name here - sign above

General Conditions
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Exhibit GC-2
Submittal and Response
**Proposed Equivalent No. XX and Response**

**From:** Company Name  
Mailing Address  
City, ST Zip  
Name

**Proposed Equivalent**

A. When the first specified item is followed by a second maker's name and "or equal," the Contractor may submit Proposed Equivalent items for the Engineer's review. Proposed Equivalent items that are in the Engineer's judgment equal to the first specified item in quality, utility, and appearance, will be Favorably Reviewed. Where a product description and first maker's name is followed by "or equal" with no second maker's name, it means the specifier knows of no equivalent product and the Contractor may submit Proposed Equivalent products by other makers for review. Where the term "or equal" is omitted, it means that the named item is required to meet the Owner's needs; no products or makers other than those specified will be considered.

B. This request shall include adequate technical information to fully describe the function and quality of the item. Submittals of Proposed Equivalent items that are not made within 35 days of the Notice to Proceed will be rejected unless the Engineer has agreed in writing to a later submittal date and the Contractor agrees to comply with all conditions of the Engineer for the late submittal. If the Contractor's second attempt to obtain Favorable Review of a Proposed Equivalent item is unsuccessful, the Contractor shall submit the first specified item.

C. Inclusion of a second maker's name indicates the maker is acceptable but does not necessarily indicate the maker offers a standard product equal to the first specified item. Items by the second named maker are subject to the same conditions of review and compatibility as other Proposed Equivalent items. Inclusion of a maker's name and/or model number after a specification description is not a representation that the maker will furnish an item meeting the Contract requirements at bid time or at time of need. It is the Contractor's sole responsibility to furnish items meeting the Contract requirements.

D. The Engineer's review of Proposed Equivalent items is based solely on information provided by the Contractor and on the Contractor's warranty that the proposed item is equal in quality, utility, function and appearance to the first specified item. Favorable Review of a Proposed Equivalent item has the same meaning and is subject to the same limitations that apply to the Favorable Review of Product Data and Shop Drawings described in the Contract Documents.

E. Submit with proposal:

1. Description of item being proposed including the Manufacturer's model number.
2. Manufacturer's representation that item is equal to or superior to specified item in all respects.
3. Manufacturer's product data.
4. Information about several recent similar installations, including project name, owner's name, address, telephone number, and name of knowledgeable person to contact for information on performance of the product.
5. Whether a reduction in the Contract Price is being proposed and, if so, how much.
6. Any differences between the product specified and the Proposed Equivalent, including the warranty.
F. Certification of Equivalency, Completeness and Accuracy:

We certify that we have reviewed this request in detail and that the item proposed is:

1. Equal to or superior to the specified item
2. Complete and accurate and in complete compliance with the Contract Documents,
3. Compliant with the requirements of "Material and Equipment" in Section 01040, especially the subparagraph titled "Compatibility of Equipment and Material",
4. Compliant with the paragraph titled "Performance Specifications and Contractor Designed Work" in Section 01040,
5. Without any deviations from the Contract Documents, except the following (describe deviation) which have the following advantages and disadvantages:

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

We further represent and warrant to be solely responsible for any extra cost or expense necessary to make the proposed item or service fully equivalent to and compatible with the Contract Documents and meet or exceed the design intent.

If we use the Proposed Equivalent, we agree to comply with all additional requirements imposed upon us by the Engineer and Owner.

Signed by Subcontractor: ___________________________ Title: ___________________________ Date: __________

Signed by Contractor: ___________________________ Title: ___________________________ Date: __________

G. Certification of Year 2000 Compliance:

We certify that all material, equipment, hardware, software and firmware product submitted is "Year 2000 Compliant". Year 2000 Compliant products perform without error, loss of data or loss of functionality arising from any failure to process, calculate, compare or sequence date data accurately. In addition, Year 2000 Compliant products and/or services will not cause any associated products or systems in which they may be used to fail in any ways described above. We include the manufacturer's Year 2000 Compliance Certification with this submittal.

Signed by Subcontractor: ___________________________ Title: ___________________________ Date: __________

Signed by Contractor: ___________________________ Title: ___________________________ Date: __________

General Conditions
© KJ January 2001

Exhibit GC-3
Proposed Equivalent and Response
Proposed Equivalent No. XX and Response

Response Date: __________________________ K/J Job No.: __________________________
Specification Section: __________________________ Project Name: __________________________
Page: __________________________

Response

<table>
<thead>
<tr>
<th>Item</th>
<th>K/J Action</th>
<th>Refer to Comment</th>
<th>Manufacturer or Supplier</th>
<th>Title of Submittal / Drawing / Information</th>
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<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

A. The action(s) noted above have been taken on the enclosed document(s).

NET = No Exceptions Taken  A&R = Amend and Resubmit  NR = Not Reviewed
MCN = Make Corrections Noted  RR = Rejected, Resubmit

Comment(s):

Delete or replace this text with your response. Space is limited; attach additional sheets if necessary.

B. Corrections or comments made on the submittal during this review does not relieve the Contractor from compliance with the requirements of the Drawings and Specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for: confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating its work with that of all other trades, and performing its work in a safe and satisfactory manner.

Responder: type name here & sign above

Distribution

Proposed Equivalent  Encl.  Response

Owner
Engineer
Contractor

File

General Conditions
© K/J January 2001
Exhibit GC-3
Proposed Equivalent and Response
Application for Payment and Engineer's Recommendation No.: 9999

To: Name
Mailing Address
CityStateZip

Date: Date

K/J Job No.: 000000.00
Project: ProjectName
Contract Date: Date
Period To: Date

Distribution to:

Owner
Engineer
Contractor
Architect

Attn: Name

Reviewed By: Kennedy/Jenks Consultants, Inc.
Mailing Address
CityStateZip

Recommended
By: Name

The undersigned Contractor certifies that to the best of the Contractor's knowledge information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Recommendations for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

By: _____________________________ Date: __________

Contractor

State of: __________________________
County of: _______________________

Subscribed and sworn to before me this ________ day of ____________

Notary Public: ______________________

My Commission expires: ____________

Engineer's Recommendation for Payment: In accordance with the Contract Documents, the Engineer recommends to the Owner that the Contractor is entitled to payment in the amount recommended, subject to withholds, deductions or credits pursuant to the Contract Documents.

Amount Recommended: __________________________

By: _____________________________ Date: __________

Kennedy/Jenks Consultants, Inc.

This Certificate is not negotiable. The amount recommended is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

General Conditions
© K/J January 2001

Exhibit GC-4
Application for Payment and Engineer's Recommendation
Contractor's signed certification is attached. In tabulations below, amounts are stated to the nearest dollar. Use Column I on Contracts where variable retainage for line items may apply.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description of Work</th>
<th>Scheduled Value</th>
<th>Work Completed</th>
<th>Materials Presently Stored (not in D or E)</th>
<th>Total Completed and Stored to Date (D+E+F)</th>
<th>% (G=C)</th>
<th>Balance to Finish (C-G)</th>
<th>Retainage (if variable rate)</th>
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<td>D+E</td>
<td>D+E+F</td>
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Grand Totals
PART 1 – GENERAL

1.01 SUPPLEMENTARY CONDITIONS – CLEAN WATER STATE REVOLVING FUND (CWSRF) REQUIREMENTS

A. Requirements of the Nevada Department of Environmental Protection (NDEP) for projects receiving Clean Water State Revolving Funds (CWSRF) require the Contractor to be in compliance with the following State and Federal provisions.

1. State of Nevada Labor Standards
2. Washoe County 2004 Prevailing Wage Rates
4. Affirmative Steps toward Small Businesses in Rural Areas
5. Affirmative Steps toward Small, Minority, and Women’s Businesses
6. Projects Sign Detail Requirements
7. Historic Preservation Requirements
8. Air Quality Permit Requirements
9. Water and Sewer Line Separation Requirements

B. The references and documents presented in this section are provided to assist the Contractor in meeting his contract obligations with respect to Federal and State requirements for CWSRF projects. It is the sole responsibility of the Contractor to familiarize himself with all applicable State and Federal requirements and to comply with the requirements therein.

1. The State of Nevada Labor Standards for Public Works Projects can be found at the following website address: www.laborcommissioner.com. Payroll and other forms required for Contractors Engaged in Public Works Projects in Nevada are available at this website.

The documents listed below are included as an attachment to this section.

2. Washoe County 2004 Prevailing Wage Rates
5. Project Sign Details
6. Historic Preservation
7. Air Quality – Permits
8. Water and Sewer Line Separations
2004 PREVAILING WAGE RATES
WASHOE COUNTY

DATE OF DETERMINATION: October 1, 2003

APPLICABLE FOR PUBLIC WORKS PROJECTS BID/AWARDED
OCTOBER 1, 2003 THROUGH SEPTEMBER 30, 2004*

*Pursuant to NAC 338.040(3), "After a contract has been awarded, the prevailing rates of wages in effect at the time of the opening of bids remain in effect for the duration of the project."

As Amendments/Addenda are made to the wage rates, such will be posted to sites of the respective counties. Please review regularly for any amendments posted or contact our offices directly for further assistance with any amendments to the rates.

AIR BALANCE TECHNICIAN

ALARM INSTALLER
BOILERMAKER
BRICKLAYER
CARPENTER
CEMENT MASON
ELECTRONIC COMMUNICATION TECH.
ELECTRICIAN-LINE
ELECTRICIAN-NEON SIGN
ELECTRICIAN-WIREMAN
ELEVATOR CONSTRUCTOR
FENCE ERECTOR
FLAGPERSON
FLOOR COVERER
GLAZIER
HIGHWAY STRIPER
HOD CARRIER-BRICK MASON
HOD CARRIER-PLASTERER TENDER
IRON WORKER
LABORER
MECHANICAL INSULATOR
MILLWRIGHT
OPERATING ENGINEER
OPERATOR-STEEL FABRICATOR/ERECTOR
OPERATING ENGINEER-PILEDRIVER
OPERATING ENGINEER-TUNNEL
PAINTER
PILEDRIVER (NON-EQUIPMENT)
PLASTERER
PLUMBER/Pipefitter
REFRIGERATION
ROOFER (Does not include sheet metal roofs)
SHEET METAL WORKER
SPRINKLER FITTER
SURVEYOR (NON-LICENSED)
TAPER
TILE/TERRAZZO/MARBLE
TRAFFIC BARRIER ERECTOR
TRUCK DRIVER
WELL DRILLER
## CRAFT

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<td>Air Balance Technician-Journeyman</td>
<td>37.35</td>
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<td>Air Balance Technician-Foreman</td>
<td>39.15</td>
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<td>Air Balance Technician-General Foreman</td>
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<td><strong>ALARm INSTAllER</strong></td>
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<tr>
<td>Alarm Installer</td>
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<td><strong>BOILERMAKER</strong></td>
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<tr>
<td>Boilermaker-Journeyman</td>
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<td>Boilermaker-Foreman</td>
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<td>Boilermaker-General Foreman</td>
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<td><strong>BRIckLAYER</strong></td>
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<td>Bricklayer-Journeyman</td>
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<td>Bricklayer-Foreman</td>
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<td>Bricklayer-General Foreman</td>
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<td><strong>CARPENTER</strong></td>
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<td>Carpenter-Journeyman</td>
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<td>Carpenter-Foreman</td>
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<td><strong>CEMENT MASON</strong></td>
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<td>Cement Mason-Journeyman</td>
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<td>Cement Mason-Foreman</td>
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http://www.laborcommissioner.com/04rates/washoe.html
<table>
<thead>
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<th>Job Title</th>
<th>Wage Rate</th>
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<tr>
<td><strong>ELECTRICIAN-ELECTRONIC COMMUNICATION TECHNICIAN</strong></td>
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<td>Communication Installer</td>
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<td>Communication Technician</td>
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<td>Senior Technician</td>
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<td><strong>ELECTRICIAN-LINE</strong></td>
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<tr>
<td>Electrician Groundman</td>
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<tr>
<td>Electrician Lineman</td>
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<td>Electrician Foreman</td>
<td>47.61</td>
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<tr>
<td>Electrician General Foreman</td>
<td>51.64</td>
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<tr>
<td>Heavy Equipment Operator</td>
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<tr>
<td><strong>ELECTRICIAN-NEON SIGN</strong></td>
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<tr>
<td>Neon Sign-Journeyman</td>
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<td><strong>ELECTRICIAN-WIREMAN</strong></td>
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<tr>
<td>Wireman-Journeyman</td>
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<td>Wireman-Cable Splicer</td>
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<td>Wireman-Foreman</td>
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<td>Wireman-General Foreman</td>
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<td><strong>ELEVATOR CONSTRUCTOR</strong></td>
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<tr>
<td>Elevator Constructor-Journeyman Mechanic</td>
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<td>Elevator Constructor-Mechanic in Charge</td>
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<tr>
<td><strong>FENCE ERECTOR</strong></td>
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<td>Fence Erector</td>
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<tr>
<td><strong>FLAGPERSON</strong></td>
<td>ADD LABORER ZONE RATE</td>
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<tr>
<td>Flagperson</td>
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<tr>
<td><strong>FLOOR COVERER</strong></td>
<td>ADD LABORER ZONE RATE</td>
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<tr>
<td>Floor Coverer-Journeyman</td>
<td>27.05</td>
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<td>Floor Coverer-Foreman</td>
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<td><strong>GLAZIER</strong></td>
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<td>Glazier</td>
<td>40.45</td>
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<td>Glazier-Foreman</td>
<td>43.50</td>
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<tr>
<td><strong>HIGHWAY STRIPER</strong></td>
<td>ADD LABORER ZONE RATE</td>
</tr>
<tr>
<td>Highway Stripper</td>
<td></td>
</tr>
</tbody>
</table>

### HOD CARRIER-BRICK MASON TENDER
**Brick Mason-Journeyman**
Brick Mason-foreign

**ADD LABORER ZONE RATE**
- 24.25
- 24.75

### HOD CARRIER-PLASTERER TENDER
**Plasterer Tender-Journeyman**
**Plasterer Tender-Gun Tender**
**Plasterer Tender-Foreman**

**ADD LABORER ZONE RATE**
- 26.31
- 27.31
- 27.67

### IRON WORKER
**Ironworker-Journeyman**
**Ironworker-foreman**
**Ironworker-General Foreman**

**ADD LABORER ZONE RATE**
- 44.15
- 46.88
- 49.88

### LABORER
**SEE GROUP CLASSIFICATIONS**
- Landscafer
- Furniture Mover
- Group 1
- Group 1A
- Group 2
- Group 3
- Group 4
- Group 5
- Group 6
- Nozzlemen, Rodmen
- Gunmen, Materialmen
- Reboundmen
- Gunite Foremen

**ADD ZONE RATE**
- 20.31
- 21.81
- 25.47
- 22.60
- 25.57
- 25.72
- 25.97
- 26.27
- 26.27
- 25.62
- 26.67

### MECHANICAL INSULATOR
**Mechanical Insulator-Mechanic**
**Mechanical Insulator-Foreman**
**Mechanical Insulator-General Foreman**

**ADD ZONE RATE**
- 42.08
- 44.33
- 45.83

### MILLWRIGHT
**Millwright-Journeyman**
**Millwright-Welder**
**Millwright-Foreman**
**Millwright-General Foreman**

**ADD ZONE RATE**
- 39.02
- 40.02
- 41.51
- 44.21

### OPERATING ENGINEER
**SEE GROUP CLASSIFICATIONS**

**ADD ZONE RATE**

---

http://www.laborcommissioner.com/04rates/washoe.html  
2/5/2004
### Group 1
- Foreman: 41.58

Add 7% to base rate for "Second" Shift: -
Add 12.5% to base rate for "Special" shift: -

### OPERATING ENGINEER: STEEL FABRICATOR & ERECTOR

#### ADD ZONE RATE

- Add $7\%$ to base rate for "Second" Shift
- Add $12.5\%$ to base rate for "Special" Shift

#### SEE GROUP CLASSIFICATIONS
- **Group 1**
  - **Group 1 Truck Crane Oiler**: 42.36
  - **Group 1 Oiler**: 40.40
- **Group 2**
  - **Group 2 Truck Crane Oiler**: 42.11
  - **Group 2 Oiler**: 40.19
- **Group 3**
  - **Group 3 Truck Crane Oiler**: 41.89
  - **Group 3 Oiler**: 39.97
  - **Group 3 Hydraulic**: 41.56
- **Group 4**
  - **Group 4**: 44.05
- **Group 5**
  - **Group 5**: 42.95

### OPERATING ENGINEER - PILEDRIVER

#### ADD ZONE RATE

- Add $7\%$ to base rate for "Second" Shift: -
- Add $12.5\%$ to base rate for "Special" Shift: -

#### SEE GROUP CLASSIFICATIONS
- **Group 1**
- **Group 1 Truck Crane Oiler**: 42.54
- **Group 1 Oiler**: 40.62
- **Group 2**: 46.46

---

http://www.laborcommissioner.com/04rates/washoe.html  
2/5/2004
<table>
<thead>
<tr>
<th>Group</th>
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<tbody>
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<td>2 Oiler</td>
<td>40.42</td>
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<tr>
<td>3</td>
<td>45.01</td>
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<tr>
<td>3 Truck Crane Oiler</td>
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<td>40.19</td>
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<tr>
<td>4</td>
<td>43.50</td>
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<td>5</td>
<td>42.39</td>
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<td>6</td>
<td>41.28</td>
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<td>7</td>
<td>40.32</td>
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<tr>
<td>8</td>
<td>39.36</td>
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<tr>
<td>Add 7% to base for &quot;Second&quot; Shift</td>
<td>-</td>
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<tr>
<td>Add 12.5% to base for &quot;Special&quot; Shift</td>
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**PAINTER**

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<th>Role</th>
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<tr>
<td>Brush/Roller Painter</td>
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<td>Spray Painter/Paperhanger</td>
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<td>Sandblaster</td>
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<td>Structural Steel &amp; Steeplejack</td>
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<td>Swing Stage</td>
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<td>Special Coating Application-Brush</td>
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<td>Special Coating Application-Spray</td>
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<td>Special Coating Application-Spray Steel</td>
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Foreman $1.00 above highest paid journeyman supervised.

**PILEDRIVER**

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<td>Driverman, Rigman, Bridge and Dock Carpenter</td>
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<td>Certified Welder</td>
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<tr>
<td>Piledriver-Foreman</td>
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<td>Diver-Diving (wet pay)</td>
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<td>Stand-By Diver</td>
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<td>Tender</td>
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**PLASTERER**

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**PLUMBER/PIPEFITTER**

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**REFRIGERATION**

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### ROOFER (Does not include sheet metal roofs)

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<tr>
<td>Roofer</td>
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### SHEET METAL WORKER

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<td>Sheet Metal Worker-General Foreman</td>
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### SPRINKLER FITTER

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<td>Sprinkler Fitter-Foreman</td>
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<tr>
<td>Sprinkler Fitter-General Foreman</td>
<td>42.85</td>
</tr>
</tbody>
</table>

### SURVEYOR

<table>
<thead>
<tr>
<th>Position</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rodman/Chainman</td>
<td>36.79</td>
</tr>
<tr>
<td>Instrument Man</td>
<td>38.25</td>
</tr>
<tr>
<td>Chief of Party</td>
<td>39.51</td>
</tr>
</tbody>
</table>

### TAPER

<table>
<thead>
<tr>
<th>Position</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taper</td>
<td>28.73</td>
</tr>
</tbody>
</table>

### TILE SETTER/TERRAZZO WORKER/MARBLE MASON

<table>
<thead>
<tr>
<th>Position</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finisher-Journeyman</td>
<td>22.64</td>
</tr>
<tr>
<td>Finisher-Foreman</td>
<td>23.89</td>
</tr>
<tr>
<td>Finisher-General Foreman</td>
<td>25.64</td>
</tr>
<tr>
<td>Tile Setter-Journeyman</td>
<td>30.45</td>
</tr>
<tr>
<td>Tile Setter-Foreman</td>
<td>31.70</td>
</tr>
<tr>
<td>Tile Setter-General Foreman</td>
<td>33.45</td>
</tr>
<tr>
<td>Marble Mason-Journeyman</td>
<td>32.14</td>
</tr>
<tr>
<td>Marble Mason-Foreman</td>
<td>33.39</td>
</tr>
<tr>
<td>Marble Mason-General Foreman</td>
<td>35.14</td>
</tr>
</tbody>
</table>

### TRAFFIC BARRIER ERECTOR

<table>
<thead>
<tr>
<th>Position</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Barrier Erector</td>
<td>25.47</td>
</tr>
</tbody>
</table>

### TRUCK DRIVER

**ADD LABORER ZONE RATE**

### ADD ZONE RATE

**Dump Trucks (Single or Multiple Units Including Semi's & Double Transfer Units), Dumpcement a Spreader**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 4 yds. (water level)</td>
<td>29.52</td>
</tr>
<tr>
<td>4 yds. &amp; under 8 yds. (water level)</td>
<td>29.74</td>
</tr>
<tr>
<td>8 yds. &amp; under 18 yds. (water level)</td>
<td>29.95</td>
</tr>
<tr>
<td>18 yds. &amp; under 25 yds. (water level)</td>
<td>30.12</td>
</tr>
</tbody>
</table>

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25 yds. & under 60 yds. (water level) 30.54
60 yds. & under 75 yds. (water level) 31.98
75 yds. & under 100 yds. (water level) 32.72
100 yds. & under 150 yds. (water level) 33.40
150 yds. & under 250 yds. (water level) 35.40
250 yds. & under 350 yds. (water level) 38.40
350 yds. & over (water level) 39.90

Transit Mix
Under 8 yds. 29.95
8 yds. & including 12 yds. 30.06
Over 12 yds. 30.28

Transit Mix (Using Boom)
Transit mix with boom shall receive 16 cents per hour above the appropriate yardage classification rate of pay when such boom is used

Water & Jetting Trucks
Up to 2,500 gallons 29.74
2,500 gallons & over 29.95

DW 20's & 21's & other similar Cat type, Terry Cobra
LeTourneau pulls, Tournerocker, Euclid, & similar type equipment when pulling Aqua/Pak, Water Tank Trailers, & Fuel, and/or Grease Tank Trailer, or other miscellaneous Trailers, (except as defined under "Dump Trucks") 30.23

Heavy Duty Transport (High Bed) 30.12
Heavy Duty Transport(Gooseneck low bed) 30.12
Tiltbed or Flatbed Pull Trailers 30.12
Bootman, Comb. Bootman & Road Oiler 30.01
Flat Rack (2 or 3 axle unit) 27.84

Bus & Manhaul Drivers
Up to 18,000 lbs. (single unit) 29.57
18,000 lbs. & over (single unit) 29.68
Helicopter Pilot (transporting men/materials) 44.16
Lift Jitneys 29.79

Winch Truck & "A" Frame Drivers
Up to 18,000 lbs. 29.68
18,000 lbs. and over 29.79
Warehousemen Spotter 29.63
Warehouse Clerk 29.74
Tire Repairmen 29.95
Truck Repairmen 30.28

Pick Up Truck & Pilot Cars (Jobsite) 27.64
Pick Up Truck & Pilot Cars (Over the road) 29.63
Truck Oil Greaser 29.68

Job Descriptions for Recognized Classes of Workmen

Regarding job descriptions for public works projects, please take notice of the following:

1. Pursuant to NAC 338.0095(1)(a), "A workman employed on a public work must be paid based on the type of work that the workman actually performs on the public work and in accordance with the recognized class of the workman."

2. The work description for a particular class is not intended to be jurisdictional in scope nor to be construed as limiting or prohibiting any worker from performing the work of one or more classes.

3. Any person who believes that a type of work is not classified, or who otherwise needs clarification pertaining to the recognized classes or job descriptions, shall contact the Labor Commissioner, in writing, for a determination of the applicable classification and pay rate for a particular type of work.

4. The job descriptions set forth or referenced herein supercede any and all descriptions previously agreed upon by the Labor Commissioner in any settlement agreements or stipulations arising out of contested matters.

5. The following specific provisions, where applicable, shall prevail over any general provisions of the job descriptions:

- Amendments to the prevailing wage determinations;

- Group Classifications and/or descriptions included with wage determinations for a particular type of work in a particular county.

AIR BALANCE TECHNICIAN, includes but is not limited to:
Inspecting, testing, programming, documenting, adjusting and balancing heating, cooling and ventilating systems using specialized tools and testing equipment to attain performance standards specified in the design of the systems.

ALARM INSTALLER, includes but is not limited to:
1. Installing or testing electrical protective signaling systems used to provide notification of fire, burglary or other irregularities on the premises of the subscriber of the system;
2. Installing of wiring and signaling units;
3. Repairing electrical protective signaling systems
4. Starting up, programming and documenting systems;

BOILERMAKER, includes but is not limited to:
1. Constructing, assembling, maintaining and repairing stationary steam boilers and boiler house auxiliaries;
2. Aligning structures or plate sections to assemble boiler frame tanks or vats;
3. Assisting in the testing of assembled vessels, directing cleaning of boilers and boiler furnaces;
4. Inspecting and repairing boiler fittings, including, without limitation, safety valves, regulators, automatic-control mechanisms, water columns and auxiliary machines.

BRICKLAYER, includes but is not limited to:
1. Laying materials, including without limitation, brick, structural tile and blocks of concrete, cinder, glass, gypsum and terra cotta, but not including stone, to construct or repair walls, partitions, arches, sewers, and other structures;
2. Laying and aligning bricks, blocks or tiles to build or repair structures for high temperature equipment, including, without limitation, cupola, kilns, ovens and furnaces; and
3. Fastening or fusing brick or other building materials to structures with wire clamps, anchor holes, torches or cement.

CARPENTER, includes but is not limited to:
1. Laying out, constructing, erecting, fabricating, installing and repairing structures and fixtures of wood, plywood, or alternative materials, doors and hardware and the fastening of the same, inclusive of garage or overhead door openers, cabinets, framework, floors, and acoustical ceiling systems using carpenter’s hand tools and power tools;
2. Installing or erecting metal studs, drywall, lathing, wall partitions, prefabricated EFIS panels or any other system of panels that is attached to the interior or exterior of any building or structure, insulation and all types of ceilings;
3. Pre-cast concrete and concrete form work which includes but is not limited to: setting of templates, layout, fabrication, constructing, placing, erection, rigging and hoisting, stripping and removing of all forms which are to be reused;
4. Plywood decking, including, without limitation, stacking and installation of the plywood and the plywood decking;
5. Cutting, setting, removing of beam sides and soffits, bracing, and pads;
6. Constructing all wood panel forms and frame wall;
7. Building, erecting and disassembling self-supporting scaffolds that are more than 14 feet in height;
8. Laying out, cutting, joining, fitting of Foam Architectural Elements if same are attached mechanically; and
9. Shaping, cutting and planing by any means if done by hand or machine.

CEMENT MASON, includes but is not limited to:

1. Smoothing and finishing surfaces of poured concrete floors, walls, sidewalks and curbs to specified textures;
2. patching holes with fresh concrete or an epoxy compound;
3. Molding expansion joints and edges through the use of edging tools, jointers and straightedges;
4. Setting of curb and gutter forms one board high;

ELECTRONIC COMMUNICATION INSTALLER, includes but is not limited to:

1. Pulling cable and trimming devices on field circuits and loops;
2. Does not include energizing or performing work on any energized circuits, loops, or other equipment.

ELECTRONIC COMMUNICATION TECHNICIAN, includes but is not limited to:

1. Pulling cable, installing and trimming devices, terminating loops, circuits, or other data gathering points;
2. Termination of main control panels, racks, or other head end equipment, as well as testing of all circuits from the field devices to the main control panels and/or equipment;
3. Utilizing test equipment for the purpose of troubleshooting and verifying the integrity of the circuits in question;
4. Using hand tools to assemble and install data communication lines and equipment computer systems, antennas and towers;
5. Disassembling equipment to adjust, repair or replace parts using hand tools;
6. Starting up, programming and documenting systems;
7. Measuring, cutting, splicing, connecting, soldering and installing wire and cable associated with communication systems

ELECTRICIAN LINEMAN, includes but is not limited to:

1. Erecting and repairing wood poles and prefabricated light duty metal towers, cable and related equipment to construct overhead transmission and distribution power lines used to conduct electrical energy between generating stations, substations and consumers;
2. Directing and assisting electrician ground men in attaching cross arms, insulators, lightning arresters, switches, wire conductors and auxiliary equipment to poles and towers in preparation of erecting the poles or towers;
3. Climbing erected poles or towers and installing equipment such as transformers
4. Strings wire conductors between erected poles with assistance of ground helpers and adjusts slack in conductors to compensate for contraction and elongation of conductors due to temperature variations, using winch.

ELECTRICIAN GROUNDMAN, includes but is not limited to:

1. Working under the direct supervision of linemen, including the operation of jackhammers and man hauls;
2. Loading and unloading of materials and equipment used by electrician lineman.

3. Does not include climbing poles, towers or other structures or working in the proximity of energized lines or equipment;

**ELECTRICIAN-NEON SIGN**, includes but is not limited to:

1. Installing, servicing and repairing plastic, neon and illuminated signs;
2. Ascending ladders or operating hydraulic or electric hoist to install, service, or examine sign to determine cause of malfunction;
3. Wiring, rewiring or removing defective parts and installing new parts using electrician's tools;
4. Removing sign or part of sign for repairs, such as structural fabrication, scroll repair, or transformer repair;

**ELECTRICIAN WIREMAN**, includes but is not limited to:

1. Laying out plans, installing, testing and repairing wiring, electrical fixtures, apparatus and control equipment;
2. Measuring, cutting, bending, threading, assembling and installing electrical conduit by using tools including, without limitation, a hacksaw, pipe threader, or conduit bender;
3. Pulling wiring through conduit;
4. Splicing wires;
5. Connecting wiring to lighting fixtures and power equipment;
6. Installing control and distribution apparatus, including, without limitation, switches, relays and circuit breakers, and fastening such apparatus into place;
7. Connecting power cables to equipment, including, without limitation, electric ranges and motors, and installing grounding leads;
8. Testing the continuity of a circuit to ensure electrical compatibility and safety of components using testing instruments, including, without limitation, an ohmmeter, a battery and buzzer, and an oscilloscope;
9. As necessary, cutting and welding steel structural members;

**ELEVATOR CONSTRUCTOR**, includes but is not limited to:

1. Assembling, installing, repairing and maintaining electric and hydraulic freight and passenger elevators, escalators and dumbwaiters;
2. Cutting pre-fabricated sections of framework, rails and other elevator components to specified dimensions, using acetylene torch, power saw, and disc grinder;
3. Installing cables, counterweights, pumps, motor foundations, escalator drives, guide rails, elevator cars, and control panels, using hand tools;

**FENCE ERECTOR**, includes but is not limited to:

1. Erecting or repairing chain link, wooden, tortoise, wire/wire mesh, or temporary fencing;
2. Mixing and pouring concrete around bases of posts and tamping soil into post hole to embed post;
3. Digging post holes with a spade, post hole digger or power driven auger;
4. Aligning posts through the use of lines or by sighting;
5. Verifying vertical alignment of posts with a plumb bob or spirit level;

**FLAG PERSON**, includes but is not limited to:

1. Directing movement of vehicular traffic through construction projects;
2. Distributing traffic control signs and markers along site in designated pattern;
3. Informing drivers of detour routes through construction sites;

**FLOOR COVERER**, includes but is not limited to:

1. Applying blocks, strips or sheets of shock-absorbing, sound-deadening or decorative covering to floors and walls, including carpets or rugs;
2. Measuring and cutting covering materials, such as rubber, linoleum, astro-turf, or cork tile and foundation material such as felt, using rule, straightedge, linoleum knife and snips;
3. Spreading adhesive cement over floor to cement foundation material to floor for sound-deadening, and to prevent covering from wearing at the board joints;
4. Rolling finished floors to smooth the floor and press cement into base and covering;
5. Fitting of devices for the attachment of carpet, linoleum, rubber and all resilient floor coverings and the fitting of metal edges, corners and caps used in the installation of the foregoing materials and all other preparatory work;

**GLAZIER**, includes but is not limited to:

1. Installing, setting, cutting, preparing, or removal of glass, or materials used in lieu thereof, including, without limitation, in windows, doorways, showers, bathtubs, skylights and display cases;
2. Installing glass on surfaces, including, without limitation, fronts of buildings, interior walls and ceilings;
3. Installing pre-assembled framework for windows and doors designed to be fitted with glass panels, including stained glass windows by using hand tools;
4. Loading and arranging glass, or materials used in lieu thereof, on trucks at the site of the public work;

**HIGHWAY STRIPER**, includes but is not limited to:

1. Painting highways, streets and parking surfaces by using manually propelled or mechanically propelled machines, brushes, rollers or spray guns;
2. Installing any device or application of any material used in lieu of paint for traffic direction, including, without limitation, buttons, tapes, plastics, rumble bars and other similar materials;

**HOD CARRIER-BRICK MASON**, includes but is not limited to:

1. Tending to or assisting brick masons, bricklayers and stonemasons;
2. Mixing, packing, wheeling and tempering mortar and fire clay;
3. Mixing, supplying and holding materials or tools;
4. Mixing, handling and conveying all other materials used by brick masons, bricklayers and stone masons;
5. Building scaffolds, trestles, boxes and swinging staging used exclusively by bricklayers and stone masons;
6. Hanging cables and placing putlogs;
7. Carrying bricks and mortar in a hod;
8. Cleaning work area and equipment of bricklayers and stone masons.

**HOD CARRIER-PLASTERER TENDER**, includes but is not limited to:
1. Serving Plasterers in any capacity;
2. Handling materials after the materials are delivered as used by a Plasterer;
3. Building and handling all necessary trestle, scaffolding and planking of scaffolding for the exclusive use of Plasterers;
4. Building mortar boxes, mortar boards and stands.

IRONWORKER, includes but is not limited to:

1. Performing duties, as part of a crew, to raise, place and unite girders, columns and other structural steel members to form completed structures or structure frameworks;
2. Setting up hoisting equipment for raising and placing structural steel members;
3. Fastening steel members to cable of hoist, using chains, cable or rope;
4. Forcing steel members into final position using turnbuckles, crowbars, jacks, hand tools;
5. Aligning rivet holes in steel members with corresponding holes in previously placed steel members by driving drift pins to handle of wrench through holes;
6. Bolting aligned steel members to keep them in position until the steel members can be permanently riveted, bolted or welded into place;
7. Cutting and welding steel members;
8. Installing and repairing gates, iron doors, flagpoles, iron fences and roof decking;
9. Installing corrugated sheets when attached to steel frames;
10. Stud welding of all iron, steel and metal to structural steel;
11. Handling and setting of steel and metal joists;
12. Loading, unloading, hoisting, handling, signaling, placing and erecting of pre-stressed and pre-cast materials;
13. Handling, racking, sorting, cutting, bending, hoisting, placing, burning, welding and tying all material used to reinforce concrete construction;

LABORER, includes but is not limited to:

LABORER

Group 1
All cleanup work of debris, grounds, and building including windows and tile Dumpmen or Spotter (other than asphalt) Handling and Servicing of Flares, Watchman General Laborer (Does not include work otherwise classified.) Limber, Brushloader and Piler Traffic Control Supervisor

Group 1A
Flagperson

Group 2
Choker setter or Rigger (clearing work only) Pittsburgh Chipper and similar type brush shredders Concrete worker (wet or dry) all concrete work not listed in Group3 Crusher or Grizzly Tender Greasing Dowels Guinea Chaser (Stakemen) Panel Forms (wood or metal) handling, cleaning and stripping of Loading and unloading, (Carrying and handling of all rods and material for use in reinforcing concrete

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Railroad Trackmen (maintenance, repair or builders)
Sloper
Semi-Skilled Wrecker (salvaging of building materials other than those listed in Group 3)

**Group 3**
Asphalt Workers (Ironers, Shovelers, Cutting Machine)
Buggymobile
Chainsaw, Faller, Logloader and Bucker
Compactor (all types)
Concrete Mixer under 1/2 yard
Concrete Pan Work (Breadpan type), handling, cleaning\stripping
Concrete Saw, Chipping, Grinding, Sanding, Vibrator
Cribbing, Shoring, Lagging, Trench Jacking, Hand-Guided Lagging Hammer
Curbing or Divider machine
Curb Setter (precast or cut)
Ditching Machine (hand-guided)
Drillers Helper, Chuck Tender
Form Raiser, Slip Forms
Grouting of Concrete Walls, Windows and Door Jams
Headerboardmen
Jackhammer, Pavement Breaker, Air Spade
Mastic Worker (wet or dry)
Pipewrapper, Kettlemen, Potmen, and men applying asphalt, creosote and similar type materials
All Power Tools (air, gas, or electric), Post Driver
Riprap-Stonepaver and RockSlinger, including placing of sack concrete wet or dry
Rototiller
Rigging and Signaling in connection with Laborers' work
Sandblaster, Potmen, Gunmen or Nozzlemen
Vibra-screed
Skilled Wrecker (removing and salvaging of sash, windows, doors, plumbing and electrical fixtures)

**Group 4**
Burning and Welding in connection with Laborers' work
Joy Drill Model TWM-2A, Gardner Denver Model DN143 and similar type drills (in accordance with Memorandum of Understanding between Laborers and Operating Engineers dated at Miami, Florida, Feb. 3, 1954) and Track Drillers, Diamond Core Drillers, Wagon Drillers, Mechanical Drillers on Multiple Units
High scalers
Concrete pump operator
Heavy Duty Vibrator with Stinger 5" diameter or over
Pipelayer, Caulker and Bander
Pipelayer-Waterline, Sewerline, Gasoline, Conduit
Cleaning of Utility Lines
Slip Lining of Utility Lines (including operation of Equipment)
TV Monitoring and Grouting of Utility Lines
Asphalt Rakers

**Group 5**
Foremen
Construction Specialists
Blasters and Powermen, all work of loading, placing, and blasting of all powder and explosives of any

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type, regardless of method used for such loading and placing
Asbestos removal
Lead abatement
Hazardous waste
Material removal

Group 6
Gunit Foremen, Nozzlemen, Rodmen, Gunmen, Materialmen, Reboundmen

MARBLE MASON, includes but is not limited to:

1. Cutting, tooling, and setting marble slabs in floors and walls of buildings and renovating and polishing marble slabs previously set in buildings;
2. Trimming, facing and cutting marble to a specific size using a power saw, cutting and facing equipment, and hand tools
3. Drilling holes in marble slabs and attaching brackets;
4. Spreading mortar on the bottom and sides of a marble slab and on the side of adjacent marble slabs;
5. Setting blocks in positions, tamping a marble slab into place and anchoring bracket attachments with wire;
6. Filling joints between marble slabs with grout and removing excess grout with a sponge;
7. Cleaning and beveling cracks and chips on marble slabs using hand tools and power tools;
8. Heating cracked or chipped areas of a marble slab with a blowtorch and filling the defect with a composition mastic that matches the grain of the marble slab; and
9. Polishing marble slabs and other ornamental stone to a high luster by using hand tools and power tools.

MECHANICAL INSULATOR, includes but is not limited to:

1. Covering and lining structures with cork, canvas, tar paper, magnesia and related materials;
2. Installing blown-on insulation on pipe and machinery;
3. Lining of mechanical room surfaces and air handling shafts;
4. Filling and damming of fire stops and penetrations including, but not limited to, electrical and mechanical systems;
5. Foam applications for the purpose of thermal, acoustical, or fire protective purposes, including RTV foams or equivalents, applied to mechanical or electrical systems;
6. Duct lining and duct wrapping, direct application and installation of fire protection of grease ducts, exhaust systems, or any other ductwork for acoustical or thermal purposes;
7. Insulation of field joints on pre-insulated underground piping and the pouring of Gilsilite or its equivalent;
8. The application of material, including metal and PVC jacketing, on piping, fittings, valves, flanges, boilers, ducts, plenums, flues, tanks, vats, equipment and any other hot or cold surface for the purpose of thermal control;

MILLWRIGHT, includes but is not limited to:

1. Installing machinery and equipment according to layout plans, blueprints and other drawings in industrial establishments by using hoists, lift trucks, hand tools and power tools;

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2. Dismantling machines by using hammers, wrenches, crowbars and other hand tools;
3. Assembling and installing equipment, including, without limitation, shafting, conveyors, monorails and tram rails, by using hand tools and power tools;
4. Constructing foundations for machines by using hand tools and building materials, including, without limitation, wood, cement and steel;
5. Assembling machines and bolting, welding, riveting or otherwise fastening them to a foundation or other structure by using hand tools and power tools; and
6. Repairing and lubricating machines and equipment (at the site of the public work) assembled and used by millwrights.

OPERATING ENGINEER, includes but is not limited to:

Group 1
Engineer Assistant

Group 1A
Heavy Duty Repairman Helper
Oiler
Parts man

Group 2
Compressor Operator
Material Loader and/or Conveyor Operator (handling building materials)
Pump Operator

Group 3
Bobcat or similar loader, 1/4 cu. yd. or less
Concrete Curing Machines (streets, highways, airports, canals)
Conveyor Belt Operator (tunnel)
Forklift (under 20)
Engineer Generating Plant (500 K.W.)
Mixer Box Operator (concrete plant)
Motorman
Rodman/Chainman
Rotomist Operator
Oiler (truck crane)

Group 4
Concrete Mixer Operator, Skip type
Dinky Operator (Assistant to Engineer required)
Forklift (20' or over) or Lumber Stacker
Heavy Duty Repairman/Welder
Ross Carrier
Skip Loader Operator (under one (1) cu. yd.)
Tie Spacer

Group 5
Concrete Mixers (over one (1) cu. yd.)
Concrete Pumps or Pumpcrete Guns
Elevator and Material Hoist (one (1) drum)

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2/5/2004
Groundman for Asphalt Milling and similar

**Group 6**
- Auger type drilling equipment up to and including 30 ft. depth digging capacity m.r.c. (any assistance required will be performed by an Employee covered by this Agreement)
- Boom Truck or Dual Purpose a-Frame Truck
- B.L.H. Lima Road Pactor or similar
- Chip Box Spreader (Flaherty type or similar)
- Concrete Batch Plant (wet or dry)
- Concrete Saws (highways, streets, airports, canals)
- Locomotives (over thirty (30) tons)
- Lubrication and Service Engineer (mobile and grease rack)
- Maginnis International Full Slab Vibrator (airports, highways, canals and warehouses)
- Mechanical Finishers (concrete) (Clary, Johnson, Bidwell Bridge Deck or similar types)
- Mechanical Burn, Curb and/or Curb and Gutter Machine (concrete or asphalt)
- Pavement Breaker, Truck Mounted, with compressor combination (Assistant to Engineer required)
- Pavement Breaker or Tamper (with or without compressor combination)
- Power Jumbo Operator (setting slip-forms, etc., in tunnels)
- Roller Operator (except asphalt)
- Self-Propelled Tape Machine
- Self-Propelled Compactor (single engine)
- Self-Propelled Power Sweeper Operator
- Slip-Form Pump (power-driven by hydraulic, electric, air, gas, etc. lifting device for concrete forms)
- Small Rubber-Tired Tractors
- Snooper Crane, Paxton-Mitchell or similar
- Stationary Pipe Wrapping, Cleaning and Bending Machine Operator

**Group 7**
- Auger type drilling equipment over 30 ft. depth digging capacity m.r.c. (Assistant to Engineer or Mechanic/Welder required)
- Compressor (over 2)
- Concrete Conveyor or Concrete Pump, truck or equipment mounted (any assistance required shall be performed by an Assistant to Engineer) Boom length to apply
- Concrete Conveyor, Building Site (any assistance shall be an employee covered by this Agreement)
- Drilling and Boring Machine, vertical and horizontal (not to apply to waterliners, wagon drills or jack hammers) (Assistant to Engineer or Mechanic/Welder required)
- Crusher Plant Engineer
- Generators
- Instrument Man
- Kolman Loader
- Material Hoist (two (2) or more drums)
- Mechanical Finishers or Spreader Machine (asphalt, Barber-Greene or similar)
- Mine or Shaft Hoist
- Pipe Bending Machines (pipeline only)
- Pipe Cleaning Machines (tractor-propelled and supported)
- Pipe Wrapping Machines (tractor-propelled and supported)
- Portable Crushing and Screening Plants (Assistant to Engineer required)
- Post Driller And/Or Driver
- Pumps (over 2)
- Roller Operator (asphalt)
- Screedman (except asphaltic or concrete paving)

http://www.laborcommissioner.com/04rates/washoe.html
Screeaman (Barber-Greene and similar) (asphaltic or concrete paving)
Self-Propelled Boom-Type Lifting Device (center mount) (on ten (10) ton capacity or less)
Slusher Operator
Surface Heater and Planer Operator
Trenching Machine (maximum digging capacity three (3) ft. depth) (Any assistance in the operation, if needed, shall be performed by an Assistant to Engineer)
Truck-Type Loader
Welding Machines (gasoline or diesel)

Group 8
Asphalt Plant Engineer
Asphalt Milling Machine
Cast-In-Place Pipe-Laying Machine
Combination Slusher and Motor Operator
Concrete Batch Plant (multiple units)
Dozer Operator
Drill Doctor
Elevating Grader Operator
Grooving and Grinding Machine (highways)
Ken Seal Operator
Loader (up to and including two and one-half (2 1/2) cu. yds)
Mechanical Trench Shield
Mixermobile
Push Cats
Road Oil Mixing Machine Operator Wood-Mixer (and other similar Pugmill equipment)
Rubber-Tired Earthmoving Equipment (up to and including thirty-five (35) cu. yds. "struck" m.r.c., Euclids, T-Pulls, DW10, 20, 21 and similar)
Self-Propelled Compactors with Dozer; Hyster 450, Cat 825 or similar
Sheepfoot
Small Tractor (with boom)
Soil Stabilizer (P & H or equal)
Timber Skidder (rubber-tired) or similar equipment
Tractor-Drawn Scraper
Tractor Operator
Tractor-Mounted Compressor Drill Combination (Assistant to Engineer required)
Trenching Machine Operator (over three (3) feet depth) (Assistant to Engineer required)
Tri-Batch Paver (Assistant to Engineer required)
Tunnel Badger or Tunnel Boring Machine Operator (Assistant to Engineer required)
Tunnel Mole Boring Machine (Assistant to Engineer required)
Vermee T-600b Rock Cutter

Group 9
Chicago Boom
Combination Backhoe and Loader (up to and including 3/8 cu. yd.) (Assistant to Engineer required when more than 200 hundred degrees on swing)
Combination Mixer and Compressor (gunite)
Heavy Duty Repairman and/or Welder
Lull Hi-Lift (twenty (20) feet or over)
Mucking Machine (Assistant to Engineer required)
Sub-Grader (Gurries or other types) (Assistant to Engineer required)
Tractor (with Boom) (D6 or larger)

Track-Laying-Type Earthmoving Machine (single engine with tandem scrapers)

**Group 10**
- Boom-Type Backfilling Machine (Assistant to Engineer required)
- Bridge Crane
- Cary-Lift or similar
- Chemical Grouting Machine (Assistant to Engineer required)
- Derricks (two (2) Group 10 Operators required when swing engine remote from hoist)
- Derrick Barges (except excavation work) (Deck Engineer and Assistant to Engineer required)
- Euclid Loader and similar types (Assistant to Engineer required when not controlled from the Pullcat)
- Gradesetter, Grade Checker
- Heavy Duty Rotary Drill Rigs (any assistance required shall be performed by an Employee covered by this agreement)
- Lift-Slab (Vagtborg and similar types)
- Loader (over two and one-half (2 1/2 cu. yds.) up to and including four (4) cu. yds.)
- Locomotive (over one hundred (100) tons, single or multiple units)
- Multiple-Engine Earthmoving Machines (Euclid Dozers, etc.)
- Pre-Stress Wire Wrapping Machine
- Rubber-Tired Scraper, Self-Loading
- Single-Engine Scraper (over thirty-five (35) cu. yds.)
- Shuttle Car (Reclaim Station)
- Train Loading Station
- Trenching Machine (Assistant to Engineer required) multi-engine with sloping attachments (Jefco or similar)
- Vacuum Cooling Plant
- Whirley Crane (up to and including twenty-five (25) tons) (Assistant to Engineer required)

**Group 10A**
- Backhoe-Hydraulic (up to and including one (1) cu. yd.) (Assistant to Engineer required)
- Backhoe (up to and including one (1) cu. yd.) (Cable) (Assistant to Engineer required)
- CMI Dual Lane Auto-Grader SP30 or similar type (Assistant to Engineer required)
- Cranes (not over twenty-five (25) tons) (hammerhead and gantry) (Assistant to Engineer required)
- Finish Blade
- Gradalls (up to and including one (1) cu. yd.) (Assistant to Engineer required)
- Motor Patrol Operator
- Power Shovels, Clamshells, Draglines, Cranes (up to and including one (1) cu. yd.)
- Rubber-Tired Scraper, Self-Loading (twin engine)
- Self-Propelled Boom-Type Lifting Device, center mount (over 10 tons up to and including 25 tons) (Assistant to Engineer required)

**Group 11**
- Automatic Asphalt or Concrete Slip-Form Paver (Gradesetter, Screedman and Assistant to Engineer required)
- Automatic Railroad Car Dumper
- Canal Trimmer (two (2) Assistants to Engineer required)
- Cary Lift, Campbell or similar type
- Cranes (over twenty-five (25) tons) (Assistant to Engineer required)
- Euclid Loader when controlled from the Pullcat

**Group 12**
- Loader (over four (4) cu. yds. up to and including twelve (12) cu. yds.)
- Multi-Engine Earthmoving Equipment (up to and including seventy-five (75) cu. yds. struck m.r.c.)

http://www.laborcommissioner.com/04rates/washoe.html
Multi-Engine Scrapers (when used to Push Pull)
Power Shovels, Clamshells, Draglines, Backhoes Gradalls (over one (1) cu. yd. and up to and including seven (7) cu. yds. m.r.c.) (Assistant to Engineer required) (two (2) Assistants to Engineer required on 120B, similar or larger)
Self-Propelled Boom-Type Lifting Device (center mount) (over 25 tons m.r.c.)
Self-Propelled Compactor (with multiple-propulsion power units)
Single-Engine Rubber-Tired Earthmoving Machine, with Tandem Scraper
Slip-Form Paver (concrete or asphalt) (one (1) Operator and two (2) Screedman)
Tandem Cats and Scraper
Tower Crane Mobile (Assistant to Engineer required) (including Rail Mount)
Truck Mounted Hydraulic Crane when remote control equipped (over 10 tons up to and including 25 tons)
Universal Liebher and Tower Cranes (and similar types) (in the erection, dismantling and moving of equipment there shall be an additional Operating Engineer at Group 8 rates)
Wheel Excavator (up to and including seven hundred fifty (750) cu. yds. per hour) (Assistant to Engineer required)
Whirley Cranes (over twenty-five (25) tons) (Assistant to Engineer required)

Group 11A
Band Wagons (in conjunction with Wheel Excavators)
Operator of Helicopter when used in construction work
Loader (over twelve (12) cu. yds.)
Multi-Engine Earthmoving Equipment (over seventy-five (75) cu. yds. "struck" m.r.c.)
Power Shovels, Clamshells, Draglines, Backhoes, and Gradalls (over seven (7) cu. yds. m.r.c.) (Assistant to Engineer required)
Remote-Controlled Earth Moving Equipment
Wheel Excavator (over seven hundred fifty (750) cu. yds. per hour) (two (2) Group 11A Operators and one (1) Assistant to Engineer required; any additional assistance shall be an Assistant to Engineer)

Group 11B
Holland Loader or similar or Loader (over 18 cu. yds.)

OPERATING ENGINEERS - Steel Fabricator & Erector

Group 1
Cranes over 100 tons (Assistant to Engineer required)
Derrick over 100 tons
Self-Propelled Boom Type Lifting Devices over 100 tons

Group 2
Cranes over 45 tons up to and including 100 tons (Assistant to Engineer required)
Derrick, 100 tons and under
Self-Propelled Boom Type Lifting Device, over 45 tons
Tower Crane

Group 3
Cranes, 45 tons and under (Assistant to Engineer required)
Self Propelled Boom Type Lifting Device, 45 tons and under

Group 4

Chicago Boom
Forklift, 10 tons and over
Heavy Duty Repairman/Welder

**Group 5**

**Boom Cat**

**OPERATING ENGINEER - Piledriver**

**Group 1**
Derrick Barge Pedestal mounted over 100 tons (Assistant to Engineer or Assistant Operator in lieu of Assistant to Engineer required)
Clamshells over 7 cu. yds.
Self Propelled Boom Type Lifting Device, over 100 tons
Truck Crane or Crawler, land or barge mounted over 100 tons (Assistant to Engineer or Assistant Operator in lieu of Assistant to Engineer required)

**Group 2**
Derrick Barge Pedestal mounted 45 tons up to and including 100 tons (Assistant to Engineer or Assistant Operator in lieu of Assistant to Engineer required)
Clamshells up to and including 7 cu. yds.
Self Propelled Boom Type Lifting Device over 45 tons
Truck Crane or Crawler, land or barge mounted, over 45 tons up to and including 100 tons (Assistant to Engineer or Assistant Operator in lieu of Assistant to Engineer required)

**Group 3**
Derrick Barge Pedestal mounted under 45 tons (Assistant to Engineer or Assistant Operator in lieu of Assistant to Engineer required)
Self Propelled Boom Type Lifting Device 45 tons and under
Skid/Scow Piledriver, any tonnage (Any assistance required shall be by an Employee covered by this Agreement)
Truck Crane or Crawler, land or barge mounted 45 tons and under (Assistant to Engineer or Assistant Operator in lieu of Assistant to Engineer required)

**Group 4**
Assistant Operator in lieu of Assistant to Engineer
Forklift, 10 tons and over
Heavy Duty Repairman/Welder

Group 5
No current classification

**Group 6**
Deck Engineer

**Group 7**
No current classification

**Group 8**
Deckhand
Fireman

http://www.laborcommissioner.com/04rates/washoe.html
PAINTER, includes but is not limited to:

1. All painting of walls, equipment, buildings, bridges and other structural surfaces by using brushes, rollers and spray guns;
2. Application of wall coverings/wall paper;
3. Removing old paint to prepare surfaces before painting the surface;
4. Mixing colors or oils to obtain desired color or consistency;
5. Sanding surfaces between coats and polishing final coat to a specified finish;
6. Cutting stencils and brushing and spraying lettering and decorations on surfaces;
7. Washing and treating surfaces with oil, turpentine, mildew remover or other preparations;
8. Filling cracks, holes and joints with caulk, putty, plaster or other filler by using caulking gun or putty knife;

PILEDRIVER, includes but is not limited to:

1. Operating pile drivers mounted on skids, barge, crawler, treads or locomotive crane to drive piling as foundations for structures including, without limitation, buildings, bridges and piers;
2. Barking, shoeing, splicing, form building, heading, centering, placing, driving, staying, framing, fastening, automatic pile threading, pulling and/or cutting off of piling;
3. Fabricating, forming, handling and setting of all such pre-cast, pre-stressed and post-stressed shapes that are an integral part of docks, piers, wharves, bulkheads, jetties, and similar structures;

PIPEFITTER, includes but is not limited to:

Assembling, installing, modifying and maintaining pipe systems, pipe supports and pneumatic equipment and related machines and equipment components for steam, hot water, heating, cooling, lubricating, sprinkling and industrial and processing systems which may require:

a. Cutting, threading and hammering pipe to specifications using tools, including, without limitation, saws, cutting torches and pipe threaders and benders;
b. Attaching pipes to walls, structures and fixtures, including without limitation, radiators or tanks, using brackets, clamps, tools, or welding equipment;
c. Coating non-ferrous piping materials by dipping in mixture of molten tin and lead to prevent erosion, or galvanic and electrolytic action;

PLASTERER, includes but is not limited to:

1. Applying coats of plaster onto interior or exterior walls, ceilings, or partitions of buildings to produce a finished surface according to blueprints, architects' drawings and oral instruction;
2. Creating decorative textures in finish coat by using sand, pebbles or stones;
3. Installing guide wires on exterior surfaces of buildings to indicate thickness of plaster or stucco;
4. Applying weatherproof, decorative covering to exterior surfaces of a building;
5. Molding and installing ornamental plaster pieces, panels and trim;
6. Directing workers to mix plaster to a desired consistency;
7. Assembly of EFIS panels;
8. Laying out, cutting, joining, fitting and installation of Architectural Foam Elements which are trowel applied or adhesive set;
9. Applying, shaping, cutting, and planing in preparation for netting done by hand or machine;
10. All plaster or synthetic finishes applied to Foam Architectural Elements.
Assembling, installing and repairing pipes, fittings and fixtures for heating, water and drainage systems inside of buildings and to a point 5 feet outside of buildings which may therein require:

a. Repairing and maintaining plumbing by replacing defective washers, repairing or mending broken pipes, and opening clogged drains;
b. Assembling pipe sections, tubing and fittings by using screws, bolts, solder, plastic solvent and caulkling;
c. Installing pipe assemblies, fittings, valves and fixtures, including, without limitation, sinks, toilets and tubs, by using hand tools and power tools;
d. Cutting openings in structures, excluding concrete, to accommodate pipe and pipe fittings by using hand tools and power tools;
e. Filling pipes and plumbing fixtures with water or air and observing pressure gauges to detect and locate leaks.

Refrigeration Mechanic, includes but is not limited to:

1. Installing and repairing industrial and commercial refrigeration systems;
2. Mounting compressors, condensers and other refrigeration components to the frame of a refrigerator by using hand tools and acetylene welding equipment;
3. Assembling structural and functional components needed for refrigeration, including, without limitation, controls, switches, gauges, wiring harnesses, valves, pumps, compressors, condensers, cores and pipes;
4. Installing expansion and control valves by using hand tools and acetylene welding equipment;
5. Cutting, bending, threading and connecting pipe from functional components to water, power or refrigeration systems;
6. Fabricating and assembling components and structural portions of a refrigeration system;

Roofers, includes but is not limited to:

1. Installing and covering roofs and structures with slate, asphalt, wood and other related materials, other than sheet metal, by using brushes, knives, punches, hammers and other tools;
2. Spraying roofs, sidings and walls with material to bind, seal, insulate or soundproof sections of a structure;
3. Installation of all plastic, slate, slag, gravel, asphalt and composition roofing, and rock asphalt mastic when used for damp and waterproofing;
4. Installation of all damp resisting preparations when applied on roofs with mop, three-knot brush, roller, swab or spray system;
5. All types of preformed panels used in waterproofing;
6. Handling, hoisting and storing of all roofing, damp and waterproofing materials;
7. The tear-off and/or removal of roofing and roofing materials;

Sheet Metal Worker, includes but is not limited to:

1. Fabricating, assembling, dismantling, installing or repairing:
   o Sheet metal roofs, including #30 felt roofing paper installed to form a metal roofing system;
   o Sheet metal parts or equipment, including, without limitation, duct work, metal lockers and kitchen equipment;
   o Air-veyor and air-handling systems, regardless of materials used;
2. Setting up and operating fabrication machines to cut, bend and straighten sheet metal;  
3. Shaping metal over anvils, blocks or forms using a hammer;  
4. Operating soldering and welding equipment to join sheet metal parts;  
5. Inspecting, assembling and smoothing seams and joints of burred surfaces;  
6. Welding, soldering, bolting, riveting, screwing, clipping, caulking or bonding component parts to assemble products by using hand tools, power tools and devices for lifting and handling;

SPRINKLER FITTER, includes but is not limited to:

Installing, dismantling, maintaining, repairing, adjusting and correcting all fire protection and fire control systems, including the installation of piping or tubing, appurtenances and equipment pertaining thereto, including both overhead and underground water mains, fire hydrants, hydrant mains, standpipes and hose connection to sprinkler systems, sprinkler tank heaters, air lines and thermal systems used in connection with sprinkler and alarm systems.

SURVEYOR, includes but is not limited to:

1. Planning ground surveys designed to establish base lines, elevation and other geodetic measurements;  
2. Compiling data relevant to the shape, contour, gravitation, location, elevation and dimension of land and land features on or near the surface of the Earth for engineering, map making, mining, land evaluation, construction and other purposes;  
3. Surveying bodies of water to determine navigable channels and to secure data for construction of breakwaters, piers and other marine structures;  
4. Computing data necessary for driving and connecting underground passages, underground storage and volume of underground deposits.

TAPER, includes but is not limited to:

1. Sealing joints between plasterboard or other wallboards to prepare a wall surface for painting or papering;  
2. Mixing sealing compound by hand or with a portable electric mixer and spreading the compound over the joints between boards using a trowel, broad knife, or spatula;  
3. Filling cracks and holes in walls and ceilings with sealing compound;  
4. Applying texturing compound and primer to walls and ceiling to prepare a surface for a final finish by using brushes, rollers and spray guns;  
5. Coating of joint compound or taping mud;

TERRAZZO WORKER, includes but is not limited to:

1. Applying cement, sand, pigment and marble chips to floors and stairways to attain durable and decorative surfacing according to specifications or drawings;  
2. Spreading mixtures of sand, cement and water over surface with a trowel to form terrazzo;  
3. Cutting metal division strips and pressing the metal division strips into a terrazzo base so that top edges form a desired design or pattern and define level of finished floor surface;  
4. Spreading mixtures of marble chips, cement, pigment and water over a terrazzo base to form a finished surface by using a float and trowel;  
5. Pre-casting terrazzo blocks in wooden forms.

TILE SETTER, includes but is not limited to:

1. Applying tile and materials made for tile in tile-like units to walls, floors, ceilings and promenade roof decks following design specification;

2. Applying glazed, unglazed, mosaic and other ceramic tiles, which are used as a surface on floors, walls, ceilings, and other surfaces and which must be set to specific grade;

3. Applying and floating all setting beds into which glazed, unglazed, mosaic, or other ceramic tiles are set;

4. Leveling and plumbing tiles to a specified grade.

**TILE, TERRAZZO AND MARBLE FINISHER**, includes but is not limited to:

1. Supplying and mixing construction materials for a tile setter, terrazzo worker or marble setter;

2. Applying grout and finishing the surface of installed tile, terrazzo and marble;

3. Cleaning installed tile, terrazzo and tile surfaces;

4. Renovation and filling chipped, cracked and broken pieces of tile, terrazzo and marble;

5. Grinding and polishing tile, terrazzo and marble;

6. Assisting a tile setter, terrazzo worker or marble setter;

**TRAFFIC BARRIER ERECTOR**, includes but is not limited to:

Erects or places instruments to provide directional assistance to traffic on or near the public works construction project.

**TRUCK DRIVER**, includes but is not limited to:

Driving a tractor trailer combination or a truck to transport goods or materials at the site of a public work or between sites of a public work.

**WELL DRILLER**, includes but is not limited to:

1. Setting, operating or tending to portable drilling rig machinery and related equipment to drill wells;

2. Extending stabilizing jackscrews to support and level a drilling rig;

3. Installing water well pumps;

4. Drilling wells for industrial water supplies, irrigation water supplies or water supplies for any other purpose; dewatering or other similar purposes; exploration; hole drilling for geologic and hydrologic information; and core drilling for geologic information.

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**ZONE RATES**

UNLESS ZONE RATES HAVE CONTROLLING LANGUAGE
RATES ARE BASED ON DIRECT TRAVELED ROUTE.

**BRICKLAYER**

In addition to BRICKLAYER rates add the applicable amounts per hour, calculated based on a radius of over thirty five (35) miles from the Washoe County Courthouse in Reno, Nevada:

<table>
<thead>
<tr>
<th>Miles</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-35</td>
<td>Free Zone</td>
</tr>
<tr>
<td>35-75</td>
<td>$10.00 Per Day</td>
</tr>
<tr>
<td>Over 75</td>
<td>$43.00 Per Day</td>
</tr>
</tbody>
</table>

CARPENTER (Building and Heavy Highway and Dam Construction)
In addition to CARPENTER rates add the applicable amounts per hour, calculated from the Washoe County Courthouse:
- Zone 1-0 to 50 miles: 0.00
- Zone 2-50 to 150 miles: 2.00
- Zone 3-150 to 300 miles: 3.00
- Zone 4-300 miles and over: 4.00

LABORER (Highway and Dam Construction only)
In addition to LABORER rates add the applicable amounts per hour, calculated as follows:
- Zone 1-0 to 50 miles: 0.00 (from either the Carson City or Washoe County Courthouse)
- Zone 2-50 to 150 miles: 1.50 (from the Washoe County Courthouse)
- Zone 3-150 to 300 miles: 2.00 (from the Washoe County Courthouse)
- Zone 4-300 miles and over: 3.00 (from the Washoe County Courthouse)

LABORER (Building Construction)
In addition to LABORER rates add the applicable amounts per hour, calculated based on a radius from either the Carson City Courthouse or the Washoe County Courthouse:
- Zone 1-0 to 35 miles: 0.00
- Zone 2-35 miles and over: 2.50

MILLWRIGHT
In addition to MILLWRIGHT rates add the applicable amounts per hour, calculated based on a radius from the County Courthouse located in Reno:
- Zone 1-0 to 15 miles: 0.00
- Zone 2-15 to 35 miles: 1.50
- Zone 3-Over 35 miles: 3.25

OPERATING ENGINEER
In addition to OPERATING ENGINEER; STEEL FABRICATOR and ERECTOR, and PILEDRIVER rates add the applicable amounts per hour calculated as follows:
- Zone 1-0 to 50 miles: 0.00 (from either the Carson City or Washoe County Courthouse)
- Zone 2-50 to 150 miles: 2.00 (from the Washoe County Courthouse)
- Zone 3-150 to 300 miles: 3.00 (from the Washoe County Courthouse)
- Zone 4-300 miles and over: 4.00 (from the Washoe County Courthouse)

PLASTERER
In addition to PLASTERER rates add the applicable amounts per hour, calculated based on a radius from South Virginia and Mill Street, Reno:
- Zone 1-0 to 70 miles: 0.00
- Zone 2-70 miles and over: 5.00

TRUCK DRIVER
In addition to TRUCK DRIVER rates add the applicable amounts per hour, calculated from Washoe County Courthouse:
- Zone 1-0 to 50 miles: 0.00
- Zone 1-50 to 150 miles: 2.00
- Zone 1-150 to 300 miles: 2.50
- Zone 1-Over 300 miles: 3.50
1. As used in these specifications:
   a) "Covered area" means the geographical area described in the solicitation from which this contract resulted;
   b) "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
   c) "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return. U.S. Treasury Department Form 941.
   d) "Minority" includes:
      i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
      ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
      iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands); and
      iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith
effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor’s or Subcontractor’s failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the FEDERAL REGISTER in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor’s obligations under these specifications. Executive Order 11246 or the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor’s compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

a) Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor’s employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor’s obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
b) Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations’ responses.

c) Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

d) Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor’s efforts to meet its obligations.

e) Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor’s employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.

f) Disseminate the Contractor’s EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc. by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g) Review, at least annually, the company’s EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of the items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h) Disseminate the Contractor’s EEO policy externally by including it in any advertising in the news media, specifically including minority and female news
media, and providing written notification to and discussing the Contractor’s EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.

i) Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor’s recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j) Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor’s work force.

k) Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m) Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor’s obligations under these specifications are being carried out.

n) Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o) Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations minority and female contractor associations and other business associations.

p) Conduct a review, at least annually, of all supervisors’ adherence to and performance under the Contractor’s EEO policies and affirmative action obligations.

8) Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling
any one or more of its obligations under 7a through p of these Specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligations to comply, however, are the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9) A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

10) The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11) The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12) The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13) The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14) The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g. mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the
indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15) Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g. those under the Public Works Employment Act of 1977) and the Community Development Block Grant Program.)
A. General Instructions:

MBE/WBE utilization is based on Executive Orders 11625, 12138 and 12432 and OMB Circular A-102. Standard Form 334 must be completed by recipients of Federal grants, cooperative agreements, or other Federal financial assistance valued at $500,000 or more and which involve procurement of supplies, equipment, construction or services to accomplish Federal assistance programs.

Recipients are required to report to agency award officials within one month following the end of each Federal fiscal year quarter (i.e. January 31, April 30, July 31 and October 31) during which any procurement in excess of $10,000 is actually executed under this assistance agreement.

B. Definitions

Procurement is the acquisition through order, purchase, lease or barter of supplies, equipment, construction or services needed to accomplish Federal assistance programs.

A minority business enterprise (MBE) is a business concern that is (1) at least 51 percent owned by one or more minority individuals, or, in the case of a publicly owned business, at least 51 percent of the stock is owned by one or more minority individuals; and (2) whose daily business operations are managed and directed by one or more of the minority owners.

There is no standard definition of minority individuals used by all Federal financial assistance agencies. However, recipients shall presume that minority individuals include Black Americans, Hispanic Americans, Native Americans, Asian Pacific Americans, or other groups whose members are found to be disadvantaged by the Small Business Act or by the

Secretary of Commerce under Section 5 of Executive Order 11625. The reporting contact at your Federal financial assistance agency can provide additional information.

A woman business enterprise (WBE) is a business concern that is, (1) at least 51 percent owned by one or more women, or, in the case of a publicly owned business, at least 51 percent of the stock is owned by one or more women; and, (2) whose daily business operations are managed and directed by one or more of the women owners.

Business firms which are 51 percent owned by minorities or women, but are in fact managed and operated by non-minority individuals do not qualify for meeting MBE/WBE procurement goals.

The following affirmative steps for utilizing MBEs and WBEs are suggested:

1. Inclusion of MBEs/WBEs on solicitation lists.

2. Assure MBEs/WBEs are solicited once they are identified.

3. Where feasible, divide total requirements into smaller tasks to permit maximum MBE/WBE participation.

4. Where feasible, establish delivery schedules which will encourage MBE/WBE participation.

5. Encourage use of the services of the U.S. Department of Commerce’s Minority Business Development Agency (MBDA) and the U.S. Small Business Administration to identify MBES/WBEs.

6. Require that each party to a subgrant, sub-agreement, or contract award take the affirmative steps outlined here.

There is no reporting threshold for the Environmental Protection Agency (EPA) Recipients of EPA financial assistance must report under all assistance agreements regardless of the size of the award.
C. Instructions for Part I:

1. Complete Federal fiscal year and check applicable reporting quarter. (Federal fiscal year runs from October 1 through September 30.)

2. Identify the federal financial assistance department or agency including the bureau office or other subactivity which administers your financial assistance agreement.

3. Identify the agency, state, authority, university or other organization which is the recipient of the Federal financial assistance and the person to contact concerning this report.

4a. Assistance agreement number assigned by Federal financial assistance agency.

4b. If appropriate, identify specific department or agency Federal financial assistance program under which this project is awarded.

4c. Check type of Federal assistance.

5a. Period during which contracts and other purchases under this award will actually be executed.

5b. Includes procurement using Federal funds plus recipient matching funds and funds from other sources.

5c. Portion of total procurement dollars recipient plans to spend with MBEs or WBEs this fiscal year. With the concurrence of the Federal financial assistance agency, a fair share goal shall be determined by each recipient.

5d. Dollar amount of all MBE/WBE contracts awarded under this assistance agreement this quarter.

5e. Check only if one or more procurements in excess of $10,000 were executed this reporting quarter but no MBE/WBE procurements occurred. Sign and date form and return it to Federal financial assistance agency.

D. Instructions for Part II:

For each MBE/WBE procurement over $10,000 made under this assistance agreement during the reporting quarter, provide the following information. (Recipients may also report on individual MBE/WBE procurements of less than $10,000 if they want these credited toward their MBE/WBE goals; however, reporting on smaller procurements is not required.)

1. Check whether this is a first tier procurement made directly by Federal financial assistance recipient or other second tier procurement made by recipient's subgrantee or prime contractor. Include all qualifying second tier purchases executed this quarter regardless of when the first tier procurement occurred.

2. Check MBE or WBE.

3. Dollar value of procurement.

4. Date of award, shown as month, day, year.

5. Using codes at the bottom of the form, identify type of product or service acquired through this procurement (e.g., enter 1 if agriculture, 2 if mining, etc.).

6. Name and address of MBE/WBE firm.
Keep sign a proper distance above prevailing grade to permit public viewing.

Section A-A

PROJECT SIGN DETAIL

SUPPLEMENTARY CONDITIONS
Project Sign Detail

00800 – Appendix C-1

037012.10
Historic Preservation

In accordance with NRS 383.121, the following procedures shall be followed in the event that historic; prehistoric or paleoenvironmental evidence are discovered during subsurface excavation at the site of construction.

1) The engineer shall issue a “Stop Work Order” directing the Contractor to cease all construction operations at the location of such potential cultural resources find.

2) Such “Stop Work Order” shall be effective until such time as the State Historic Preservation Office has been notified at:

    State Historic Preservation Office
    100 North Stewart Street
    Carson City, Nevada 89701-4285

and the engineer and the contractor have cooperated with the Office to preserve or permit study of such evidence before its destruction, displacement or removal.

If the Office determines that the potential find is a bonified historic resource, the engineer shall extend the stop work order in writing until the impacts upon the find have been mitigated to the satisfaction of the Office to the fullest extent practicable.

Equitable adjustment of the construction contract shall be made, by change order in the following manner:

1) Time Extension

    If the work temporarily suspended is on the “critical path”, the total number of days for which the suspension is in effect shall be added to the number of allowable contract days.

    If a portion of work at the time of such suspension is not on the “critical path”, but subsequently becomes work on the critical path, the allowable contract time will be computed from the date such work is classified as on the critical path.

2) Additional Compensation

    If, as a result of a suspension of the work the Contractor sustains a loss which could not have been avoided by his judicious handling of forces, equipment, and (plant) or redirection of forces or equipment to perform other work on the contract, there shall be paid to the Contractor an amount as determined by the Engineer to be fair and reasonable compensation for the Contractor’s actual loss in accordance with the following:

    a) **Idle Time of Equipment**
Compensation for equipment idle time will be determined on a force account (time and materials) basis, and shall include the cost of extra moving of equipment and rental loss.

b) **Idle Time of Labor**

Compensation for idle time of workers will be determined by the engineers "Labor" less any actual productivity factor of this portion of the work force.

c) **Increased costs of Labor and Materials**

Increased costs of labor and materials will be compensated only to the extent such increase was in fact caused by the suspension, as determined by the engineer.

Compensation for actual loss due to idle time of either equipment or labor shall not include markup for profit.

The hours for which compensation will be paid will be the actual normal working time during which such delay condition exists, but will in no case exceed eight hours in any one day.

The days for which compensation will be paid shall be full or partial calendar days, excluding Saturdays, Sundays and legal holidays, during the existence of such delay.
AIR QUALITY – PERMITS

The contractor may be required to obtain permits to construct and/or operating permits for sources of air pollution.

Information concerning these permits may be obtained from:

The Air Quality Section
Nevada Division of Environmental Protection
123 West Nye Lane
Carson City, Nevada 89706-0851
(775) 687-9350

Certificates and permits are required for sources such as, but not limited to:

1. Fuel burning equipment
2. Gasoline and petroleum distillate storage containers
3. Land disturbing activities
4. Processing equipment (sand, gravel, concrete batch plant etc.)
5. Sludge incinerators
6. Odors

Permits to construct and/or operating permits for construction in Clark and Washoe counties and in Carson City should be obtained from:

Clark County
Air Pollution Control Division
Clark County Health Protection
P.O. Box 4426
Las Vegas, Nevada 89106

Washoe County
Division of Environmental Protection
Washoe County Health Department
P.O. Box 11130
Reno, Nevada 89520
WATER AND SEWER LINE SEPARATIONS

State regulations on the separation of water and sewer lines shall be followed. These are listed under NAC 445A.6715 to NAC 445A.67175.

Contact the Nevada State Health Division for reviews on this matter:

State Health Division
Consumer Health Protection Services
Public Health Engineering
1179 Fairview Drive, Suite 101
Carson City, NV 89701-5405
(775) 687-6353

For projects in Washoe County or Clark County, contact the following:

Clark County
Clark County Health Protection
P.O. Box 4426
Las Vegas, Nevada 89106
(702) 383-1275

Washoe County
Washoe County Health Department
P.O. Box 11130
Reno, Nevada 89520
(775) 328-2434
DIVISION 1

GENERAL REQUIREMENTS

01010 Summary of Work and Contract Considerations
01025 Measurement and Payment
01040 Coordination and Project Requirements
01140 Environmental Protection
01190 Seismic Requirements for Contractor Furnished and/or Installed Items
01300 Submittals
01500 Construction Facilities and Temporary Controls
01650 Facility Startup
01700 Contract Closeout
01730 Operations and Maintenance Manuals
PART 1 - GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. The project covers all work shown on the Drawings and covered in the Specifications including: Construction of a new wastewater treatment plant including a headworks with fine screening and a grit removal system, an influent flow meter and vault, a flow splitter box, an oxidation ditch, two secondary clarifiers, a utility water system, a RAS/WAS pumping and dewatering facility including a decanter centrifuge, polymer feed system and a screw conveyor, an in-plant pump station, a scum pump station, new motor control centers, SCADA and HMI equipment, instrumentation, yard piping, an operations building including a laboratory, control center and bathroom/Janitor facilities, modifications to the existing control building and pipe gallery, conversion of the existing aeration basins to digesters, modifications to the existing disinfection system, and modifications to the existing security and electrical system. Civil work includes site grading, landscaping, an irrigation system, roads, sidewalks, and site fencing. The project also includes electrical and mechanical modifications to the Diamond Peak and Woodland Village pump stations.

1.02 TYPE OF CONTRACT

A. The Work covered by these Contract Documents shall be provided under a single Lump Sum Contract.

1.03 WORK UNDER OTHER CONTRACTS

A. Work associated with this project includes construction of new rapid infiltration basins, construction of the Woodland Village force main extension, and extension of an 8-inch water main to service the new treatment facility. This work should be completed by others prior to initiation of the treatment plant work. If it is not, the contractor shall coordinate efforts as necessary to complete the work defined in the contract documents.

1.04 OWNER-FURNISHED AND INSTALLED ITEMS (N.I.C.)

A. Certain items shown or referred to in the Contract Documents are not included in this contract and are marked "Not in Contract" (N.I.C.). The Owner will furnish and install N.I.C. items. The Contractor shall make the required connections between N.I.C. items and mechanical and electrical services provided under this Contract.

B. The Contractor shall cooperate with the Owner's workers and shall provide access to work areas and space to store tools, material and equipment. The Owner shall coordinate his work efforts with those of the Contractor and shall adjust his schedule to accommodate the Contractor's schedule.
1.05 OWNER-FURNISHED CONTRACTOR INSTALLED ITEMS (O.F.C.I.)

A. Certain items required for this project will be furnished by the Owner and installed by the Contractor. Such items are referred to as "Owner-Furnished Contractor Installed (O.F.C.I.)." O.F.C.I. items shall be picked up by the Contractor at the Owner's local warehouse, transported to the project site and installed by the Contractor.

B. Contractor's installation of O.F.C.I. items shall include attaching or anchoring items, connecting utilities and controls, lubricating and necessary adjustment, startup, testing, placing items in service. If items are new Contractor shall turn over operation and maintenance manuals and equipment warranties to Owner.

1.06 ITEMS ORDERED IN ADVANCE

A. The Owner has not ordered any items in advance for this project. There are existing items the contractor shall be responsible for maintaining relocating and/or modifying.

1.07 PROVISIONS FOR FUTURE WORK

A. The Owner intends to build a second oxidation ditch when flows increase to the treatment plant (Phase 2). A knock-out section is being incorporated into the design of the proposed oxidation ditch (Phase 1) that will provide a passageway between the two basins. The Contractor shall not locate or support any conduits, pipes, ductwork, equipment or other items in such a way that they will have to be relocated or re-supported when the wall opening is cut.

1.08 WORK SEQUENCE

A. Construct work to accommodate Owner's continued use and operation of the existing facility. The new facility must be brought on-line without any interruption in treatment plant service. Work required in the existing facilities must not interfere with the daily operation of the existing treatment plant and in some cases will need to be undertaken after the new treatment plant is brought on-line.

The project includes three major milestones of work completion as follows. The milestones and the time for completing each is as follows:

- Milestone 1 – Beneficial Use of the "Liquid Stream Processes" (260 days)
- Milestone 2 – Beneficial Use of the remaining portions of the project. This milestone is defined as “Substantial Completion” of the project (320 days)
- Milestone 3 – Final Completion of the entire project (365 days)

The work sequence as defined in the Construction Schedule (see Section 01300-1.04) shall clearly reflect how the Contractor plans to meet the three major construction "milestones" identified above.
The phrase “Liquid Stream Processes” shall include the headworks, splitter box, oxidation ditch, clarifiers, RAS pumping, effluent pump station, and all building, piping, electrical and controls necessary to allow the systems function as intended in the contract documents. Also included in this list would be any associated work required for issuance of Certificate of Occupancy of the RAS/WAS pump room or other related buildings.

1.09 CONTRACTOR'S USE OF SITE AND OWNERS CONTINUED OPERATIONS

A. The Contractor shall confine his use of the site for work and storage to the Work Area Limits shown on the contract drawings. The Contractor's use of adjacent lands and roads for access to move onto and off of the site and for daily access of workers, material and equipment shall be arranged and scheduled to minimize interference with the Owner's continued operations.

B. The Owner intends to continue operation of portions of its existing facility during all of the construction period. The Contractor shall plan and schedule its work to minimize impacting the Owner's continued operations and shall, at all times, maintain safe access for the Owner's operating personnel and equipment.

C. The Contractor shall be responsible for maintaining safe emergency exiting for the Owner's and Contractor's personnel in all areas affected by the Contractor's work.

D. If operation of the Owner's existing facility is adversely affected by the Contractor's work, the Owner may suffer a financial loss and may make a claim against the Contractor to recover its loss.

E. Contractor shall perform work only during regular working hours. Regular working hours are defined as Monday through Friday, 7:00 A.M. through 6:00 P.M. Any work performed outside of the regular working hours shall require written permission from the Owner.

1.10 DOCUMENTING EXISTING

A. Prior to commencing the Work, tour the site with the Owner and the Engineer. Examine and document photographically and in writing the condition of existing buildings, equipment, improvements, and landscape planting on or adjacent to the site. This record shall serve as a basis for determination of subsequent damage due to the Contractor's operations and shall be signed by all parties making the tour. Record existing conditions on 35 mm film.

1.11 SHUTDOWN OF EXISTING UTILITIES, SERVICES OR OPERATIONS

A. Obtain the Owner's approval at least 5 days prior to the shutdown of any utility, service or operation of any existing facility. Give required notice and make appropriate arrangements with utility owners and other affected parties prior to shutdown of any utility service. Base bids on work performed during normal working hours.
B. Schedule utility service or operations shutdowns for periods of minimum use and at the Owner's convenience. Have all required material, equipment and workers on site prior to beginning any work involving a possible shutdown. Perform work as required to reduce shutdown time to the minimum. In some cases, this may require increased numbers of workers and/or premium time night or weekend work.

C. The Contract Price shall include the cost of additional workers and premium time work required to minimize the impact of utility service or operations shutdowns.

1.12 ALLOWANCES

A. A $10,000 allowance is included as part of this project to purchase laboratory and miscellaneous equipment. No contractor markup is allowed on these items.

B. Retesting or Rebalancing caused by the Contractor's failure to provide Work complying with the Contract Documents shall be paid for by the Contractor.

1.13 SCHEDULE OF VALUES

A. Specific provisions are described in Article 13, paragraph 13.1 of the General Conditions and Specifications section 01025 – 1.05.

B. The Contractor's Schedule of Values shall be in a form acceptable to the Owner/Engineer and have at least the following level of detail: a separate line item for each technical specification section, for site mobilization, for Construction Scheduling, for bonds and insurance, for final cleanup and for final deliverables. Subdivide final deliverables into: Record Drawings; Operation and Maintenance Manuals with Parts Lists; and Special Guarantees. Include the appropriate specification section and paragraph number for each line item. Subdivide major trades or portions of the work into multiple line items that relate to observable milestones to aid monthly progress evaluations in accordance with the following example:

Concrete Work
Foundations
Slab on grade
First floor walls and columns
Second floor beams and slabs
Second floor walls and columns, etc.

C. The Engineer may recommend payment for the cost of making a successful Shop Drawing Product Data or Sample submittals required for Product Review not to exceed 2% of the value of the work or item submitted.
A. Applications for Payment may be made only on General Conditions Exhibit GC-4, in accordance with General Conditions paragraph 13.2. Line items on the Application for Payment shall be the same as those used on the Schedule of Values. Applications for Payment shall contain the Contractors Certification required by General Conditions paragraph 13.2.
1.15 CONTRACT MODIFICATIONS

A. Methods of modifying the Contract Documents are covered in General Conditions, Article 9.

B. The following documents may be used by the Engineer:
   1. Request for Quotation: Issued by the Engineer, a Request for Quotation is used to describe a proposed change and request a cost quotation from the Contractor but does not authorize a change in the Work or in the Contract Time or Price.
   2. Change Order: Signed by the Engineer signifying its recommendation, and signed by the Contractor and Owner signing their acceptance, a Change Order changes the Scope of Work and possibly the Contract Price and/or Contract Time.
   3. Work Directive Change: Signed by the Owner (and in some cases by the Contractor) signifying their acceptance and issued by the Engineer, a Work Directive Change is used: (1) to direct the Contractor to do extra work on a cost accounting basis with a fixed maximum sum when the Owner and Contractor have not agreed on the price and time for the change, and (2) to direct the Contractor to do work that the Contractor contends is not included in the contract scope. Work done under case 1 will be converted to a Change Order when the Contractor and Owner agree on the change in price and time. The Contractor may make a claim under General Conditions Article 10 for recovery of cost and time extension for work done under case 2; but if the claim is denied because the work is determined to be included in the contract scope, then the Contract Time and Price will not be changed. Work done under both cases 1 and 2 shall be done in accordance with the requirements for work done on a cost accounting basis described in General Conditions paragraphs 9.11 through 9.14.
   4. Response to Request for Information: Issued by the Engineer, a Response to Request for Information is used to order or document minor changes in the work consistent with the intent of the Contract Documents and NOT involving a change in price or time. Information issued on a Response to Request for Information shall NOT authorize a change in Contract Price or Contract Time and shall not be considered a Constructive Change Order. If the Contractor considers that a Response to Request for Information would cause a change in Contract Price or Time, it shall notify the Engineer in writing within 15 days of receipt of the Response to Request for Information and shall not proceed with the work. See General Conditions paragraphs 7.8, 9.9 and 9.10.
   5. The Contractor hereby expressly waives any claim or right to make a claim for an increase in contract time or price without written notice to the Engineer of the Contractor's intent to make a claim 5 days prior to proceeding to execute the work or portion thereof giving rise to such claim. See General Conditions paragraph 10.3.
   6. The Contractor agrees that it shall not consider any Response to Request for Information, order, instruction, clarification, suggestion or any other communication either written or oral, given intentionally or unintentionally by the Engineer, Owner or any other person as authorization or direction to do any
work that would cause a change in Contract Time or Price unless it is a formal
written Change Order or Work Directive Change signed by the Owner.

1.16  REGULATORY REQUIREMENTS

A. The codes and regulations adopted by the State and other governmental authorities
having jurisdiction shall establish minimum requirements for this project. This
project shall comply with the latest edition of the following:
1. Uniform Building Code (UBC)
2. Uniform Building Code Standards (UBCS)
3. Uniform Fire Code (UFC)
4. Uniform Mechanical Code (UMC)
5. Uniform Plumbing Code (UPC)
7. Nevada Building Code

B. The latest edition of the requirements in effect at the date of submission of bids
shall apply.

C. General Conditions paragraph 5.11 covers the Contractor’s responsibility to comply
with laws and codes applicable to Means and Methods for performing the Work.

D. General Conditions paragraph 5.14 covers the Contractor’s responsibility to report
code deficiencies in the design to the Engineer prior to proceeding with the Work.

E. Paragraphs addressing Pre-Engineered Systems and Performance Specifications
in other Sections cover the Contractor’s responsibility to comply with code
requirements when (1) performance specifications are used to describe all or
portions of Work or items and (2) when pre-engineered (contractor designed)
systems are specified.

F. In cases where the Contract Documents are more restrictive than applicable codes,
the Contractor shall comply with the Contract Documents.

1.17  REFERENCE STANDARDS

A. When these specifications state that Work or tests shall conform to specific
provisions in a referenced standard, specification, code, recommendation or manual
published by an association, organization, society or agency the referenced
provisions, as they apply to the Work of the Contractor only shall be considered a
part of these specifications as fully as if included in total. When these specifications
or applicable codes contain higher or more restrictive requirements than those
contained in reference standards these specifications or applicable codes shall
govern.

B. The latest edition of a referenced standard published at the time of submission of
bids shall apply unless a specific date for the referenced standard is cited in these
specifications.
C. General provisions in referenced standards, specifications, manuals or codes shall not change the specific duties and responsibilities between any of the parties involved in this work from those described in the General Conditions. Provisions in referenced standards with regard to measurement and payment shall not apply to this Work unless specifically cited. See General Conditions paragraph 2.3.

1.18 SPECIFICATION LANGUAGE AND STYLE

A. Many parts of the Specifications as well as notes on the Drawings are written in the active voice and are addressed to the Contractor.

1. When words or phrases requiring an action or performance of a task are used, it means that the Contractor shall provide the action or perform the task. For example: provide, perform, install, furnish, erect, connect, test, operate, adjust or similar words mean that the Contractor shall perform the action or task referred to.

2. When words or phrases requiring selection, acceptance, approval, review, direction, designation or similar actions are referred to, it means that such actions are the Owner's or the Engineer's prerogative and that the Contractor must obtain such action before proceeding.

B. Requirements in the Specifications and Drawings apply to all work of a similar type, kind or class even though the word "all" or "typical" may not be stated.

1.19 DEFINITIONS

A. The following terms, when used in the Contract Documents, shall have the meanings listed:

        ACCEPTABLE
            "acceptable to the Engineer"
        PERFORM
            "perform all operations required to complete the work referred to in accordance with the intent of the Contract Documents"
        PROVIDE
            "furnish and install the work referred to including proper anchorage, connection to required utilities or other work, testing, adjustment and startup ready to put in service and perform the intended function"
        REQUIRED
            "required by the Contract Documents or required to complete the Work and produce the intended results"
        SATISFACTORY
            "acceptable to the Engineer"
        SHOWN
            "as indicated on the Drawings"
        SITE
            "geographical location of the Project and land within the work area shown on the contract drawings and within which the Work will be installed or built"
        SPECIFIED
            "as written in the Contract Documents including the Specifications and the Drawings"
        SUBMIT
            "submit to the Engineer"

1.20 ABBREVIATIONS
A. The following acronyms or abbreviations are used in these specifications for the organizations listed.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Stands for</th>
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<tbody>
<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
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<tr>
<td>AAMA</td>
<td>Architectural Aluminum Manufacturers Association</td>
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<tr>
<td>ABMA</td>
<td>American Boiler Manufacturers Association</td>
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<td>ACI</td>
<td>American Concrete Institute</td>
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<td>ADC</td>
<td>Air Diffusion Council</td>
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<td>AGA</td>
<td>American Gas Association</td>
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<td>AGMA</td>
<td>American Gear Manufacturers Association</td>
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<td>AI</td>
<td>Asphalt Institute</td>
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<td>AISC</td>
<td>American Institute of Steel Construction</td>
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<td>AISI</td>
<td>American Iron and Steel Institute</td>
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<td>AITC</td>
<td>American Institute of Timber Construction</td>
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<td>AMCA</td>
<td>Air Moving and Conditioning Association</td>
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<tr>
<td>ANSI</td>
<td>American National Standard Institute (formerly United States of America Standards Institute)</td>
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<td>APA</td>
<td>American Plywood Association</td>
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<td>API</td>
<td>American Petroleum Institute</td>
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<td>APWA</td>
<td>American Public Works Association</td>
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<td>AREA</td>
<td>American Railway Engineering Association</td>
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<td>ASCE</td>
<td>American Society of Civil Engineers</td>
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<tr>
<td>ASHRAE</td>
<td>American Society of Heating, Refrigerating and Air Conditioning Engineers</td>
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<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
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<td>ASTM</td>
<td>American Society for Testing and Materials</td>
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<td>AWPA</td>
<td>American Wood-Preservers' Association</td>
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<td>AWS</td>
<td>American Welding Society</td>
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<td>AWWA</td>
<td>American Water Works Association</td>
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<tr>
<td>CAGI</td>
<td>Compressed Air and Gas Institute</td>
</tr>
<tr>
<td>CBM</td>
<td>Certified Ballast Manufacturers</td>
</tr>
<tr>
<td>CI</td>
<td>Chlorine Institute</td>
</tr>
<tr>
<td>CISPI</td>
<td>Cast Iron Soil Pipe Institute</td>
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<tr>
<td>CMAA</td>
<td>Crane Manufacturers Association of America</td>
</tr>
<tr>
<td>CPSC</td>
<td>Consumer Products Safety Commission</td>
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<tr>
<td>CRA</td>
<td>California Redwood Association</td>
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<tr>
<td>CRSI</td>
<td>Concrete Reinforcing Steel Institute</td>
</tr>
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<td>CS</td>
<td>Commercial Standards for the U.S. Department of Commerce</td>
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<tr>
<td>CTI</td>
<td>Cooling Tower Institute</td>
</tr>
<tr>
<td>DFPA</td>
<td>Douglas Fir Plywood Association</td>
</tr>
<tr>
<td>EIA</td>
<td>Electronic Industries Association</td>
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<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
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<tr>
<td>ETL</td>
<td>Electronic Testing Laboratory</td>
</tr>
<tr>
<td>FM</td>
<td>Factory Mutual Insurance Company</td>
</tr>
<tr>
<td>FPS</td>
<td>Fluid Power Society</td>
</tr>
<tr>
<td>FS</td>
<td>Federal Specifications</td>
</tr>
<tr>
<td>GO 95</td>
<td>General Order No. 95, California Public Utilities Commission Rules for Overhead Electric Line Construction</td>
</tr>
</tbody>
</table>
Abbreviation	Stands for

GO 128	General Order No. 128, California Public Utilities Commission
Rules for Underground Electrical Construction

HI	Hydraulic Institute

HMI	Hoist Manufacturers Institute

IAPMO	International Association of Plumbing and Mechanical Officials

ICBO	International Conference of Building Officials

IEEE	Institute of Electrical and Electronic Engineers

IES	Illuminating Engineering Society

IGCC	Insulating Glass Certification Council

IPCE	International Power Cable Engineers Association

ISA	Instrument Society of America

NAAMM	National Association of Architectural Metal Manufacturers

NBS	National Bureau of Standards

NCPI	National Clay Pipe Institute

NDEP	Nevada Department of Environmental Protection

NDOT	Nevada Department of Transportation

NEC	National Electric Code

NEMA	National Electrical Manufacturers Association

NETA	International Electrical Testing Association

NFPA	National Fire Protection Association

NGVD	National Geodetic Vertical Datum

NSF	National Sanitation Foundation

NWMA	National Woodwork Manufacturers Association

OSHA	Occupational Safety and Health Act

PCA	Portland Cement Association

REA	Rural Electrification Administration

SAMA	Scientific Apparatus Makers Association

SMACNA	Sheet Metal and Air Conditioning Contractors National Association

SSPC	Structural Steel Painting Council

TCA	Tile Council of America

UBC	Uniform Building Code

UFC	Uniform Fire Code

UMC	Uniform Mechanical Code

UPC	Uniform Plumbing Code

USDC	U.S. Department of Commerce

UL	Underwriters Laboratories

WCLIB	West Coast Lumber Inspection Bureau

WIC	Woodwork Institute of California

WQCB	Water Quality Control Board (Regional)

WRCB	Water Resources Control Board

END OF SECTION
SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section covers the method of measuring completed Work for payments to the Contractor. Payment shall be as set forth in the proposal and the Contract Agreement shall be considered to be in full compensation for completed Work in place and shall cover all mobilization, clearing, excavation, shoring, dewatering, backfill, paving, materials, equipment, machinery, supplies, tools, labor, cleanup, overhead, profit, and all other expenditures incidental to satisfactory compliance with the Contract Documents in order to achieve a complete, connected, tested, calibrated, and fully operable system.

1.02 PROGRESS PAYMENTS

A. Progress payments shall be made monthly for Work completed and shall be based on the measurement Sections specified in Part 3 herein.

1.03 DESCRIPTION OF BID ITEMS

A. It is expressly understood that all bid items shall include setting to final grade of all utility boxes, valve boxes, catch basins, manhole castings, monument cases, and other utility vaults or access thereto that exist in the construction area regardless of the type of surface. Traffic control, slope protection, erosion control, and ground cover shall be included in all bid items as appropriate. All labor, material, and equipment required for this Work shall be included in the price bid and no other compensation shall be allowed.

1.04 MEASUREMENT

A. For lump sum items, estimates of percent complete will be made monthly based on the amount of work completed.

1.05 SCHEDULE OF VALUES

A. Description of Work:

1. Contractor to submit to the Engineer a Schedule of Values allocated to the various portions of the work, within 15 days after Award of Contract.

2. Upon request of the Engineer, support the values with data that will substantiate their correctness.

3. The Schedule of Values, unless objected to by the Engineer, shall be used only as the basis for the Contractor's Applications for Payment.
4. Payment shall not be made until the schedule of values has been reviewed and accepted by the engineer.

B. Form and Content of Schedule of Values
   1. Type schedule on 8 ½-inch by 11-inch inch white paper; Contractor’s standard forms and automated printout will be considered for approval by Engineer upon Contractor’s request. Identify schedule with:
      a. Title of project and location
      b. Engineer and project number
      c. Name and address of Contractor
      d. Date of submission.
   2. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing value for progress payments during construction.
   3. Follow the table of contents of this project manual as the format for listing component items.
   4. For each major line item, list subvalues of major products or operations under the time.
   5. For the various portions of the work:
      a. Each item shall include a directly proportional amount of the Contractor’s overhead and profit.
      b. For items on which progress payments will be requested for stored materials, break down the values into:
         1. The cost of the materials, delivered and unloaded, with taxes paid.
         2. The total installed value.
   6. The sum of all values listed in the schedule shall equal the total contract sum.

C. Review and Resubmittal
   1. After review by Engineer, revise and resubmit schedule as required.
   2. Resubmit revised schedules in same manner.

PART 2 - PRODUCTS - Not applicable to this Section.

PART 3 – PAYMENT

3.01 The Lump Sum price for the Facility Expansion shall constitute full compensation for furnishing all labor, equipment and materials, and for performing all operations required to complete the work as shown on the Drawings and/or described in the Specifications in order to achieve a complete, connected, tested, calibrated, and fully operable system.

END OF SECTION
SECTION 01040
COORDINATION AND PROJECT REQUIREMENTS

1.01 PROJECT COORDINATION

A. Coordinate scheduling, submittals and work of various Sections of the Specifications and subcontractors to assure efficient and orderly sequence of interdependent construction. Provide accommodations for items to be furnished and installed by Owner and labeled "NIC" (not in contract) on the Drawings and for Owner Furnished Contractor Installed items.

1.02 MECHANICAL AND ELECTRICAL COORDINATION

A. The Contractor's superintendent or a specially assigned assistant shall be designated the mechanical/electrical coordinator and shall coordinate the exact location, space priorities and sequence of installation of all mechanical and electrical work with each other and with all other trades. The mechanical/electrical coordinator shall assure compliance with the requirements of this paragraph 1.02.

B. The location of mechanical and electrical work may be indicated diagrammatically on the Drawings. Actual locations shall follow locations shown on the Drawings as closely as practicable but shall be altered or adjusted in the field by the mechanical/electrical coordinator as required by the following:
1. In finished spaces install mechanical and electrical work concealed within the space available.
2. Organize mechanical and electrical work to make efficient use of space. Combine similar items into groups; make all runs parallel to or at right angles with building lines.
3. Layout and install work to provide adequate space and access for adjustment, servicing, and maintenance and maximize space available for future installation of additional services or replacement of existing services.
4. Assure that all access doors required by code or required for adjustment, servicing or maintenance are provided in accordance with Section 08305. Locate access doors to provide convenient access and to coordinate with finished visual elements.
5. Coordinate location of fixtures, registers, grills, outlets, switches, panelboards, pullboxes, access doors, and other exposed mechanical and electrical items with functional and visual elements. Verify location of questionable items with Engineer before proceeding.

C. Prepare large scale coordinated detailed installation drawings showing the work of all affected trades to coordinate the actual installed location of all equipment and of all mechanical and electrical work. A 24" x 36" detailed yard piping exhibit shall be prepared showing invert of all yard piping fittings and inlets/outlets to basins. Review coordination drawings with Engineer and all affected trades before proceeding.
D. Review Shop Drawings and Product Data prior to submission for the Engineer's Review to assure that physical characteristics and service requirements are compatible with contract requirements, field conditions, and other items submitted.

E. Verify that required services such as electrical power characteristics, control wiring, and utility requirements of items and equipment submitted and furnished are compatible with services provided. Notify Engineer of potential problems prior to ordering items or equipment and prior to installing services or completing construction in areas where services would have to be installed.

F. Schedule installation sequence of various elements of mechanical and electrical work to achieve optimum compliance with requirements under Mechanical and Electrical Coordination in this Section.

G. Conduct regular weekly coordination meetings with affected trades and Engineer to establish and maintain coordination and resolve conflicts or disputes.

1.03 CUTTING, FITTING, AND PATCHING

A. Provide cutting, fitting, or patching required to complete the Work and to make all of its parts fit together properly. Include cutting, fitting, and patching required to:
   1. Fit the several parts together and to integrate with other work.
   2. Uncover work to install or correct ill-timed work.
   3. Provide openings in elements of work for penetrations of mechanical and electrical work.
   4. Remove and replace defective and non-conforming work.
   5. Remove samples of installed work for testing.

B. Request guidance from the Engineer prior to beginning cutting or altering construction, which affects:
   1. Structural integrity of any element.
   3. Integrity of weather-exposed or moisture-resistant elements.
   4. Efficiency, maintenance, or safety of elements.
   5. Visual qualities of sight-exposed elements.
   6. Work by Owner or separate contractor.

C. Execute cutting and patching using workers that specialize in and are skilled in installing the type of work being cut or patched.

D. Perform work in accordance with the Contract Documents or in the absence of specific requirements comply with best trade practice for the work involved.
   1. Execute work by methods that will avoid damage to other work.
   2. Provide proper support and substrates to receive patching and finishing materials.
   3. Cut concrete materials using masonry saw or core drill. Locate all reinforcing steel, conduits and pipes with electronic detecting devices prior to cutting or core drilling existing concrete.
   4. Replace or patch work with new materials meeting the requirements of these specifications or if not specified matching materials and finishes of existing or
5. Cut wall, ceiling and floor finishes to fit snugly around pipes, sleeves, ducts, conduit, and other penetrations. Provide fire and/or acoustical caulking as required by code or conditions of use.

6. Maintain integrity of wall, ceiling, or floor construction; completely seal voids against smoke, fire and water.

7. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

8. Report any hazardous or unsatisfactory conditions to the Engineer.

1.04 ALTERATION PROJECT PROCEDURES

A. Plan, schedule and perform alteration work as required to minimize impacting the Owner's continued operations. See Section 01010 paragraph titled "Contractor's Use of Site and Owner's Continued Operations."

B. The existing treatment plant must remain in operation during construction. Schedule utility interruptions, piping connections, and interruption of existing plant operations as required to permit continued compliance with regulatory requirements and to meet Owners flow and processing requirements.

C. Perform cutting fitting and patching in accordance with provisions in other paragraphs of this Section. Where new work abuts or aligns with existing work perform a smooth even transition. When a smooth unnoticeable transition is not feasible cut existing surfaces along a straight line at a natural dividing point and provide a groove or cover plate as recommended by the Engineer.

1.05 CONNECTIONS TO UNDERGROUND UTILITIES, CONDUITS, OR PROCESS PIPING

A. Obtain best available current information on location, identification and marking of existing utilities, piping and conduits and other underground facilities before beginning any excavation. In areas where utilities that participate in Underground Service Alert may occur, call 800-227-2600 in Nevada for information at least 48 hours in advance of beginning work. Give Engineer 24 hours notice before beginning work.

B. The location of existing utilities and underground facilities are shown in their approximate location based on information available at the time of preparing the Drawings. The actual location, size type and number of utilities and underground facilities may differ from that shown and utilities or underground facilities may be present that are not shown. See General Conditions Article 3 for the Contractor’s responsibilities and for differing conditions that warrant a change in Contract Price.

C. Use extreme care when excavating or working in areas that may contain existing utilities, process piping, conduits or other underground facilities. Use careful potholing, hand digging and probing to determine the exact location of underground installation. Some locations contain multiple pipes or conduits.

D. Where connections to existing utilities or other underground facilities is required or
where new piping or conduits may cross or interfere with existing utilities or underground facilities carefully excavate and uncover existing installations to a point 1 foot below the pipe or conduit to determine the actual elevation and alignment. Call the Engineer's attention to differing existing conditions that may require a clarification or change.

E. Shutdown of existing utilities, services or operations shall be done in accordance with Section 01010.

1.06 FIELD ENGINEERING AND LAYOUT

A. See General Conditions, Article 3.9 regarding reference points provided by Owner.

B. General Conditions, Article 3.10 require the Contractor to accurately layout the Work including the corners of buildings and other structures and the elevation of every floor, deck, roof, tank bottom, and channel.

C. Employ a Surveyor or experienced surveying instrument technician to layout all detailed dimensions and elevations from reference points. Use recognized engineering survey methods and documentation techniques.

1.07 PRECONSTRUCTION MEETING

A. Prior to beginning the Work, the Contractor and its key personnel and Subcontractors including the Contractor's Superintendent, Project Manager, and Field Engineer shall attend a meeting with the Owner and the Engineer to discuss the following:
   1. Name, Authority, and Responsibilities of Parties Involved
   2. Project Procedures:
      a. Progress meetings
      b. Correspondence
      c. Notification
      d. Submittal of Product Data, Shop Drawing Samples, and Proposed Equivalents
      e. Requests for Information
      f. Response to Requests for Information
      g. Requests for Quotation
      h. Work Directive Change
      i. Change Orders
      j. Engineer's "Items of Concern List"
   3. Temporary Schedule and Contractor's Construction Schedule
   4. Temporary Facilities and Control
   5. Testing During Construction
   6. Contractors Coordination
   7. Mechanical/Electrical Coordination
   8. Maintenance of Record Drawings
   9. Owner Provided Items or Work and Owner Furnished Contractor Installed items
   10. Early Beneficial or Partial Occupancy
   11. Final Testing, Startup, and Balancing
12. Punch Lists and Project Closeout Procedures
13. Final Deliverables including Record Drawings, Operation and Maintenance Manuals, and Special Guarantees.

1.08 PROGRESS MEETINGS

A. The Engineer will conduct weekly progress meetings with Contractor and Owner at the job site. Attendance is required by Contractor's project manager, superintendent and affected Subcontractors and suppliers. The Engineer will prepare, maintain and distribute agenda and dated record of: (1) actions required and taken and (2) decisions needed and made.

B. Agenda:
1. Review critical items/action list.
2. Review work progress. Compare actual progress with planned progress shown on Contractors Construction Schedule. Discuss Corrective action required. Compare actual and projected progress with Contractor's Construction Schedule, propose methods to correct deficiencies.
3. Review status of Submittals; review delivery dates and date of need for critical items.
4. Review coordination problems.
5. Schedule needed testing and critical inspections.
6. Review critical requirements for each trade or major piece of equipment prior to beginning work or installation.
7. Discuss Contractor Quality Control.
8. Discuss open items on Engineers "Items of Concern List."
9. Discuss impact of proposed changes on progress Schedule.
10. Other business.

1.09 PERFORMANCE SPECIFICATIONS AND CONTRACTOR DESIGNED WORK

A. Work under this Contract may be specified by a combination of descriptive, performance, reference standard and proprietary specifications. In the event of conflict between any of the various specification methods used to specify a single item the order of precedence shall be the order in which the methods are listed in the preceding sentence. The terms used to describe types of Specifications are taken from the Construction Specification Institute (CSI) Handbook of Practice.

B. Where Specifications are used to define the characteristics of Contractor designed systems, items or components, the Contractor shall be fully responsible to design, engineer, manufacture, and install the systems, items and components to meet the specified functional requirements, performance requirements, quality standards, durability standards and conditions of use as well as all applicable codes, regulations and referenced trade or industry standards. The Contractor shall perform such design by employing engineers licensed in the State in which the Work is being constructed. The Contractor's design submittals shall include calculations and assumptions on which the design is based and shall be stamped and signed by appropriately licensed engineers.
C. The Owner and the Engineer shall have the right to rely on the expertise and professional competence of the Contractor's design. Favorable review of the Contractor's design submittal shall not relieve the Contractor from full responsibility for the adequacy of the Contractor design.

1.10 MATERIAL AND EQUIPMENT

A. General:
1. Verify that products delivered meet requirements of Contract Documents and the requirements for Favorably Reviewed submittals.

B. Compatibility of Equipment and Material:
1. Similar items, equipment, devices or products furnished under a single specification section shall all be made by the same maker and have interchangeable parts.
2. In addition, but only if so stated in each affected Specification Section, similar items furnished under two or more Specification Sections shall be made by the same maker and have interchangeable parts.
3. All similar materials or products that are interrelated or used together in an assembly shall be compatible with each other.

C. Transportation and Handling:
1. Transport and handle products in accordance with manufacturer's instructions.
2. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
3. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

D. Storage and Protection:
1. Store and protect products in accordance with manufacturer's instructions. Seals and labels shall be intact and legible.
2. Store moisture sensitive products including finish woodwork, gypsum products, acoustical products, motors, electrical equipment, instruments and controls in weathertight, humidity and temperature controlled enclosures.
3. For exterior storage of fabricated products, place items on sloped supports, aboveground.
4. Cover products subject to deterioration from moisture, dust, or sunlight with opaque watertight but breathable sheet covering. Provide ventilation to avoid condensation.
5. Provide offsite storage and protection including insurance coverage when site does not permit onsite storage or protection.
7. Provide facilities, equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
8. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

E. Installation Standards and Manufacturers' Recommendations:
1. Install all products and materials in strict compliance with the most restrictive of the following:
   a. The manufacturer's or provider's written instructions or recommendations. Follow step-by-step installation procedures.
   b. Recommendations of referenced trade associations or standards.
   c. These specifications and drawings.

2. Where conflicts exist present alternatives with advantages and disadvantages to Engineer for decision.

F. If reference standards or manufacturer's instructions contain provisions that would alter or are at variance with relationships between the parties to the Contract set forth in the Contract Documents, the provisions in the Contract Documents shall take precedence. See General Conditions paragraph 2.3.

1.11 BACKING, SUPPORTS AND FASTENERS

A. Provide backing, supports, bracing, fasteners and other provisions required for the proper support and attachment of all work. Backing, supports, bracing and fasteners shall be sized to resist vertical and horizontal loads including seismic and wind loads required by codes listed under Regulatory Requirements in Section 01010 and in accordance with Seismic Design Requirements in this Section. Where finishes in existing facilities must be removed to install backing or where finishes are installed in new construction prior to installing backing the Contractor shall remove finishes, install backing and reinstall finishes.

B. Low velocity pneumatic type power-driven fasteners may be used only:
   1. Where specifically shown, specified or approved.
   2. Where they meet the structural requirements for a particular assembly with a safety factor of at least 400 percent.
   3. Power-driven fasteners may not be used for electrical or mechanical installations or to attach any items loaded in withdrawal or subject to vibration.

1.12 SAFETY

A. In accordance with generally accepted construction practice, applicable law and the General Conditions, especially paragraphs 5.3, 5.20 through 5.28 and 7.3, the Contractor shall be solely and exclusively responsible for:
   1. Construction means and methods.
   2. Safety of employees engaged in the work while on and off the site.
   3. Safety of the Owner, the Engineer, the Design Engineer, and others who may visit or be affected by the work.
   4. Safety of the work itself including material and equipment to be incorporated therein.
   5. Safety of other property at the site or adjacent thereto.
   6. Safety programs, equipment and protective devices required to assure the safety of persons and property for whom/which the Contractor is responsible.

B. The duties of the Engineer in conducting review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's work methods,
equipment, bracing, scaffolding or safety measures in, on, or near the construction site. See General Conditions, paragraph 7.3.

C. The Contractor is hereby informed that work on this project could be hazardous. The Contractor shall carefully instruct all personnel working in potentially hazardous work areas as to potential dangers and shall provide such necessary safety equipment and instructions as required to prevent injury to personnel and damage to property, and to comply with all applicable laws and regulations including State OSHA, Federal OSHA, and other regulations referenced in these Contract Documents.

D. The Contractor shall, at all times, maintain the job in a condition that is safe for the Owner, the Engineer and their Consultants to make site visits and to conduct construction reviews. If the Owner or the Engineer cannot allow personnel to visit the job because it is not safe, the Contractor is not providing required safe access to the Work as required by General Conditions, paragraph 12.2.

E. The Contractor shall prepare a Safety Plan meeting the requirements of applicable regulations. As a minimum, the Contractors Safety Plan shall set forth definite procedures for informing workers about safety, for instructing workers in safe practices, for assuring that workers are using appropriate safety equipment and safe work practices and for reporting accidents.

1.13 EXCAVATION AND TRENCHING; WORK WITHIN CONFINED SPACES

A. Submit specific plans to the Engineer showing details of provisions for worker protection from caving ground in accordance with State of Nevada State Labor Code. The detailed plans shall show the design of shoring, bracing, sloping banks or other provisions and shall be prepared, signed and stamped by a Civil or Structural Engineer licensed in the State in which the Work is performed and retained by the Contractor. The acceptance of the detailed plans submitted is only an acknowledgment of the submission and does not constitute review or approval of the designs, design assumptions, criteria, completeness, applicability to areas of intended use, or implementation of the plans, which are solely the responsibility of the Contractor and his Registered Engineer.

B. Work Within Confined Spaces: Work within confined spaces is subject to applicable laws, regulations and safety orders.

C. The foregoing provisions do NOT reduce the requirement for the Contractor to maintain safety in ALL operations performed by the Contractor or its Subcontractors.

1.14 CONTRACTOR'S QUALITY CONTROL

A. The Contractor shall be fully responsible for inspecting the work of its suppliers and Subcontractors to assure that the work when completed will comply with the standards for materials and workmanship required by the Contract Documents. See General Conditions paragraph 13.9.
B. Inspections, periodic observations and testing performed by the Owner or the Engineer are for the Owner's benefit and information only and shall not be construed as partial or incremental acceptance of the work and shall not be deemed to establish any duty on the part of the Owner or the Engineer to the Contractor, its subcontractors or suppliers. See General Conditions paragraphs 7.5 and 12.10.

C. The Contractor shall:
   1. Be responsible and pay for all testing and quality control for the Project.
   2. Monitor quality control over suppliers, manufacturer, products, services, site conditions, and workmanship, to produce work of specified quality.
   3. Comply fully with manufacturer's installation instructions, including performing each step in sequence as recommended by the manufacturer.
   4. Submit a Request for Information to Engineer before proceeding with work when manufacturers' instructions or reference standards conflict with Contract Documents.
   5. Comply with specified standards as a minimum quality for the work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
   6. Perform work by persons specializing in the specific trade and class of work required and qualified to produce workmanship of specified quality.
   7. Secure products in place with positive anchorage devices designed and sized to withstand seismic, static and dynamic loading, vibration, and physical distortion or disfigurement.

D. If reference standards or manufacturers' instructions contain provisions that would alter or are at variance with relationships between the parties to the Contract set forth in the Contract Documents, the provisions in the Contract Documents shall take precedence.

E. The Contractor shall provide assistance required by the Engineer to adequately inspect the Work including ladders, scaffolding, lighting, ventilation and other aids to facilitate access and provide a safe working environment.

1.15 TESTING LABORATORY SERVICES AND CERTIFIED LABORATORY REPORTS

A. Provide testing service in accordance with General Conditions Article 12.3 and specific requirements contained in each technical specification section. Submit Certified Laboratory Reports required by technical specification sections.

B. Schedule of Required Testing and Certified Laboratory Reports for cast-in-place concrete and structural steel.
### Schedule of Required Testing and Certified Laboratory Reports

<table>
<thead>
<tr>
<th>Specification Section</th>
<th>Item</th>
<th>Testing Service Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>03300, Cast-In-Place Concrete</td>
<td>Concrete Mix Design</td>
<td>Independent Testing Laboratory</td>
</tr>
<tr>
<td></td>
<td>Reinforcing Steel and Portland Cement</td>
<td>Mill certificates or test reports by an independent testing laboratory if certificates are not available.</td>
</tr>
<tr>
<td></td>
<td>Concrete Aggregate</td>
<td>Independent Testing Laboratory</td>
</tr>
<tr>
<td></td>
<td>Slump Tests</td>
<td>Independent Testing Laboratory</td>
</tr>
<tr>
<td></td>
<td>Compression Tests</td>
<td>Cylinders shall be cast by an Independent Laboratory. Cylinders cured at job site in a curing box provided by Contractor and meeting ASTM recommendations. Cylinders picked up at the jobsite and tested by independent testing laboratory. One set of three cylinders required for each 150 cu. yards or fraction for each concrete class placed each day.</td>
</tr>
<tr>
<td></td>
<td>Testing of Concrete in place if required</td>
<td>Independent Testing Laboratory</td>
</tr>
<tr>
<td>05100, Structural Steel</td>
<td>Welders Qualifications</td>
<td>Submit ANSI/AWS D1.1 qualifying tests</td>
</tr>
<tr>
<td></td>
<td>Test Weld by Each Welder</td>
<td>Witnessed by ENGINEER and tested by an independent testing laboratory.</td>
</tr>
<tr>
<td></td>
<td>Steel Material and Fasteners</td>
<td>Mill laboratory certificates for steel from each melt used. If mill certificates are unavailable or if steel from an unidentified melt is used, submit test report from an independent testing laboratory.</td>
</tr>
<tr>
<td></td>
<td>Welding Inspection</td>
<td>Independent Testing Laboratory shall continuously inspect multiple pass welds and inspect single pass welds on completion.</td>
</tr>
<tr>
<td></td>
<td>Full Penetration Welds in Moment Resisting Joints</td>
<td>Independent Testing Laboratory shall ultrasonically test 100% of joints</td>
</tr>
<tr>
<td></td>
<td>High Strength Bolted Connections</td>
<td>Independent Testing Laboratory shall inspect all high strength bolted connections.</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 01140
ENVIRONMENTAL PROTECTION

1.01 SCOPE

A. During the progress of the work, keep the work areas occupied by the Contractor in a neat and clean condition and protect the environment both onsite and offsite, throughout and upon completion of the construction project.

B. A Storm Water Pollution Prevention Plan (SWPPP) has been prepared by the Engineer for this project. The Contractor is responsible to familiarize himself with the requirements of the SWPPP and to implement the pollution prevention measures called for therein. The SWPP will require that certain Best Management Practices (BMPs) be implemented and maintained during the course of construction. The Contractor is required to certify that the requirements of the SWPPP are being implemented.

1.02 SUBMITTALS

A. Develop an Environmental Protection Plan in detail and submit to the Engineer in the within thirty (30) days from the date of the Notice to Proceed. Distribute the favorably reviewed plan to all employees and to all subcontractors and their employees. The Environmental Protection Plan shall include, but not be limited to, the following items:

2. Proposed sanitary landfill site.
3. Other proposed disposal sites.
4. Copies of any agreements with public or private landowners regarding equipment, materials storage, borrow sites, fill sites, or disposal sites. Any such agreement made by the Contractor shall be invalid if its execution causes violation of local or regional grading or land use regulations.

1.03 MITIGATION OF CONSTRUCTION IMPACTS

A. Requirements: All operations shall comply with all federal, state and local regulations pertaining to water, air, solid waste and noise pollution.

B. Definitions of Contaminants:

1. Sediment: Soil and other debris that have been eroded and transported by runoff water.
2. Solid Waste: Rubbish, debris, garbage and other discarded solid materials resulting from construction activities, including a variety of combustible and non-combustible wastes, such as ashes, waste materials that result from construction or maintenance and repair work, leaves and tree trimmings.
3. Chemical Waste: Includes petroleum products, bituminous materials, salts, acids, alkalies, herbicides, pesticides, disinfectants, organic chemicals and inorganic wastes. Some of the above may be classified as "hazardous."
4. Sanitary Wastes:
   a. Sewage: That which is considered as domestic sanitary sewage.
b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing and consumption of food.

5. Hazardous Materials: As defined by applicable laws and regulations. Undisclosed hazardous material contamination, if encountered will constitute a changed site condition. The Owner may retain a separate contractor to dispose of undisclosed hazardous material encountered.

C. Protection of Natural Resources:
1. General: It is intended that the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract be preserved in their existing condition or be restored to an equivalent or improved condition upon completion of the work. Confine construction activities to areas defined by the public roads, easements, and work area limits shown on the Drawings. Return construction areas to their pre-construction elevations except where surface elevations are otherwise noted to be changed. Maintain natural drainage patterns. Conduct construction activities to avoid ponding stagnant water conducive to mosquito breeding.

2. Land Resources: Do not remove, cut, deface, injure or destroy trees or shrubs outside the work area limits. Do not remove, deface, injure or destroy trees within the work area without permission from the Engineer.
   a. Protection: Protect trees that are located near the limits of the Contractor's work areas which may possibly be defaced, bruised or injured or otherwise damaged by the Contractor's operations. No ropes, cables or guys shall be fastened to or attached to any existing nearby trees or shrubs for anchorages unless specifically authorized. Where such special emergency use is permitted, the Contractor shall be responsible for any damage resulting from such use.
   b. Trimming: Trim and seal tree limbs overhanging the line of the work and in danger of being damaged by the Contractor's operations in accordance with recognized standards for such work. Remove other tree limbs under the direction of the Engineer, so that the tree will present a balanced appearance.
   c. Treatment of Roots: Do not cut roots unnecessarily during excavating or trenching operations. Expose major roots encountered in the course of excavation and do not sever. Wrap them in burlap as a protective measure while exposed. Neatly trim all other roots larger than 1-inch in diameter that are severed in the course of excavation at the edge of the excavation or trench and paint them with a heavy coat of an approved tree seal.
   d. Repair or Restoration: Repair or replace any trees or other landscape features scarred or damaged by equipment or construction operations as specified below. The repair and/or restoration plan shall be favorably reviewed prior to its initiation.
   e. Temporary Construction: Obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction as directed by the Engineer. Level all temporary roads, parking areas and any other areas that have become compacted or shaped. Any unpaved areas where vehicles are operated shall receive a suitable surface treatment or shall be periodically wetted down to prevent construction operations from producing dust damage and nuisance to

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persons and property, at no additional cost to the Owner. Keep haul roads clear at all times of any object that creates an unsafe condition. Promptly remove any contaminants or construction material dropped from construction vehicles. Do not drop mud and debris from construction equipment on public streets. Sweep clean turning areas and pavement entrances as necessary.

3. Water Resources: Investigate and comply with all applicable federal, state and local regulations concerning the discharge (directly or indirectly) of pollutants to the underground and natural waters. Perform all work under this Contract in such a manner that any adverse environmental impacts are reduced to a level that is acceptable to the Engineer and regulatory agencies. Refer to the paragraph on control of water in Section [02301, 02302, Earthwork], for "dewatering" water disposal requirements.
   a. Oily Substances: At all times, special measures shall be taken to prevent oily or other hazardous substances from entering the ground, drainage areas or local bodies of water in such quantities as to affect normal use, aesthetics or produce a measurable impact upon the area. Any soil or water that is contaminated with oily substances due to the Contractor’s operations shall be disposed of in accordance with applicable regulations.
   b. Chlorinated Water: Take special measures to prevent chlorinated water from entering the ground or surface waters. Dechlorinate chlorinated water prior to discharge.

4. Fish and Wildlife Resources: Perform all work and take such steps required to prevent any interference or disturbance to fish and wildlife. The Contractor will not be permitted to alter water flows or otherwise significantly disturb native habitat adjacent to the project area which are critical to fish and wildlife except as may be indicated or specified.

5. Cultural Resources: Although the project is on a "disturbed site" with no known cultural resources, in the event cultural resources are discovered during subsurface excavations at locations of the work, the Contractor shall comply with requirements of NRS.381 as follows:
   a. All departments, commissions, boards and other agencies of the state and its political subdivisions shall cooperate with the Nevada Division of Historic Preservation and Archaeology in order to salvage or preserve historic, prehistoric or paleoenvironmental evidence located on property owned or controlled by the United States, the State of Nevada or its political subdivisions.
   b. When any agency of the state or its political subdivisions is preparing to or has contracted to, excavate or perform work of any kind on property owned or controlled by the United States, the State of Nevada or its political subdivisions which may endanger historic, prehistoric or paleoenvironmental evidence found on the property, or when any artifact, site or other historic, prehistoric, or paleoenvironmental evidence is discovered in the course of such excavation or work, the agency or the Contractor hired by the agency shall notify the Division and cooperate with the Division to the fullest extent practicable, within the appropriations available to the agency or political subdivision for the purpose, to preserve or permit study of such evidence before its destruction, displacement or removal.
6. Noise Control: The following noise control procedures shall be employed:
   a. **Maximum Noise Levels within 1,000 Feet of any Residence, Business, or Other Populated Area:** Noise levels for trenchers, pavers, graders and trucks shall not exceed 90 dBA at 50 feet as measured under the noisiest operating conditions. For all other equipment, noise levels shall not exceed 85 dBA at 50 feet.
   b. **Equipment:** Jack hammers shall be equipped with exhaust mufflers and steel muffling sleeves. Air compressors should be of a quiet type such as a "whisperized" compressor.
   c. **Operations:** Keep noisy equipment as far as possible from noise-sensitive site boundaries. Machines should not be left idling. Use electric power in lieu of internal combustion engine power wherever possible. Maintain equipment properly to reduce noise from excessive vibration, faulty mufflers, or other sources. All engines shall have mufflers.
   d. **Scheduling:** Schedule noisy operations so as to minimize their duration at any given location.
   e. **Monitoring:** To determine whether the above noise limits are being met and whether noise barriers are needed, the Contractor shall use a portable sound level meter meeting the requirements of American National Standards Institute Specification S1.4 for Type 2 sound level meters. If non-complying noise levels are found, the Contractor shall be responsible for monitoring and correction of excessive noise levels.

7. Dust Control, Air Pollution and Odor Control: Employ measures to prevent the creation of dust, air pollution and odors.
   a. **Unpaved areas** where vehicles are operated shall be periodically wetted down or given an equivalent form of treatment, to eliminate dust formation.
   b. Store all volatile liquids, including fuels or solvents in closed containers.
   c. No open burning of debris, lumber or other scrap will be permitted.
   d. Properly maintain equipment to reduce gaseous pollutant emissions.

8. Construction Storage Areas: Storage of construction equipment and materials shall be limited to the designated Contractor's storage area.
   a. **Store and service equipment** at the designated Contractor's storage area where oil wastes shall be collected in containers. Oil wastes shall not be allowed to flow onto the ground or into surface waters. Containers shall be required at the construction site for the disposal of materials such as paint, paint thinner, solvents, motor oil, fuels, resins and other environmentally deleterious substances. No dumping of surplus concrete or grout on the site will be permitted.

9. Sanitation: During the construction period, provide adequate and conveniently located chemical sanitation facilities, properly screened, for use of construction crews, and visitors to the site. Facilities shall be regularly maintained at the expense of the contractor.

10. Fire Prevention: Take steps to prevent fires including, but not limited to the following:
    a. Provide spark arrestors on all internal combustion engines.
    b. Store and handle flammable liquids in accordance with the Flammable and Combustible Liquids Code, NFPA 30.
    c. Provide fire extinguishers at hazardous locations or operations, such as welding.
11. Erosion and Sediment Transport Control:
a. Discharge construction runoff into small drainages at frequent intervals to avoid buildup of large potentially erosive flows.
b. Prevent runoff from flowing over unprotected slopes.
c. Keep disturbed areas to the minimum necessary for construction.
d. Keep runoff away from disturbed areas during construction.
e. Direct flows over vegetated areas prior to discharge into public storm drainage systems.
f. Trap sediment before it leaves the site, using such techniques as check dams, sediment ponds, or siltation fences.
g. Remove and dispose of all project construction-generated siltation that occurs in offsite retention ponds.
h. Stabilize disturbed areas as quickly as possible.

1.04 DISPOSAL OPERATIONS

A. Solid Waste Management:
1. Supply solid waste transfer containers. Daily remove all debris such as spent air filters, oil cartridges, cans, bottles, combustibles and litter. Take care to prevent trash and papers from blowing onto adjacent property. Encourage personnel to use refuse containers. Convey contents to a sanitary landfill.
2. Washing of concrete containers where wastewater may reach adjacent property or natural water courses will not be permitted. Remove any excess concrete to the sanitary landfill.

B. Chemical Waste and Hazardous Materials Management: Furnish containers for storage of spent chemicals used during construction operations. Dispose of chemicals and hazardous materials in accordance with applicable regulations.

C. Garbage: Store garbage in covered containers, pick up daily and dispose of in a sanitary landfill.

D. Dispose of vegetation, weeds, rubble, and other materials removed by the clearing, stripping and grubbing operations off site at a suitable disposal site in accordance with applicable regulations.

E. Excavated Materials:
1. Native soil complying with the requirements of Section 02302, Earthwork, may be used for backfill, fill and embankments as allowed by that section.
2. Spoil Material:
   a. Remove all material which is excavated in excess of that required for backfill, and such excavated material which is unsuitable for backfill, from the site and dispose of off site in accordance with applicable regulations at the disposal site indicated in the Environmental Protection Plan. No additional compensation will be paid to the Contractor for such disposal. Include all such costs in the lump sum prices bid for the project.
   b. Rubbish shall consist of all materials not classified as suitable materials or rubble and shall include shrubbery, trees, timber, trash and garbage.
F. Permitting and Disposal Costs:
   1. Contractor shall be responsible for all costs associated with and shall secure all permits and disposal or waste sites which may be required for excavating, transporting, placing, compacting, and site reclamation for offsite disposal of any surplus or unsuitable materials and for disposal of any and all construction waste material generated on this project.

END OF SECTION
SECTION 01190
SEISMIC REQUIREMENTS FOR
CONTRACTOR-FURNISHED AND/OR INSTALLED ITEMS

1.01 GENERAL REQUIREMENTS

A. Comply with the UBC Chapter 16, Division IV - Earthquake Design plus clarifications and additions specified in this Section.

B. Provide vertical support, lateral bracing, anchorage and adequate space for movement of the following items:
   1. Equipment. Examples include tanks, vessels, electrical and mechanical machinery.
   2. Non-Structural Components. Examples include suspended ceilings, raised floors, partitions, storage racks and architectural features.
   3. Systems. Examples include conduit, piping, cable trays, raceways and ducts.

C. Take full responsibility for the equipment anchorage design, which may be performed by the manufacturer or supplier.

D. Furnish and install all integral parts of the anchoring system as well as any anchorages or restraints that are independent of the equipment, but required by the manufacturer or supplier.

E. Install anchorages with direct connections to structural elements shown on the drawings.

F. Notify the Engineer if, in the opinion of the manufacturer, supplier or the Contractor, the anchorage conditions are so special that the available structural elements will not resist the anchorage forces. The Engineer will then provide instructions for procedures to be followed.

G. Submit certification for all equipment specified in Divisions 2 through 17 inclusive. State that the equipment or component anchorage, and where required, the equipment itself, complies with the requirements of this Section. Include in the Certification the following:
   1. Description, sketch and seismic load capacity of the anchorage.
   2. Where required by the technical specifications, equipment anchorage calculations by an engineer registered in the State in which the project is being built.
   3. Where required by 1.02 D.1 or 2 below, a statement that the equipment assembly is designed to resist seismic forces required by this Section.

H. Coordinate the layout and detailing of each system so that adequate space is provided between different items for seismic motions. Provide additional supports and restraints between items of different systems when necessary to prevent seismic impacts or interaction.
I. In accordance with General Conditions 8.13, the Owner and the Engineer shall have the right to rely on the Contractor's design and the Engineer's Favorable Review of the Contractor's submittal shall be limited to acknowledgment that the design was prepared with the intent of meeting the specified performance criteria.

J. The Engineer's Review of items within a Specification Division cannot be completed until all items have been coordinated and submitted for review.

1.02 SPECIFIC REQUIREMENTS

A. The project site is located in Seismic Zone 3.

B. The project area Soil Profile Type is S_p.

C. The occupancy categories are as follows:
   1. Standard Occupancy for all buildings, non-building structures and non-structural components.
   2. Apply the Importance Factors appropriate for the category of occupancy.

D. Equipment Design:
   1. Design the following non-building structures and equipment to maintain structural integrity, operability and remain leak-proof after a seismic event, using an Importance Factor I = 1.25. Design the anchorages using an Importance Factor I_p = 1.5.
      a. Headworks structure grit chamber equipment, fine screen, screw conveyor and grit separator.
      b. Oxidation ditch access walkways, brush rotor, and submersible mixers.
      c. Secondary clarifier drive, influent well, center pier, truss and access bridge.
      d. Solids processing building centrifuge and spiral conveyor and RAS pumps.
   2. Assume the hazardous, essential, or life-safety equipment to be non-rigid and increase the in-structure Component Amplification Factor, a_p = 2.5, unless demonstrated otherwise by the Manufacturer.

E. Design anchorages of all equipment, non-structural components or systems not specifically covered above to resist static and dynamic operational loads, plus minimum seismic loads specified in the UBC and as follows:
   1. For rigid or flexible equipment and piping with non-ductile material or attachments decrease the Component Response Modification Factor, R_p = 1.5.
   2. For suspended equipment, multiply dead load by 1.2 to account for vertical seismic effects in the downward direction.
   3. For anchorage uplift, multiply dead load by 0.8 if used to reduce vertical seismic effects.

F. Provide support details for piping, conduit, duct or other systems to resist minimum loadings specified above, if not shown on the Drawings. Support systems required for fluid carrying piping greater than 5 inches diameter are shown on the Drawings.

Also comply with more detailed requirements in Division 2 through 17 inclusive and the requirements of the relevant nationally recognized Society or Association:
1. For ductwork, mechanical piping, process piping and electrical conduits, follow Guidelines for Seismic Restraints of Mechanical Systems by SMACNA modified as follows:
   a. Seismically brace all piping regardless of size or location. Provide transverse braces at all changes in direction and at the end of all pipe runs. Space transverse braces not more than 20 feet apart. Provide longitudinal braces at 40-foot centers.
   b. Seismically brace all ductwork regardless of size or location. Provide transverse braces at all changes in direction and at each end of run. Space braces not over 20 feet apart. Provide longitudinal braces at 40-foot centers.

2. For fire protection systems, follow NFPA 13 modified as in paragraph 1.b above. Ensure that no seismic interaction occurs with items of other systems.

1.03 SPECIFIC REQUIREMENTS FOR UNDERWATER ITEMS

   A. To allow for water sloshing, design rigid items such as piping or equipment supports for twice the lateral force, computed as if the item were above water.

1.04 SPECIFIC REQUIREMENTS FOR EQUIPMENT.

   A. To allow for water sloshing, design rigid items of equipment for twice the lateral force, computed as if the item were above water.

   B. Design flexible items to accommodate sloshing motions without damage to rigid machinery.

   C. Provide retainers to hold items from falling and damaging rotating equipment below, if bolted connections will fail because of ground motion displacing the supports.

END OF SECTION
SECTION 01300
SUBMITTALS

PART 1 - GENERAL

1.01 SUBMITTAL PROCEDURES

A. Accompany each submittal with a Submittal form, General Conditions Exhibit GC-2, which contains the following information:

1. Contractor's name and the name of Subcontractor or supplier who prepared the submittal.
2. The project name and identifying number.
3. Description of the submittal and reference to the Contract requirement or technical specification section and paragraph number being addressed.

B. Submit the number and type of copies for each submittal and follow the procedures described below or in other paragraphs in this Section. Submit four copies of submittals not covered in this Section 01300.

1. Designation of Superintendent: Submit three copies for information. Include name, address, home telephone number and a brief resume.
2. List of Subcontractors and Major Suppliers: Submit three copies for information. Include address, telephone number and name of responsible party.
3. Schedule of Values, in a form acceptable to the Engineer: Submit three copies for information. No copy will be returned. See General Conditions paragraph 13.1.
5. Environmental Protection Plan. Submit three copies for information.

1.02 SCHEDULE OF SUBMITTALS

A. Submit three copies for information.

B. See General Conditions paragraph 5.19. Within 15 days after the Notice to Proceed, submit a Schedule of Submittals showing the date by which each submittal required for Product Review or Product Information will be made. Identify the items that will be included in each submittal (see paragraph 1.05 of this Section) by listing the item or group of items and the Specification Section and paragraph number under which they are specified. Indicate whether the submittal is required for Product Review of Proposed Equivalents, Shop Drawings, Product Data or Samples or required for Product Information only.

1.03 PLAN OF OPERATIONS

A. Submit three copies for information.

B. Before mobilizing equipment or installing temporary facilities, submit a plan showing Contractor's intended use of the project site. Show location of any temporary
enclosing fence and access points and gates. Show location for Contractor's, Subcontractor's, and Engineer's field office and parking area. Show location of Contractor's and Subcontractor's equipment storage areas, material storage areas and areas intended for use as temporary barrow areas.

1.04 CONSTRUCTION SCHEDULE

A. Submit four copies for information. No copy will be returned. See General Conditions paragraphs 5.15 through 5.19.

B. The form of Construction Schedule may be selected by the Contractor but the Schedule shall meet the minimum requirements of General Conditions paragraph 5.16. Updates shall be Contemporaneous Period Analysis.

C. If the Construction Schedule does not reflect the format requirements, the specified work, or the Contract Time, it will be returned to the Contractor for modification.

D. Revise the Construction Schedule and resubmit within seven (7) days following any monthly meeting to review Contractor's Application for Payment when Contractor's work is fifteen (15) days or more behind schedule.

E. Accelerated Work if Required to Meet Schedule: See General Conditions paragraph 11.6. Give Engineer 3 days prior notice of construction that will take place outside of normal work hours or work days. Compensate Owner for extra inspection cost caused by Accelerated Work required to meet Schedule.

F. Give Engineer 3 days prior notice of normal work days on which construction will not take place or of scheduled construction that will not take place. Compensate Owner for extra inspection cost resulting from failure to give notice.

1.05 SHOP DRAWING, PRODUCT DATA AND SAMPLES SUBMITTED FOR PRODUCT REVIEW

A. This paragraph covers submittal of Shop Drawings, Product Data and Samples required for the Engineer's review referred to as Product Review submittals in the Technical Specifications (Division 2 through 17). Submittals required for information only are referred to as Product Information submittals in the Technical Specifications and are covered in paragraph 1.07 of this Section. See General Conditions Article 8.

B. Number and type of submittals:
   1. Shop Drawings: Submit three copies more than the number required by the Contractor. Copies in excess of three will be marked, stamped and returned to the Contractor. The Contractor shall make and distribute the required number of additional copies to its superintendent, subcontractors and suppliers.
   2. Product Data: Submit four clear copies. One copy will be marked, stamped and returned. The Contractor shall make and distribute the required number of additional copies to its superintendent, subcontractors and suppliers.
   3. Samples: Submit three labeled samples or three sets of samples of manufacturer's full range of colors and finishes. Comply with requirements in Technical Specification Sections. One sample will be returned to Contractor.
C. The Contractor shall make all Product Review submittals early enough to allow adequate time for the Engineer's review, for manufacture and for delivery at the construction site without causing delay to the Work. Submittals shall be made early enough to allow for unforeseen delays such as:
1. Failure to obtain Favorable Review because of inadequate or incomplete submittal or because the item submitted does not meet the requirements of the Contract Documents.
2. Delays in manufacture.
3. Delays in delivery.

D. Content of Submittals:
1. Each submittal shall include all of the items and material required for a complete assembly, system or Specification Section.
2. Submittals shall contain all of the physical, technical and performance data required by the specifications or necessary to demonstrate conclusively that the items comply with the requirements of the Contract Documents.
3. Include information on characteristics of electrical or utility service required and verification that requirements have been coordinated with services provided by the Work and by other interconnected elements of the Work.
4. Provide verification that the physical characteristics of items submitted, including size, configuration, clearances, mounting points, utility connection points and service access points, are suitable for the space provided and are compatible with other interrelated items that are existing or have or will be submitted.
5. Label each Product Data Submittal, Shop Drawing and Sample with the information required in paragraph 1.01A of this Section. Highlight or mark every page of every copy of all Product Data submittals to show the specific items being submitted and all options included or choices offered.
6. Additional requirements for Product Review submittals are contained in the Technical Specification sections.
7. Designation of work as "NIC" or "by others," shown on Shop Drawings, shall mean that the work will be the responsibility of the Contractor rather than the subcontractor or supplier who has prepared the Shop Drawings.

E. Compatibility of Equipment and Material:
1. Verify that items contained in the same or in different submittals meet the requirements in the paragraph titled "Material and Equipment in Section 01040 especially the subparagraphs titled "Compatibility of Material and Equipment."

F. Requirements for Contractor Designed Items and for First Specified (Named) Items.
1. Verify that items meet the requirements in the paragraph titled "Performance Specifications and Contractor Designed Items" in Section 01040.

G. Requirements for the Contractor's review and stamping of submittals prepared by the Contractor or by Subcontractors or suppliers prior to submitting them to the Engineer are covered in General Conditions paragraph 8.8.
H. Submittals that contain deviations from the requirements of the Contract Documents shall be accompanied by a separate letter explaining the deviations. See General Conditions paragraphs 8.8 and 8.11. The Contractor's letter shall:
1. Cite the specific Contract requirement including the Specification Section and paragraph number for which approval of a deviation is sought.
2. Describe the proposed alternate material, item or construction and explain its advantages and/or disadvantages to the Owner.
3. State the reduction in Contract Price if any that is offered to the Owner.

I. Engineer's Review Procedure and Meaning
1. The Engineer will stamp and mark each Product Review submittal prior to returning it to the Contractor. The stamp will indicate whether or not the review was favorable and what action is required of the Contractor. Review categories "No Exceptions Taken" and "Make Corrections Noted" both indicate Favorable Review.
2. The Engineer's Favorable Review is contingent on the Contractor's warranties required by General Conditions paragraph 8.8 and is subject to all of the limitations and conditions in General Conditions Article 8. Favorable Review is also contingent on:
   a. The compatibility of items included in a submittal with other related or interdependent items included in previous or future submittals.
   b. Future submittal of items related to or required to be part of this submittal that were not included with this submittal.
3. Favorable Review of a submittal does not constitute approval or deletion of items required as part of the submittal but not included with the submittal. Favorable Review of items included in the submittal does not constitute deletion of specified features, options or accessories that were not included in the submittal.
4. The action required by the Contractor for each category of review is as follows:
   a. **NO EXCEPTIONS TAKEN. NO RESUBMITTAL REQUIRED.**
   b. **MAKE CORRECTIONS NOTED:**
      (1) **NO RESUBMITTAL REQUIRED.** The Contractor shall make corrections noted prior to manufacture.
      (2) **PARTIAL RESUBMITTALS REQUIRED.** The Contractor shall submit related accessory or optional items as noted which are required but were not included with the submittal and/or shall resubmit unsatisfactory portions or attributes of items as noted. The Contractor may proceed to manufacture those portions of the submittal that will be unaffected by required resubmittals.
   c. **AMEND AND RESUBMIT.** The Contractor shall amend and resubmit the submittal as noted or required to comply with the Contract Documents.
   d. **REJECTED - RESUBMIT.** The item submitted does not comply with the Contract Documents in a major way. Resubmit items that comply with the requirements of the Contract Documents.
5. The letter of transmittal accompanying the returned Product Review submittal may contain numbered notes. Marking a corresponding number on a Shop Drawing or Product Data submittal shall have the same affect as applying the entire note to the submittal.
J. Re-submittals that contain changes that were not requested by the Engineer on the previous submittal shall be accompanied by a letter explaining the change. See General Conditions paragraph 8.12.

K. Favorable Review Required Prior to Proceeding.
   1. Do not proceed with manufacture, fabrication, delivery or installation of items prior to obtaining the Engineer's Favorable Review of Product Review submittals. See General Conditions paragraph 12.1.

L. Intent and Limitation on Engineer's Review
   1. See General Conditions Article 8.
   2. The Contractor has primary responsibility for submitting and providing work that complies with the requirements of the Contract Documents. That responsibility cannot be delegated in whole or in part to subcontractors or suppliers. Neither the Engineer's Favorable Review nor the Engineer's failure to notice or comment on deficiencies in the Contractor's submittals shall relieve the Contractor from the duty to provide work, which complies with the requirements of the Contract Documents.

1.06 PROPOSED EQUIVALENTS

A. Submit Proposed Equivalent submittal form, General Conditions Exhibit GC-3 and comply with the submittal requirements for Shop Drawings, Product Data, and Samples submitted for Product Review in another paragraph of this Section.

B. See General Conditions paragraphs 8.1 through 8.15.

C. Time of Submittal:
   1. General Conditions paragraph 8.3 requires submittal of Proposed Equivalents within 35 days of the Notice to Proceed. The Engineer may agree to a later submittal date if requested in writing within 35 days of the Notice to Proceed. The request shall identify the item, give the Specification reference, and proposed manufacturer and model number of the item that will be submitted and the proposed submittal date.
   2. The Engineer's agreement to a later submittal date shall be in writing and shall not be construed as Favorable Review or acceptance of the manufacturer or item proposed.

D. Content of submittals shall be the same as that required for Product Data, Shop Drawings and Samples submitted for Product Review in another paragraph of this Section. In addition, the Contractor shall provide information on several recent similar installations of the item to verify its suitability. The information shall include the project name and location, the Owner's name, address, telephone number and name of a knowledgeable person to contact for information on performance of the product.

E. When the Contractor has listed specific maker's products on Document Number 00411 Designation of Equipment or Material Manufacturers submitted with its Bid no changes will be permitted without submittal of acceptable evidence justifying the change and the Engineer's written approval.
F. If a non-equivalent substitute is submitted for review, it shall be accompanied by a proposed reduction in Contract Price which shall include the increased cost of Engineering service required to evaluate the proposed substitute (which shall be paid to the Owner whether or not the substitute is accepted) plus the greater of 1) the difference in price between the first specified item and the item submitted and 2) the difference in value to the Owner between the two items.

G. If any conflicts arise between this section and the Bidding Requirements, the Bidding Requirements language takes precedence.

1.07 PRODUCT INFORMATION SUBMITTALS

A. Submit three copies. No copies will be returned. See General Conditions paragraph 8.15.

B. Product Information submittals are required for the Owner's permanent records and will be used for future maintenance, repair, modification or replacement work. Product Information submittals will be examined only to verify that the required submittals have been made; they will NOT be reviewed for compliance with the Contract Documents.

C. Make Product Information submittals prior to delivering material, products or items for which Product Information submittals are required.

D. The Contractor has the sole and exclusive responsibility for furnishing products and work that meets the requirements of the Contract Documents.

E. The Engineer reserves the right to comment on any submittal and to reject any product or work delivered, installed or otherwise at any time that the Engineer become aware that it is defective or does not meet the requirements of the Contract Document. See General Conditions paragraph 12.1.

1.08 OPERATION AND MAINTENANCE MANUALS AND PARTS LISTS

A. Refer to Section 01730 for Operation and Maintenance Manual Requirements

1.09 MANUFACTURER'S CERTIFICATES

A. Submit three copies.

B. When specified in Technical Specification section, submit manufacturers' certificate to Engineer for review. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate. Certificates may be recent or previous test results on material or Product, but must be acceptable to the Engineer.
1.10 CONSTRUCTION PHOTOGRAPHS

A. Each month submit photographs showing all important aspects of ongoing work to Engineer with Application for Payment.

B. Photographs: Submit two (2) print; color 4x6-inch mounted on 8-1/2 x 11 inch white soft card stock, with left edge punched for 3-ring binder.

D. Identify photographs with date, time, orientation and project identification.

E. With the written consent of the Engineer, digital photographs in JPEG format may be acceptable.

1.11 YARD PIPING AND YARD PLUMBING PLANS

A. Provide a yard piping plan prior to any excavation activities. The plan shall include the following elements:
   1. On a full-size 24" x 36" Yard Piping Plan show:
      a. Invert elevations for all process gravity piping and centerline elevations of all process pressure piping at all points where the pipe enters or leaves a structure.
      b. Invert and top-of-pipe elevations wherever one or more pipes cross each other.
   2. On a full-size 24" x 36" Yard Plumbing Plan show:
      a. Centerline elevations of all pressure piping at points where pipes leaves or enters
      b. Centerline elevations of all pressure piping at points where pipes cross each other.

1.13 LIST OF SUBMITTALS FOR DIVISIONS 0 AND 1

A. As a convenience to the Contractor, Table 1 - List of Submittals for Divisions 0 and 1 provides a list of submittals required at various stages of the project. Submittals required with the Bid are not included on this table. There may be other submittal requirements not listed in Table 1. It is the Contractor's responsibility to identify and provide all submittals required by the Contract Documents.
<table>
<thead>
<tr>
<th>Description</th>
<th>Required by</th>
<th>Time of Submittal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Performance &amp; Payment Bonds GC 4.1 - 4.2</td>
<td>Prior to signing Agreement</td>
<td></td>
</tr>
<tr>
<td>2. Liability Insurance Certificates GC 4.3 - 4.5</td>
<td>Prior to beginning Construction</td>
<td></td>
</tr>
<tr>
<td>3. Property Insurance Certificates GC 4.3 - 4.5</td>
<td>Prior to beginning Construction</td>
<td></td>
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<tr>
<td>4. List of Subcontractors GC 5.2 and DIV 0</td>
<td>Prior to beginning Construction</td>
<td></td>
</tr>
<tr>
<td>5. Plan of Operations</td>
<td>01300, par. 1.03</td>
<td>Prior to beginning work on the site</td>
</tr>
<tr>
<td>6. Yard Piping and Yard Plumbing Plans</td>
<td>013001.11</td>
<td>Prior to Excavation</td>
</tr>
<tr>
<td>7. Temporary Construction Schedule GC 5.15</td>
<td>Within 10 days of the date in the Notice to Proceed</td>
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<tr>
<td>8. Schedule of Submittals GC 4.3 - 4.5</td>
<td>Prior to beginning Construction</td>
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<tr>
<td>9. Schedule of Values GC 13.1, 01010, par. 1.02</td>
<td>20 days prior to the first Application for Payment</td>
<td></td>
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<td>10. Application for Payment GC 13.2, 01010, par. 1.15</td>
<td>5 days prior to each Application for Payment date</td>
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<tr>
<td>11. Construction Schedule GC 5.16, 01300, par. 1.04</td>
<td>Within 30 days of Notice to Proceed</td>
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<tr>
<td>12. Submittal of All Proposed Equivalent Items GC 8.2 - 8.7, 01300, par. 1.06 and Technical Sections</td>
<td>Within 35 days of the Notice to Proceed unless Engineer has agreed to a later submittal date in writing</td>
<td></td>
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<tr>
<td>13. Manufacturer's Certificates GC 8.2 - 8.7, 01300, par. 1.06 and Technical Specifications</td>
<td>Prior to delivering material or equipment and in accordance with Technical Specifications</td>
<td></td>
</tr>
<tr>
<td>14. Construction Photographs GC 5.13</td>
<td>Submit within 30 days from the date of the Notice to Proceed</td>
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<tr>
<td>15. Operations and Maintenance Manuals and Parts Lists GC 5.13</td>
<td>Submit 15 days prior to Facility Startup and Training</td>
<td></td>
</tr>
<tr>
<td>16. Manufacturer's Affidavits GC 5.13</td>
<td>Within 35 days of the Notice to Proceed unless Engineer has agreed to a later submittal date in writing</td>
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<tr>
<td>17. Record Drawings GC 5.13</td>
<td>Prior to Final Acceptance</td>
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<td>18. Extra Materials GC 5.13</td>
<td>Prior to Final Acceptance</td>
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<td>19. Special Guarantees GC 5.13</td>
<td>Prior to Final Acceptance</td>
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<td>20. Maintenance Contracts GC 5.13</td>
<td>Prior to Final Acceptance</td>
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<tr>
<td>21. Release of Liens GC 5.13</td>
<td>With Progress Payments</td>
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<tr>
<td>22. Contractor's Waiver of Claims GC 5.13</td>
<td>Prior to Final Acceptance</td>
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</tr>
<tr>
<td>23. Insurance Certificate for insurance coverage beyond Final Payment including completed operations coverage and liability coverage when the Contractor is correcting defective work under the Guarantee.</td>
<td>Prior to Final Payment</td>
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</tr>
</tbody>
</table>

END OF SECTION
SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

Section includes: Requirements for providing temporary housing and utilities and temporary control of the construction site for the duration of the construction period. The Contractor is required to provide the following:

A. Provide and maintain self-contained portable sanitary facilities for the Contractor's, Subcontractor's, Owner's, and Engineer's use. Facilities shall comply with applicable regulations and shall be serviced, cleaned, and disinfected frequently.

B. Telephone: Provide separate temporary telephone service, facsimile line service, and Internet service for the Engineer's field office. Provide telephone and facsimile service for the Contractor's field office. Contractor shall pay all utility service connection charges and all periodic charges for the telephone, facsimile and Internet service to the Engineer's office, except long distance telephone charges.

C. Temporary Water and Power:
   1. Water: The Contractor shall arrange and pay for a temporary water service connection, including all costs for installation, removal, and water used. Provide proper backflow prevention and metering devices.
   2. Power: The Contractor shall arrange and pay for a temporary power connection, including all costs for installation, removal, and power used. Provide overcurrent and ground fault protection.

D. Temporary Heat:
   1. Provide temporary heat for enclosed spaces. Fuel, equipment, and installation shall comply with all applicable codes and regulations. Salamander heaters or other space heaters using kerosene are not permitted. Provide temporary heat as required for applying paint, floor cover or other temperature sensitive materials in new or improved interior spaces.

E. Temporary Ventilation:
   1. Provide equipment to ventilate enclosed areas to facilitate curing concrete, to dissipate humidity and to prevent accumulation of dust, fumes, or gases. Utilize new ventilation equipment and supplement with temporary fans to maintain clean air and safe conditions for construction operations. Replace or clean filters on existing or new equipment on completion.

F. Temporary Lighting:
   1. Provide and maintain lighting for indoor construction operations to achieve a minimum lighting level of 20-foot candles for rough work and 60-foot candles for finish work.
G. Temporary Fire Protection:
   1. Provide and maintain fire protection equipment including extinguishers, fire hoses, and other equipment required by law, insurance carriers, or necessary for proper fire protection during the course of the work.
   2. Use fire protection equipment only for fighting fires.
   3. Locate fire extinguishers in field offices, storage sheds, tool houses, temporary buildings, and throughout the construction site.

1.02 TEMPORARY CONSTRUCTION

A. The Contractor is solely and exclusively responsible for the design, construction, and maintenance of all temporary construction including forms, falsework, shoring, scaffolding, stairs, ladders, and all other similar items.

B. Construct adequate and safe forms and falsework to rigidly support partially completed structures. Provide temporary bridges and decking to maintain vehicular and pedestrian access. Design and construct temporary forms, falsework, bridges, and decking in accordance with applicable regulations and codes.

1.03 BARRICADES, FENCES, AND ENCLOSURES

A. See General Conditions paragraphs 5.3 and 5.20 through 5.28 and Section 01040.

B. Barricades: Provide temporary guard rails, ladders, stairs, guards, and barricades to protect persons in accordance with applicable regulations.

C. Site Security: The security of the site is the Contractor's responsibility at all times. In addition to the temporary fence, make other provisions necessary to protect the site.

1.04 PROTECTION OF INSTALLED WORK

A. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.

B. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects by covering surfaces with nonstaining heavy duty reinforced moisture resistant kraft building paper with joints continuously taped with waterproof tape.

C. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is unavoidable, provide adequate protection to prevent damage to waterproof membranes and comply with recommendations for protection of the waterproofing or roofing material manufacturer.

D. Provide heavy planking to protect curbs, gutters, culverts, paving, and similar surfaces from damage by heavy equipment or vehicles.

1.05 TRAFFIC REGULATION
A. Conduct operations so as to offer the least possible obstruction and inconvenience to public traffic. Do not overload or damage paved surfaces.

B. Contractor shall post and maintain a maximum speed limit of 10 mph for construction and workers' vehicles on the site access roads.

1.06 PARKING AREAS

A. Parking:
   1. Construct gravel surfaced for temporary parking for construction personnel within the Contractor's work area in location approved by the Engineer.
   2. Construct graveled surface for temporary parking for 2 vehicles adjacent to the Engineer's site office.

1.07 FIELD OFFICEs

A. Contractor's Office at the Site: Maintain a suitable office at the site for the Contractor's superintendent who shall be authorized to receive submittals, drawings, instructions, or other communications from the Engineer or the Owner.

B. Engineer's Office at the Site:
   1. Office: This office will be used by the Owner's representatives. Provide a trailer or other temporary structure for the Engineer's use as an office with the following features:
      a. All-metal frame, exterior, sides and roof.
      b. Size: 300 square feet minimum.
      c. Number of rooms: Three rooms of approximately equal size.
      d. Windows: Two minimum per room with security guard screens.
      e. Lighting: Interior fluorescent ceiling lights with 70-foot candles of uniform lighting at desk level. Outside lights above door.
      f. Heating, ventilation and air conditioning: Provide at least six air changes per hour in all rooms and provide air conditioning equipment capable of maintaining at least 70°F for heating and 78°F maximum for cooling.
      g. *Toilet room with chemical toilet - Monogram Industries Jetomatic; Pyrolet; or equal, wash basin, mirror, toilet paper and paper towel dispensers.*
      h. Door equipped with automatic retracting deadbolt lock. Provide four keys.
      i. Provide staircase with stair handrail and landing with guardrail at entrance.
      j. Electrical service, disconnect switch and a circuit breaker panel. Provide ground fault protected outlets.
      k. One hundred fifteen (115) volt, 15 amp receptacles, spaced no more than 8 feet apart.
   2. Equipment and furnishings: Provide the following:
      a. Two desks with two drawer pedestals.
      b. Two swivel desk chairs and six guest chairs.
      c. Four 4-drawer legal size file cabinets with file racks and locks. These file cabinets shall be new and shall become the property of the Owner. Hon Model Number E4314Q, or equal.
      d. Two desk lamps.
e. Two plan tables (may be built-in) of 3 foot by 8 foot minimum surface area with drafting stool.

f. One paper towel dispenser.

g. One paper cup dispenser.

h. Two book cases, minimum 3 feet wide and 4 feet high (built-in book shelves may be substituted).

i. Two waste baskets.

j. One first-aid kit

k. Two telephones with built-in answering machine.

l. One electrostatic copier machine with 8-1/2x11 and 11x17 automatic paper feed trays and 10-bin collator. Cannon NP2020, Sharp, or equal. Provide 1 box of 8-1/2x11 copy paper (5,000 sheets per box) and 1 box of 11x17 copy paper (2,500 sheets per box).

m. Plain paper facsimile machine furnished with all expendables, including facsimile paper equivalent to 2,000 8-1/2x11 sheets. The facsimile machine shall become property of the Owner upon completion of the project.

n. One 14A 60 BC dry chemical fire extinguisher.

o. Bottled water chiller with hot water accessory and refrigerated compartment, EBCO Manufacturing Co. Model ODP8AH Oasis; equivalent by Hawes; or equal.

3. Utilities: Arrange and pay for three (3) telephone lines and electrical service. The Contractor shall pay for telephone, Internet service, electrical, and temporary water service charges. The Engineer will pay for long distance telephone charges.

4. Installation and Removal: Install the Engineer's office at the location directed by the Engineer within 15 days after the Notice to Proceed. Provide rigid level supports and seismic and wind tie downs. The Contractor shall maintain the Engineer's office at the site for 6 months after substantial completion, after which the Owner shall have the option of assuming responsibility.

5. Maintenance: Maintain the Engineer's office in good repair. Provide daily cleaning and maintenance service. Replenish paper towels, paper cups, soap, toilet paper, and bottled water daily. Service, pump and clean chemical toilets at least twice weekly. Maintain the copier and facsimile machine in proper working order at all times.

1.08 CONSTRUCTION SIGN

A. The Contractor shall provide a temporary construction sign at the entrance to the construction site that reads as follows:
Cold Springs Water Reclamation Facility Expansion

Brought to you by:
Washoe County Department of Water Resources

Construction Schedule: Start Date to End Date
Contractor: XYZ Construction
Engineer: Kennedy/Jenks Consultants

Funding Assistance: CWSRF

B. Final wording for the construction sign to be approved by the Owner.

C. The sign shall be constructed of wood, a minimum of 3 feet high by 5 feet wide, and kept in a clearly visible location throughout the construction period.

END OF SECTION
SECTION 01650
FACILITY STARTUP

PART 1 - GENERAL

1.01 FACILITY STARTUP

A. Commission all systems and equipment to verify performance, function, and correct operation by performing procedures to activate, startup, adjust, test, and demonstrate that the work is in operating order in accordance with these general requirements of this Section and the detailed requirements of the technical sections under the system or equipment specified.

To ensure that the work is ready for full-time operation the procedures include verification, balancing, calibration, witness testing, documentation, inspection by equipment manufacturers, and operator training where specified.

B. Notification: Notify the Owner five (5) days prior to starting each system or piece of equipment. Notify the Owner fourteen (14) days in advance of the full facility startup.

C. Coordination: During the startup period, coordinate the operation of the facility with Owner, subcontractors, Owner's operators, and manufacturer's representatives.

D. Furnish test equipment, measuring devices and supplies required to conduct tests.

E. Maintain the equipment until final acceptance. Provide all lubricants, chemicals, and electricity necessary until final acceptance.

F. Furnish all expendable supplies, gas, diesel fuel, water, etc., required for startup, demonstration and testing and dispose of all waste or used supplies, water, etc.

1.02 SUBMITTALS

A. Startup Plan, Forms, and Schedule: Prepare a facility startup plan and schedule. The plan shall include test methods and procedures and sample forms for recording test data. It shall clearly show how start-up of the "Liquid Stream Process units" will be started up within the required time.

B. Submit documentation of tests, balancing reports, and the like.

1.03 INITIAL STARTUP AND OPERATION OF FACILITIES

A. The following listing is a general sequence of startup activity steps to be used in placing facility systems into operation:
   1. Perform initial lubrication of equipment and have manufacturers check and adjust equipment. Provide all subsequent lubrication and maintenance, and such staff as required for test operation until the Owner assumes equipment maintenance responsibility after Step 14 below.
2. Perform satisfactory testing of electrical work required prior to energizing of the electrical system.
3. After completion of Step 2, perform satisfactory electrical testing required after energizing of the electrical system.
5. Satisfactorily complete system verification of instrumentation work.
6. After completion of Steps 1 and 3, perform a rotational test of equipment and correct backward rotating drives.
7. After completion of Steps 5 and 6, test operate the equipment by manually initiating the operation. Where manual operation bypasses alarm or safety monitoring, provide continuous supervision of such parameters. Perform this step using water in lieu of chemicals or other process liquids. Use dry air or nitrogen in lieu of hazardous gases.
8. Concurrent with Step 7, perform instrumentation and control testing and adjustments as related to the equipment being tested.
9. Concurrent with Step 7 and where possible at this stage of startup, complete the performance testing specified for the equipment.
10. Concurrent with Step 7, perform adjustments of the electrical work as related to the equipment being tested.
11. Repeat Steps 1 through 10 as required for other equipment items and plant systems until all plant process components and utility systems are ready for total plant operation. It may be necessary for the Contractor to put portions of the newly constructed facility in service before constructing other portions of the facility or completing the Work as a whole.
12. Notify the Owner and the Engineer 15 days before total plant operation is to occur so that the Owner may make arrangements for full time operation.
13. Upon completion of all the above steps, the facility shall be started up and operated on a complete full time basis beginning on the indicated date. For three consecutive days beginning with the start-up day, the Contractor shall have at the site, during the day shift, a mechanic, an electrician and an instrumentation representative. Representatives of manufacturers of critical equipment shall also be present for these three days as needed or as required elsewhere in the specifications. The Contractor shall also provide these personnel, on a 24-hour per day, "on call" basis, if necessary, to adjust, repair, and correct deficiencies as required to keep the facilities in continuous operation for a period of 30 days. The Contractor shall train the operators in the proper operation and the control of the new facilities. The Contractor shall also furnish all such mechanical and electrical workers as required to make adjustments to and perform all required maintenance for the operating equipment until the end of the 30-day initial operation period. Maintenance of operating equipment shall include lubrication, adjustments, replacements, and modifications as required.
14. After successful completion of the 30-day initial operation period, the Owner will take over maintenance duties as well as operation and will begin to provide and pay for lubricants.
15. Following the commencement of Step 13, satisfactorily complete equipment performance testing, electrical testing and adjustments, and instrumentation/ control testing and adjustments to the extent that such testing and adjustments could not be made prior to full plant operation.
16. Complete the documentation of test, balancing reports, and the like commissioning for submittal during the startup process and before acceptance.

Facility Startup

01650-2

FINAL
January 2004
037012.10
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1.04 MANUFACTURER'S FIELD SERVICE AND AFFIDAVITS

A. Field Service: Where specified, manufacturers of equipment shall provide field service. Field service shall be provided by an authorized factory-trained and qualified manufacturer's representative for the specific equipment. Equipment shall not be considered ready for full time operation until after the manufacturer's representative has checked and adjusted the equipment, and certified by written affidavit that the equipment has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full time operation.

B. Affidavits: Acceptable affidavits shall be submitted prior to completion of the work.
   1. Affidavits shall contain the following specific wording:
      "The [Name of Equipment] has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full time operation. The installation has been inspected and has been found to be in conformance with our (the manufacturer's) standards and requirements."
   2. No amplification, dilution, or modification of this specific wording will be permitted.

1.05 TRAINING

A. Submit Operation and Maintenance Manuals and Parts List specified in Section 01300 at least 15 days prior to the first training session.

B. Demonstrate the operation, maintenance and safety procedures for all systems and equipment to personnel designated by the Owner.

C. Provide 8 hours of onsite demonstration of systems and equipment.
   1. Prepare a course summary illustrated with copies of visual materials. Distribute one copy to each course attendee, four copies to the Owner and two copies to the Engineer.

D. In addition to overall training specified above, provide special demonstration and training for specific pieces of equipment specified in the Technical Specification Sections.

END OF SECTION
PART 1 - GENERAL

1.01 FINAL CLEANUP

A. Just prior to Final Inspection, clean the entire construction area including buildings, other structures, landscaping, and site work included in this Contract, as well as all other areas affected by the performance of work under this Contract. Perform cleanup work using personnel specializing in and skilled in building cleaning and maintenance work. Perform cleaning to standards considered normal for commercial janitorial work. Accomplish repair work using personnel specializing in performing and repairing the type of work being repaired. Perform repair work to the highest trade standards applicable to that type of work. Include:
1. Remove all temporary construction, signs, tools, equipment, excess materials, and debris.
2. Sweep clean and then wash down all exterior pavement surfaces. Avoid washing sediment or hazardous material into drainage systems. Remove all grease and oil stains on pavement caused by Contractor's equipment.
3. Rake all landscaped area; remove debris and cut lawns. Water and fertilized landscape materials. Replace damaged plant and landscape materials.
4. Clean all glass without scratching. Scratched glass shall be replaced.
5. Remove all lumps, splatters, spots and stains caused by paint, adhesive, asphalt, concrete, mortar, plaster, sealant, or other foreign material from all exposed or finished surfaces. Remove all temporary labels.
6. Patch any holes, chips or defects in construction including finished surfaces.
7. Touch up painted surfaces that are soiled, chipped, spotted, or otherwise flawed.
8. Polish all hardware and non-ferrous metal.
9. Clean all lighting fixtures.

1.02 CONTRACTOR'S ACTION LIST OF ITEMS TO BE CORRECTED AND/OR COMPLETED

A. During construction, the Contractor shall maintain an action list of items to be corrected and/or completed. The Contractor shall regularly add items and update the list as information becomes available or as requested by the Engineer. The Contractor shall deliver a current copy of the list to the Engineer at each progress meeting.

1.03 SEMIFINAL INSPECTION/SUBSTANTIAL COMPLETION

A. See General Conditions paragraph 13.7 through 13.15. When the Contractor considers the Work nearly complete, the Contractor shall review the Contract Documents, inspect the Work, and use the Contractor's action list to prepare a Contractor's Punch List of all deficient or uncompleted items. The Contractor shall complete or correct items on the Punch List. When the Work is Substantially
Complete in accordance with General Conditions paragraph 13.7, the Contractor shall notify the Engineer in writing that the Contractor has reviewed the Contract Documents, inspected the Work and believes that the Work is Substantially Complete and ready for Semifinal Inspection.

B. On receipt of the Contractor's Punch List and notice that the work is ready for Semifinal Inspection, the Engineer will inspect the Work. The Engineer may add additional items to the Contractor's Punch List, may find that the work is not ready for inspection, is ready for inspection but not Substantially Complete or that the Work is Substantially Complete. When the Engineer finds the Work is Substantially Complete, it will prepare a Final Punch List and a notice of Substantial Completion which will state the date of Substantial Completion and the time agreed to by the Owner and the Contractor (not to exceed 30 days) in which the Work shall be fully complete and ready for Final Inspection.

1.04 FINAL INSPECTION, FINAL COMPLETION, AND FINAL PAYMENT

A. See General Conditions paragraph 13.11 through 13.15. When the Contractor has completed or corrected all the items on the Engineer's Final Punch List, the Contractor shall give the Engineer written notice that the Work is ready for Final Inspection. When the Engineer finds the Work acceptable and fully complete in accordance with the Contract Documents, and upon receipt of a final Application for Payment and all final submittals, the Engineer will recommend that the Owner issue a Notice of Final Completion, make Final Payment and Accept the Work stating that to the best of the Engineer's knowledge, information and belief, and on the basis of the Engineer's observations and inspection, the Work has been fully completed in accordance with the terms and conditions of the Contract Documents.

B. Final Submittals include:
   1. Operation and Maintenance Manuals and Parts Lists.
   2. Record Drawings.
   4. Special Guarantees.
   5. Insurance Certificate showing required continuation of coverage beyond Final Payment.
   7. Waiver of Claims by Contractor.
   8. And any other submittals required by the Contract Documents and not previously received.

C. The Owner will record any Notices as required by law in a timely manner.

1.05 RECORD DRAWINGS

A. The Contractor shall maintain on the job site, a complete set of Contract Documents and a complete file of all addenda, contract modifications and favorably reviewed submittals. The Contractor shall prepare a set of Record Drawings concurrently with the construction of the Work and in accordance with General Conditions paragraph 5.13 and the following:
1. Show the invert elevation of all gravity piping and the top of pipe, top of conduit or top of protective concrete encasement for other utilities. Elevations shall be related to a permanent visible elevation benchmark set by the Contractor.

2. Show the horizontal location of underground utilities measured from permanent visible physical features such as face of building, face of tank, or centerline of manhole.

3. Comply with detailed requirements in technical specification sections describing the type of information required on Record Drawings. The Contractor's copy of Contract Documents, Contract modifications and Record Drawings shall be available to the Owner for weekly verification that the records are being currently updated.

B. Submit Record Drawings and obtain acceptance prior to completion.

1.06 EXTRA MATERIALS

A. Deliver specified extra materials and parts to the Owner as required by the Specifications. Itemize all items on a transmittal letter in duplicate and obtain signature of receiving party. Submit copies of signed transmittals for all specified extra materials and parts prior to completion.

1.07 TWELVE-MONTH INSPECTION

A. Thirty (30) days prior to the expiration of the one-year guarantee period, the Contractor shall tour the project with the Owner to prepare a list of corrective work required under the 12-month guarantee. The Contractor shall correct all items found to be defective within 20 days of receipt of the list of items to be corrected.

END OF SECTION
PART 1 – GENERAL

1.01 DESCRIPTION
   A. Scope: Furnish to the ENGINEER 6 copies of an Operation and Maintenance Manual for all equipment and associated control systems furnished and installed.

1.02 QUALITY ASSURANCE
   A. Reference Codes and Specifications: No current government or commercial specifications or documents apply.

1.03 SUBMITTALS
   B. Prior to the Work Reaching 50 Percent Completion, submit to the ENGINEER for approval two copies of the manual with all specified material. Submit the approval copies with the partial payment request for the specified completion. Within 30 days after the ENGINEER's approval of the two-copy submittal, furnish to the ENGINEER the remaining 4 copies of the manual. Provide space in the manual for additional material. Submit any missing material for the manual prior to requesting certification of substantial completion.

1.04 FORMAT AND CONTENTS
   A. Prepare and arrange each copy of the manual as follows:

      1. One copy of an equipment data summary (see sample form) for each item of equipment.

      2. One copy of an equipment preventive maintenance data summary (see sample form) for each item of equipment.

      3. One copy of the manufacturer’s operating and maintenance instructions. Operating instructions include equipment start-up, normal operation, shutdown, emergency operation and troubleshooting. Maintenance instructions include equipment installation, calibration and adjustment, preventive and repair maintenance, lubrication, troubleshooting, parts list and recommended spare parts.

      4. List of electrical relay settings and control and alarm contact settings.

      5. Electrical interconnection wiring diagram for equipment furnished including all control and lighting systems.

      6. One valve schedule giving valve number, location, fluid, and fluid destination for each valve installed. Group all valves in same piping systems together in the
schedule. Obtain a sample of the valve numbering system from the ENGINEER.

7. Furnish all O&M Manual material on 8-1/2 by 11 commercially printed or typed forms or an acceptable alternative format.

B. Organize each manual into sections paralleling the equipment specifications. Identify each section using heavy section dividers with reinforced holes and numbered plastic index tabs. Use 3-ring, hard-back binders Type No. VS11 as manufactured by K&M Company, Torrence, CA, or equal. Punch all loose data for binding. Arrange composition and printing so that punching does not obliterate any data. Print on the cover and binding edge of each manual the project title, and manual title, as furnished and approved by the ENGINEER.

C. Leave all operating and maintenance material that comes bound by the equipment manufacturer in its original bound state. Cross-reference the appropriate sections of the CONTRACTOR's O&M manual to the manufacturers' bound manuals.

D. Label binders Volume 1, 2, and so on, where more than one binder is required. Include the table of contents for the entire set, identified by volume number, in each binder.

1.05 CD ROM MANUALS

A. Provide two CD Rom copies of the accepted complete manual.
   1. Provide manual documents formatted in Adobe portable document format (PDF) version 3.0 or higher.
   2. Produce the PDF files by either direct digital conversion or optical scanning. Use only original documents if the scanning method is employed. Scanning of copied material is not permitted.
   3. Convert black and white documents to black and white PDF files.
   4. Convert color documents to color PDF files.
   5. Large manuals may be broken down into several linked files.
   6. Save each PDF file using “image and text” format so as to permit later indexing of the document.
   7. Provide each PDF file with a table of contents of navigation links to major topic sections.
   8. Links may be provided to the manufacturer's world wide web site, or other URL site addresses, or to other PDF files being delivered by the same manufacturer.
   9. Name PDF files using equipment description identifiers along with the “PDF” file name extension.
  10. Use standard CD ROM media.

1.06 PAYMENT

A. Acceptable operating and maintenance information shall be delivered to the ENGINEER before the CONTRACTOR will be paid for more than 80 percent of the purchase value of that equipment. Purchase value shall be the net price for the equipment as given on the invoice. Acceptable operating and maintenance information for the project must be delivered to the ENGINEER prior to the project
being 75 percent complete. Progress payments for work in excess of 75 percent complete will not be made until the specified operating and maintenance information has been delivered to the ENGINEER.

1.07 SAMPLE DOCUMENTS: SEE FOLLOWING PAGES
## Equipment Data Summary

<table>
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<th>Specification Reference:</th>
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### NOTES:

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**Gold Springs Water Reclamation Facility Expansion**

**Operation and Maintenance Manuals**

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Cold Springs Water Reclamation Facility Expansion

Preventive Maintenance Summary

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### DIVISION 2

**SITEWORK**

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SECTION 02080

PRECAST CONCRETE SECTIONAL MANHOLES AND WET WELLS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Precast reinforced concrete cylindrical sectional manholes, complete with openings, inserts, hardware, drains, covers, and frames for use as manholes and submersible lift station wet wells.
2. Precast reinforced concrete manholes with precast bases, barrels, risers, cones, and flat tops.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM), Standard Specifications:
   1. A36 Structural Steel
   2. A48 Gray Iron Castings
   3. C150 Portland Cement
   4. C478 Precast Reinforced Concrete Manhole Sections

B. American Association of State Highway and Transportation Officials (AASHTO), Standard Specifications for Highway Bridges.


1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data:
1. Descriptive details of the manufacturer's proposed standard products, including:
   a. Precast manhole and wet well sections
   b. Precast manhole cone section
   c. Precast manhole and wet well base slabs
   d. Minimum concrete 28-day compressive strength
   e. Cement certification
   f. Manhole cover and frame
   g. Wet well access hatch and frame
   h. Epoxy coating catalog cut sheets.

2. Shop drawings, including:
   a. Design criteria.
b. Reinforcing steel location and concrete cover with accompanying design calculations.
c. Layout of all inserts, attachments, and openings.
d. Location and type of joints.

1.04 QUALITY ASSURANCE

A. Provide products of a manufacturer who has been regularly engaged in the design and manufacture of the product for at least 5 years.

B. Demonstrate to the satisfaction of the Owner that the quality is equal to the product made by those manufacturers specifically named herein, if an alternate product manufacturer is proposed.

PART 2 - PRODUCTS

2.01 MANHOLES AND WET WELLS

A. Design Criteria:
   1. ASTM C478
   2. Roof slab concentrated load: AASHTO H20
   3. The basis of acceptance of the base sections and flat slab tops shall be by rational design of these components in accordance with the latest revision of ACI using the design criteria specified herein.
   5. Buoyancy: Design manhole for groundwater up to 2 feet below grade.

B. Precast Sections:
   2. Lifting eyes: Provide for each section.
   3. Provide riser heights of not less than 1 foot. Provide riser sections which have preformed opening of a minimum sized to accommodate the pipe to be inserted. Heights of base sections shall be such that openings for pipes are not located at joints.
   5. Manufacturer: Jensen Precast or equal.
   6. Grade Rings. Provide 3-inch high concrete grade rings meeting the requirements of ASTM C478. Grade adjustment rings shall be limited to a minimum height of 3 inches and a maximum height of 12 inches. In no case shall the "neck-length" (grade rings plus the manhole frame) exceed 18 inches.

C. Manhole Steps.
   1. Provide manhole steps as shown on the drawings and conforming to the Standard Specifications. ASTM D4101 polypropylene encased steel manhole steps with nonslip surface. Steel reinforcing shall be \( \frac{3}{8} \)-inch minimum diameter ASTM A615, Grade 60.
2.02 CORROSION RESISTANT WET WELLS

A. Wet wells shall conform to the requirements listed above for Manholes and Appurtenances, except as modified herein.

B. Shop coat all exposed wet well concrete surfaces on new precast bases sections, risers, and flat slab tops with hydrogen sulfide/sulfuric acid resistant, 100 percent solids epoxy coating. Allow concrete to cure 28 days prior to applying coating. Prepare concrete surfaces and apply coating in strict accordance with the coating manufacturer's instructions. Coating shall be pinhole free with a minimum dry film thickness of 60 mils.

C. Provide Quantum by Polymorphic Polymer's Corporation or approved equal.

D. Provide thermosetting flexible joint compound compatible with the coating to fill field joints. Provide Mainstay Thermosetting Joint Compound as manufactured by Mainstay Corporation, or approved equal.

E. Wet well cover shall be designed for H-20 loading.

F. Wet well access hatch and frame shall conform to Section 08307 of these specifications.

2.03 SEALANT GASKETS

A. Type: Preformed, continuous rope form plastic material, protected by removable two-piece wrapper.

B. Sealing Compound: Reinforced hydrocarbon resins blended with plasticizing compounds and reinforced with inert mineral filler. No solvents, irritating fumes, or obnoxious odors.

C. Adhesive and Cohesive Strength: Not dependent on oxidizing, evaporating, or chemical action.


E. Provide: RAM-NEK as manufactured by K. T. Snyder Company, Inc., Houston, TX; QUIKSEAL as supplied by Associated Concrete Products, Santa Ana, CA; or equal.

2.04 PIPE CONNECTIONS

A. Provide one of the following methods for PVC pipe connections to manholes and wet wells.

1. PVC sand collars with sewage and grease resistant O-ring gaskets conforming to ASTM C443. Manhole adapter shall have epoxied on abrasive exterior coating. Provide manhole adapter as manufactured by GPK Products, Inc., or approved equal.
2. Elastomeric boots such as Kor-N Seal I-Wedge Korband by National Pollution Control Systems Inc.; Fowler Inserta Tee Products, Inc., or other elastomeric device approved by the Engineer.

B. The following methods shall be used for ductile iron connections.
   1. Pressurized ductile iron pipe shall use a flange by flange ductile iron wall sleeve set in epoxy grout.
   2. Gravity drain ductile iron pipe shall utilize a 4-foot section of ductile iron pipe set in epoxy grout with end configuration to match connecting pipe.

2.05 MANHOLE FRAMES AND COVERS

A. Material: Cast iron; ASTM A48, Class 30B.

B. Marking: “S” in raised lettering on manhole cover.

C. Coating: Bituminous paint, black.

D. Size: 24 3/4-inch-diameter cover.

E. Pick Hole: Closed.

F. Vent Holes: Two, 1-inch-diameter.

G. Manufacturer: South Bay Foundry, Hayward, CA.; Alhambra Foundry Company Ltd., Alhambra, CA; or equal.

2.06 GROUT

A. Grout shall be Sika 212, Euco N-S, Five Star, or approved equal nonmetallic cementitious commercial grout exhibiting zero shrinkage per ASTM C-827. Grout shall not be amended with cement or sand and shall not be reconditioned with water after initial mixing.

2.07 MORTAR

A. Standard premixed mortar conforming to ASTM C 387 or proportion one part portland cement to two parts clean, well-graded aggregate which will pass a 1/4-inch screen. Portland cement shall be Type II or V.

B. Admixtures may be used not exceeding the following percentages of weight of cement; Hydrated lime, 10 percent; diatomaceous earth; or other inert materials, 5 percent. Chloride shall not be added to the mortar to accelerate the set.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Where foundation material is unsuitable, remove material as directed by the Engineer and provide a stable foundation. Compact subgrade to 95% relative density per Section 02301 for 6-inch minimum depth.

B. Provide gravel layer under the base slab as shown on the Drawings and compact to 95% relative density per Section 02301. Grade gravel to provide uniform bearing for the base section. Leveling the base by wedging gravel under the edges is not permitted.

C. Set precast manhole sections in a concrete base joint groove, formed in concrete base slab.

D. Apply primer to joint surfaces in accordance with manufacturer's instructions. Make all joints watertight with sealant gaskets in strict conformance with the manufacturer's directions.

E. Completed manhole and wet well shall be straight, plumb, and the joints shall be watertight. All exterior joint areas shall be coated with a fast setting, quick drying mortar prior to backfill.

F. Manhole steps shall provide a continuous ladder with steps equally spaced vertically at 12 inches ±¼ inch on centers. Steps shall be capable of withstanding a force of 350 pounds applied at any place on the step and in any direction. Steps shall be vertically aligned to within ½ inch.

G. Backfill around the manhole with structural backfill material. Compact the backfill material to 95% of relative density per Section 02301 from the pipe bedding and base slab up to final finish grade.

H. Install grade rings to height indicated on the Drawings. Lay grade rings in mortar with sides plumb and top level. Seal joints with mortar. Grade rings shall be watertight.

3.02 FIELD COATINGS

A. Wet Wells:
   1. Field apply two or more coats of epoxy coating to any cast-in-place sections, grade rings, and any damaged shop coated sections.
   2. Allow all grout and cement mortar to cure 28 days prior to applying the coating system. Prepare surfaces and apply epoxy in strict accordance with the coating manufacturer's instructions. Coating shall be pinhole free with a minimum dry film thickness of 60 mils. Maintain required temperature and humidity for duration of curing period.
3.03 TEST FOR MANHOLES

A. Furnish and dispose of water used for testing.

B. Hydraulically test all manholes installed.

C. After all pipe has been laid, backfilling has been completed and after the testing of the pipes, plug the end of the pipe stubs in each manhole with flexible-joint caps, or acceptable alternate, securely fastened.

D. Fill the manhole with water and measure leakage over a period of not less than one hour.

E. Allowable Leakage: Less than one (1) gallon per hour per 10-foot depth of manhole.

F. When leakage from the manhole exceeds the above amount, determine the source or sources of the leakage, and repair or replace defective materials and workmanship.

G. The completed wetwell and manhole installations shall pass this test before the project can be accepted.

END OF SECTION
SECTION 02085
PRECAST CONCRETE UTILITY VAULTS

PART 1 - GENERAL

1.01 SUMMARY
A. Section includes:
   1. Precast reinforced concrete box structures, as shown on the Drawings and
      specified herein, complete with openings, access hatches, inserts, hardware,
      drains, and appurtenant items. See Drawings for sizes and/or specific product
      information.

1.02 REFERENCES
A. American Society for Testing and Materials (ASTM), Standard Specifications:
   1. A36 Structural Steel
   2. A48 Gray Iron Castings
   3. C150 Portland Cement
   4. C857 Minimum Structural Design Loading for Underground Precast Concrete
      Utility Structures
   5. C858 Underground Precast Concrete Utility Structures
   6. C891 Installation of Underground Precast Concrete Utility Structures

B. American Association of State Highway and Transportation Officials (AASHTO),
   Standard Specifications for Highway Bridges.

   Expansion Joints and Pipe Joints.

D. Standard Specifications: Standard Specifications for Public Works Construction,
   Washoe Co, et al.

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.

B. Product Data:
   1. Descriptive details of the manufacturer's proposed standard products,
      including:
      a. Precast sections.
      b. Minimum concrete 28-day compressive strength.
      c. Cement certification.
   2. Shop drawings, including:
      a. Design criteria.
      b. Reinforcing steel location and concrete cover.
      c. Layout of all inserts, attachments, and openings.
      d. Location and type of joints.
1.04 QUALITY ASSURANCE

A. Provide products of a manufacturer who has been regularly engaged in the design and manufacture of the product for at least 5 years.

B. Demonstrate to the satisfaction of the Owner that the quality is equal to the product made by those manufacturers specifically named herein, if an alternate product manufacturer is proposed.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

A. General: ASTM C857, C858, and also:
   1. Structure live load: AASHTO Loading Class HS 20-44.
   2. Backfill material: Structural backfill.
   3. Buoyancy: Design structure for groundwater up to 5 feet below grade.

2.02 PRECAST SECTIONS

A. General:
   2. Roof slab openings: Size to support the frame and hatch covers.
   3. Lifting eyes: Provide for each section.

B. Electrical Vaults: Comply with Standard Specifications unless otherwise modified in this document.

C. Telephone Vaults: Comply with Standard Specifications unless otherwise modified in this document.

D. Manufacturer: Jensen Precast; Vault Company; or equal.

2.03 SEALANT GASKETS

A. Type: Preformed, continuous rope form plastic material, protected by removable two-piece wrapper.

B. Sealing Compound: Reinforced hydrocarbon resins blended with plasticizing compounds and reinforced with inert mineral filler. No solvents, irritating fumes or obnoxious odors.

C. Adhesive and Cohesive Strength: Not dependent on oxidizing, evaporating, or chemical action.

E. Provide: QUIKSEAL as supplied by Associated Concrete Products, Santa Ana, CA; RAM-NEK as manufactured by K. T. Snyder Company, Inc., Houston, TX; or equal.

2.04 HATCH FRAMES AND COVERS
A. See Section 08307.

2.05 LADDERS
A. See Section 05500.

2.06 SOURCE QUALITY CONTROL
A. Precast Sections:
  1. Verify concrete compressive strength test results are satisfactory for the sections supplied.
  2. State the curing method. Identify the start and end dates for the sections supplied.
B. Frames and Covers:
  1. Verify cast test bar tensile strengths are satisfactory.

PART 3 - EXECUTION

3.01 INSTALLATION
A. General: ASTM C891 and also:
  1. Compact subgrade to 95% relative density per Section 02301 for 6-inch minimum depth.
  2. Provide 6-inch minimum gravel layer under the base slab as shown on the Drawings and compact to 95% relative density per Section 02301 prior to placement.
  3. Apply primer to joint surfaces in accordance with manufacturer's instructions. Make all joints watertight with sealant gaskets.
  4. Backfill around the vaults with structural backfill material. Compact the backfill material to 95% of relative density per Section 02301 from the base up to final finish grade, over an area defined as being within a distance of 4 feet from the exterior walls of the vault.
  5. Accurately locate and place frames to within 1/8-inch vertical elevation in paved areas and to 1/2-inch in other areas. Coordinate the activities of all trades so that this tolerance is achieved.
  6. Install the hatch and machine if necessary to obtain a solid fit, without rattling under load.

3.02 FIELD QUALITY CONTROL
A. Verify all precast sections are continuously sealed with gaskets.
B. Verify all hatches fit quietly in the frames.
3.03 TEST FOR VAULTS

A. Furnish and dispose of water used for testing.

B. Hydraulically test all vaults installed.

C. After all conduit has been laid and backfilling has been completed, plug the end of the conduit in each vault.

D. Fill the vault with water and measure leakage over a period of not less than one hour.

E. Allowable Leakage: Less than one (1) gallon per hour per 10-foot depth of vault.

F. When leakage from the vault exceeds the above amount, determine the source or sources of the leakage, and repair or replace defective materials and workmanship.

G. The completed pipe and vault installation shall pass this test before the project can be accepted.

END OF SECTION
SECTION 02200
SITE PREPARATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes provisions for clearing, grubbing, stripping, disposal, and related work necessary to prepare the site for construction operations.

PART 2 - PRODUCTS - Not applicable to this Section.

PART 3 - EXECUTION

3.01 GENERAL

A. Unless otherwise noted on the Drawings, the limits of clearing shall be determined by the Contractor and approved by the Engineer prior to beginning the work. Clearing shall be confined to the immediate vicinity of the construction, insofar as practicable, without the express written approval of the affected landowners.

3.02 CLEARING

A. Portions of the project site where trenching is to be conducted shall be cleared of all objectionable material such as brush, stumps and roots, grass, other vegetation, decayed vegetable matter, topsoil, rubbish, pavement, and other materials that may interfere with the proper execution of the work.

3.03 GRUBBING

A. Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the construction areas. This material, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be excavated and removed to a depth of not less than 18 inches below the original surface level of the ground in construction areas, such as areas for structures and trenching.

3.04 STRIPPING

A. The upper two-to-six inches of soil containing vegetation and root growth shall be stripped from construction areas and from areas which will receive landscaping.

3.05 PAVEMENT REMOVAL

A. Pavement to be removed shall be cut in neat, straight lines with vertical edges along the limits of pavement removal. Changes in removal width shall be made by...
cutting perpendicular and parallel to the centerline of the trench. The cut lines for removal of asphalt concrete pavement shall be favorably reviewed by the Owner in the field before cutting.

3.06 DISPOSAL

A. All cleared, grubbed and stripped material, including pavement and debris from demolition work, shall be conveyed to suitable waste sites and disposed of in a manner that will meet all the requirements of the applicable State and County regulations.

END OF SECTION
SECTION 02301
EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Perform all excavation, shoring, dewatering, backfilling, compaction, and grading necessary or required for the construction of the work as covered by these Specifications and indicated on the Drawings. The excavation shall include, without classification, the removal and disposal of all materials of whatever nature encountered, including water and all other obstructions that would interfere with the proper construction and completion of the required work. Major items of work covered in this section include, but shall not be limited to the following:
1. Bulk Cut and Fill
2. Structural Fill
3. Structural Excavation, Backfill, and Compaction
4. Trench Excavation, Backfill, and Compaction
5. Shoring
6. Foundation Material Installation
7. Finish Grading.

B. Site Access: Access to the site will be over public and private roads. The Contractor shall exercise care in the use of such roads and shall repair damage caused by his operations at his own expense. Such repair shall be to the satisfaction of the Owner or agency having jurisdiction over the road. The Contractor shall take whatever means are necessary to prevent tracking mud onto existing roads and shall keep roads free of debris.

1.02 REFERENCES


B. Standard Specifications for Public Works Construction, Washoe Co. et al. (Standard Specifications).

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Submit the following:
1. Qualifications for an independent laboratory to collect samples, perform tests, and submit results to the Engineer.
2. Samples and Test Results: Furnish, without additional cost to the Owner, such quantities of import materials as may be required for test purposes. Cooperate with the Engineer and independent laboratory personnel and furnish necessary facilities for sampling and testing of all materials and workmanship. Submit test
results for import materials. Tests shall be performed within 60 days of the submission. All material furnished and all work performed shall be subject to rigid inspection, and no material shall be delivered to the site until it has been favorably reviewed by the Engineer, or used in the construction work until it has been inspected in the field by the Engineer.

3. Manufacturer's or supplier's certification of compliance with referenced standards

1.04 QUALITY ASSURANCE

A. Source Quality Control: Test import materials proposed for use to demonstrate that the materials conform to the specified requirements. Tests shall be performed by an independent testing laboratory.

B. Field Quality Control:
   1. The Engineer will:
      a. Review materials proposed for use.
      b. Inspect foundation subgrade, site grading, and borrow operations.
      c. Inspect placement and compaction of fill.
   2. The Contractor shall hire an independent laboratory approved by the Engineer to perform the following tasks:
      a. Test materials proposed for use and submit results to the Engineer.
      b. Test soils during placement of fill as specified and submit results to the Engineer.
   3. Contractor shall excavate holes for in-place soil sampling. Contractor shall be responsible for costs of additional inspection and re-testing resulting from non-compliance.

C. Testing Methods:
   1. Durability Index: ASTM D3744.
   3. Laboratory Compaction: ASTM D1557, Method A or C.
   5. Particle Size Analysis of Soils: ASTM D422.
   7. Soil Classification: ASTM D2487.
   8. In-place Moisture Content: ASTM D3017.

D. Definition:
   1. Relative Compaction: In-place density divided by the maximum dry density laboratory compaction expressed as percentage.

1.05 EXPLOSIVES

A. Any construction procedure elected by the Contractor, which involves the use of explosives, shall be performed in accordance with all applicable Federal, state, and local laws and regulations. The Contractor shall obtain all permits required for such use of explosives and shall have complete responsibility for their transportation, storage, and use.
1.06 SUBSURFACE INVESTIGATIONS

A. Geotechnical investigations for design purposes for this project were made for the Owner by Kleinfelder, Inc. in report dated August 22, 2003.

B. This report is available for examination by bidders at the offices of the Owner and Engineer. While the records of data obtained may be considered by the Contractor to be correct, any conclusions or recommendations made in the reports are for information to the Design Engineer and are not a part of the Contract Documents.

C. The bidders may make additional subsurface investigations at the site prior to the bidding of the project. Prior to making any drillings or excavations, the bidder shall secure permission from the Owner, and property owners if on private property.

1.07 REFERENCE SPECIFICATIONS

A. Whenever the words "Standard Specifications" are referred to, the reference is to the Standard Specification for Public Works Construction, Washoe Co., et al.

1.08 ADDITIONAL SAFETY RESPONSIBILITIES

A. The Contractor shall select, install and maintain shoring, sheeting, bracing, and sloping as necessary to maintain safe excavations. The Contractor shall be responsible for ensuring such measures: (1) comply fully with 29 CFR Part 1926 OSHA Subpart P Excavations and Trenches requirements, (2) provide necessary support to the sides of excavations, (3) provide safe access to the Engineer's sampling and testing within the excavation, (4) provide safe access for backfill, compaction, and compaction testings, and (5) otherwise maintain excavations in a safe manner that shall not endanger property, life, health, or the project schedule. All earthwork shall be performed in strict accordance with applicable law, including local ordinances and applicable OSHA.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Crushed Rock: Imported hard, durable, angular crushed rock that has a maximum particle size of 1-inch conforming to Standard Specifications Section 200.01.03 (Type 2, Class B).

B. Pipe Bedding: Except as shown differently on the Drawings, pipe bedding material shall be imported fill consisting of well-graded granular material with a maximum particle size of 1 inch conforming to Standard Specifications Section 200.01.03 (Type 2, Class B).

C. Pipe Zone and Trench Backfill: Imported or native soil prepared as necessary to be free from clay balls, roots, organic matter and other deleterious materials and particles larger than 3/4 inches in greatest dimension. Imported backfill shall be non-expansive soil with liquid limit no greater than 40% and a plasticity index no
greater than 15%.

Backfill stockpiles shall be covered during wet weather to prevent significant increases in moisture content. Moisture content shall be continuously monitored. Fill material that is more than 2 percent above optimum moisture content as determined by laboratory compaction test, shall be dried or amended with cement or lime at no additional expense to the Owner. Fill material that is more than 2 percent below optimum moisture content shall be uniformly moistened. If in the opinion of the Engineer, native material is unsuitable for backfill, haul the unsuitable material from the site and dispose of at an approved disposal site.

D. Structural Backfill: Native material complying with the moisture content requirements containing no clay balls, roots, organic matter, or other deleterious materials or imported structural fill material consisting of clean sand, sand and gravel, pit or quarry run rock, crushed rock, crushed gravel, and sand or other manufactured materials. Imported structural fill shall be well-graded between coarse and fine, contain no clay balls, roots, organic matter, or other deleterious materials, have a maximum particle size of 4 inches, and have less than 5 percent passing the U.S. No. 200 Sieve. Fill material that is more than 2 percent above optimum moisture content as determined by laboratory compaction test, shall be dried or amended with cement or lime at no additional expense to the Owner. Fill material that is more than 2 percent below optimum moisture content shall be uniformly moistened. If in the opinion of the Engineer, native material is unsuitable for backfill, haul the unsuitable material from the site and dispose of at an approved disposal site.

E. Water: The water used shall be reasonably free of objectionable quantities of silt, oil, organic matter, alkali, salts and other impurities. Water quality must be acceptable to the Engineer.

F. Aggregate Base: Refer to Section 02700.

G. Concrete Encasement: The pipe shall be bedded in 4 inches of 2,500 psi monolithic concrete completely encasing the pipe.

H. Warning Tape: 3-inch-wide, inert, fade-resistant plastic film resistant to acids, alkalis, and other components likely to be encountered in soil. Tape shall be green, imprinted with "CAUTION SEWER MAIN BELOW" or as required. Use Griffolyn Terra Tape; or equal.

PART 3 - EXECUTION

3.01 CONTROL OF WATER

A. All excavations shall be kept free from water and all construction shall be in the dry.

1. It should be presumed that the presence of groundwater will require dewatering operations. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering all excavations, if groundwater is encountered in excavations. At all times that excavations are open, have on the project...
sufficient pumping equipment for immediate use, including standby pumps for use in case other pumps become inoperable.

2. Provide a sufficient number of pumps so as to hold the groundwater level at an elevation of not less than 1 foot below the lowest elevation of the pipe, duct or other material to be placed.

3. Dispose of water in such a manner as to cause no injury or nuisance to public or private property, or be a menace to the public health.

4. The dewatering operation shall be continuous, so that the excavated areas shall be kept free from water during construction, while concrete is setting and achieves full strength, and until backfill has been placed to a sufficient height to anchor the work against possible flotation.

5. Continue dewatering during backfilling operations such that the groundwater is at least 1 foot below the level of the compaction effort at all times. No compaction of saturated materials will be allowed.

6. Dewatering devices must be adequately filtered to prevent the removal of fines from the soil.

7. The Contractor shall be responsible for any damage to the foundations or any other parts of existing structures or of the new work caused by failure of any part of the Contractor's protective works. After temporary protective works are no longer needed for dewatering purposes, they shall be removed by the Contractor.

8. If pumping is required on a 24-hour basis and requires engine generators, then the generators shall be equipped in a manner to keep noise to a minimum.

9. Prevent disposal of sediments suspended in groundwater to adjacent lands or waterways by employing whatever methods are necessary, including settling basins.

B. The Contractor shall be responsible for furnishing temporary drainage facilities to convey and dispose of surface water falling on or passing over the site.

3.02 EXISTING UTILITIES

A. General: The known existing overhead utilities are shown on the Drawings in their approximate location. There are no known buried utilities on or crossing the wastewater treatment facility site. The Contractor shall exercise care in avoiding damage to all utilities as he will be held responsible for their repair if damaged. There is no guarantee that all utilities or obstructions are shown, or that locations indicated are accurate. Utilities are piping, conduits, wire, cable, ducts, utility poles, manholes, pull boxes and the like, located at the project site.

B. Interferences: If interferences occur at locations other than shown on the Drawings, the Contractor shall notify the Engineer, and a method for correcting said interferences shall be supplied by the Engineer. Payment for interferences that are not shown on the plans, nor which may be inferred from surface indications, shall be in accordance with the provisions of the General Conditions. If the Contractor does not expose all required utilities prior to shop drawing preparation, he shall not be entitled to additional compensation for work necessary to avoid interferences, nor for repair to damaged utilities.
C. Any necessary relocations of utilities, whether shown on the Drawings or not, shall be coordinated with the affected utility. The Contractor shall perform the relocation only if instructed to do so in writing from the utility and the Engineer.

D. Shutdowns: Planned utility service shutdowns shall be accomplished during period of minimum use. In some cases this may require night or weekend work. Such work shall be at no additional cost to the Owner. Program work so that service will be restored in the minimum possible time, and shall cooperate with the utility companies in reducing shutdowns of utility systems to a minimum.
   1. Disconnections: No utility shall be disconnected without prior written approval from the utility owner. When it is necessary to disconnect a utility, the Contractor shall give the utility owner not less than 72 hours notice when requesting written approval. The Contractor shall program his work so that service will be restored in the minimum possible time.

E. Overhead Facilities: There are existing overhead electric transmission lines at the site. Overhead utilities are shown on the Drawings, but it is the Contractor's responsibility to verify extent of the utilities, locations, and possible conflicts. Extreme caution shall be used when working in the vicinity of overhead utilities so as to prevent injury to workmen or damage to the utilities.

3.03 GENERAL CONSTRUCTION REQUIREMENTS

A. Site Access: Access to the site will be over public and private roads. Exercise care in the use of such roads and repair at own expense any damage thereto caused by Contractor's operations. Such repair shall be to the satisfaction of the Owner or agency having jurisdiction over the road. Take whatever means are necessary to prevent tracking of mud onto existing roads and shall keep roads free of debris.

B. Barriers: Barriers shall be placed at each end of all excavations and at such places along excavations as may be necessary to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely restored.

C. Demolition of Pavement: Where trenching or excavation occurs in paved areas, the pavement shall be scored and broken ahead of the trenching or excavation operation. The extent of paving removed shall be limited to the minimum necessary for the excavation.

D. Dust Control: Take proper and efficient steps to control dust.

E. Permits: Refer to General Conditions.

F. Storage of Materials: Neatly place excavated materials at a distance from the excavation that is equal to the trench depth to prevent stability problems. Keep the materials shaped so as to cause the least possible interference with drainage.
3.04 SITE GRADING

A. Rough Grading: After completion of stripping, rough grade cut areas to the lines, grades and contours shown on the Drawings.

B. Proof-Rolling: After rough grading, proof-roll the areas where roads, fills, and on-grade structures are to be constructed in order to detect soft zones. Proof-roll by passing over all required areas with a loaded scraper, loaded dump truck, or other heavy rubber tired vehicle with high tire pressure, in the presence of the Engineer. The Engineer will determine what areas tested by proof-rolling are soft zones that require corrective work.
1. Soft Zone Corrective Work: Remove all soft material as indicated by the Engineer from all soft zones exposed by proof-rolling. Properly dispose of unsuitable material off site.
2. Fill the resulting voids with moisture-conditioned structural backfill in level 8-inch uniform layers measured before compaction. Compact with appropriate equipment to at least 95% relative compaction.
3. Soft zone corrective work will be considered a change in the scope of project work and will be paid for as extra work by a Change Order in accordance with the General Conditions.

C. Fills:
1. Do not place any fill until the Engineer has inspected, tested to his satisfaction, and favorably reviewed the prepared subgrade.
2. Construct fills using structural backfill as specified in Section 2.01(D).
3. Construct fills as shown on the Drawings, true to line, grade and cross-section. Place material in approximately 8-inch-thick horizontal layers measured before compaction, and carried across the entire width to the required slopes. Compact all fills to a relative compaction of at least 95% unless otherwise specified. Properly moisture condition before compaction.
4. Where fills are to be made and compacted on sloping ground surfaces, steeper than 5:1, such slopes shall be benched a minimum of 6 feet horizontally as the work is brought up. Recompact material thus removed by benching along with the new embankment material.
5. It may be necessary to overbuild slopes and trim back to the compacted core to achieve adequate compaction of slope faces.

3.05 TRENCH EXCAVATION

A. Excavation for pipe and other utilities such as duct banks shall be in open cut. The trench shall be as wide as necessary for sheeting and bracing and the proper performance of the work up to the maximum width permitted by the typical cross-sections shown on the Drawings. The bottom of the trench shall be constructed to the grades and shapes indicated on the Drawings. Should the Contractor desire to use other equivalent methods, he shall submit his method of construction to the Engineer for favorable review prior to its use.

B. Take care not to over-excavate. Accurately grade the bottom of the trenches to provide uniform bearing and support for each section of the pipe or conduit at every point along its entire length, except for the portions of the pipe sections where it is
necessary to excavate for bell holes and for the proper sealing of pipe joints, and as hereinafter specified. Dig bell holes and depressions for joints after the trench bottom has been graded. In order that the pipe rest on the bedding for as nearly its full length as practicable, bell holes and depressions shall be only of such length, depth and width as required for properly making the joint. Remove stones as necessary to avoid point bearing.

C. Backfill and compact over-excavations to 95% relative compaction with pipe bedding material. There shall be no additional payment to the Contractor for over-excavations not directed by the Engineer. Remove unsatisfactory material encountered below the grades shown as directed by the Engineer and replace with pipe bedding material. Payment for removal and replacement of such unsatisfactory material directed by the Engineer shall be made in accordance with the provisions of the General Conditions.

D. Grade trenches so that they are uniformly sloped between the pipe elevations shown on the Drawings. If no elevations are shown on the Drawings, provide 3 feet of minimum cover. Comply with the minimum and maximum trench widths shown on the Drawings. Notify the Engineer if the trench width exceeds the maximum allowable width for any reason.

E. For all piping or conduits to be placed in any excavated and backfilled area, such as at manholes or for building connections, the structural backfill shall be first compacted to a level at least 3 feet from the top of the piping or conduit elevation and then retrenched to pipe grade.

F. Provide ladders for access to the trench by construction and inspection personnel.

3.06 EXCAVATION FOR STRUCTURES

A. All excavation for structures shall be done to the dimensions and levels indicated on the Drawings or specified herein. Excavate to such width outside the lines of the structure to be constructed as may be required for proper working methods, the erection of forms and the protection of the work.

B. Take care to preserve the foundation surfaces shown on the Drawings in an undisturbed condition. If the Contractor over-excavates or disturbs the foundation surfaces shown on the Drawings, without written authorization of the Engineer, he shall replace such foundations with concrete fill or structural fill approved by the Engineer in a manner which will show by test an equal bearing value with the undisturbed foundation material. No additional payment will be made for the added quantity of concrete fill or other material used because of over-excavation.

C. Inspection of Excavation: Notify the Engineer when excavation for the structure is complete. No forms, reinforcing steel, concrete, or precast structure shall be placed until the subgrade has been inspected by the Engineer.

D. Where unsatisfactory material is encountered below the grades shown for structural excavations, it shall be removed and replaced with selected material as directed by
the Engineer and compacted. Payment for removal and replacement of such unsatisfactory material directed by the Engineer shall be made in accordance with the provisions of the General Conditions.

3.07 SUPPORT OF EXCAVATIONS

A. Adequately support excavation for trenches and structures to meet all applicable OSHA and WISHA requirements in the current rules, orders and regulations. Excavation shall be adequately shored, braced and sheeted so that the earth will not slide or settle and so that all existing structures and all new pipe and structures will be fully protected from damage. Keep vehicles, equipment, and materials far enough from the excavation to prevent instability. Sheet ing and shoring plans shall be submitted as specified in Section 1.03(B).

B. Take all necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, or sliding soil resulting from the high groundwater table and the nature of the soil excavated.

C. The support for excavation shall remain in place until the pipeline or structure has been completed. During the backfilling of the pipeline or structure, the shoring, sheeting and bracing shall be carefully removed so that there shall be no voids created and no caving, lateral movement or flowing of the subsoils.

3.08 ROCK EXCAVATION

A. Significant rock excavation is NOT anticipated for work at the wastewater treatment facility site.

B. Rock excavations shall mean excavation of material that consists of boulders and pieces of concrete, solid ledge rock or masonry exceeding 3 feet by 3 feet by 3 feet in dimension, or which, in the opinion of the engineer, requires for its removal, drillings and blasting, wedging, sledger ing, or barring, or break up with a power operated hand tool.

C. No soft or disintegrated rock, which can be removed with a hand pick or large trackhoe with ripper teeth attached to the bucket: no loose, shaken, or previously blasted rock or broken stone in rock fillings, or elsewhere; and no rock exterior to the minimum limits of measurement allowed, which may fall into the excavation, will be measured or allowed.

D. Any rock excavation shall be paid by the Owner based on the actual quantities removed and the unit cost (dollar/cubic yard) listed in the bid schedule. Rock excavation shall be approved and measured by the Engineer. The method of rock excavation beyond the limits approved by the Engineer shall be exempt from payment.

3.09 BLASTING

A. Blasting for excavation will be permitted only if the approval of the local regulatory agencies and Owner is obtained and only when proper precautions are taken for the protection of persons and Property. The hours of blasting will be fixed by the Owner.
B. Any damage caused by blasting shall be repaired by the Contractor at his or her expense. The Contractor shall carry proper and adequate blasting insurance.

C. The Contractors method of procedure in blasting shall conform to applicable Federal, State, County, and local laws and accordance with OSHA Regulations, Part 1 92b, Subpart U.

3.10 TRENCH BACKFILL

A. Place bedding and backfill materials true to the lines, grades, and cross-sections indicated on the Drawings and compacted to the degree specified on the Drawings. Place bedding and backfill materials in horizontal lifts not to exceed 6 inches in thickness measured before compaction. The difference in level on either side of a pipe shall not exceed 4 inches.

B. Backfill material shall not be placed over the pipe or conduit until after the joints have been completed and inspected by the Engineer.

C. It shall be incumbent upon the Contractor to protect the pipe or conduit from damage during the construction period. It shall be his responsibility to repair broken or damaged pipe at no extra cost to the Owner. Carefully place backfill around and over the pipe and do not allow it to fall directly upon the pipe. Tamping of backfill over the pipe shall be done with tampers, vibratory rollers and other machines that will not injure or disturb the pipe.

D. Do not allow construction traffic nor road traffic over the pipe trench until the trench backfill has been brought back even with existing adjacent grade.

E. Compaction shall meet or exceed 95% of relative density per ASTM D 1557. There shall be a minimum of 1 test for every 150 feet of trench. Test locations shall be at different depths of the trench. In the case of failing tests the contractor shall perform additional tests to determine the extent of the deficiency. The Contractor shall take actions necessary to bring the fill into compliance with the specifications. The area shall be retested and reworked until the specifications are met. There shall be no additional cost to the owner for work required to meet the requirements of the specifications.

3.11 STRUCTURAL BACKFILL

A. Crushed Rock Subgrade: Place a layer of rock, compacted to at least 95% relative compaction per ASTM D 1557 under structures to the lines, grades and minimum thicknesses of 6-inches unless shown otherwise on the Drawings.

B. Backfill Adjacent to Structures:
   1. Backfill shall be structural backfill compacted to at least 95% relative compaction per ASTM D 1557.
   2. Do not place backfill against structures until the concrete has been patched and cured.
3. Do not place backfill against structures until at least 28 days after the concrete was placed, or until the concrete has achieved a strength of at least 2,500 psi, whichever is earlier. Concrete strength shall be demonstrated by field cured cylinders tested at the Contractor's cost, prepared and tested in accordance with ASTM C31 and ASTM C39.

4. Do not place backfill against hydraulic structures until the structure has passed the specified leakage tests.

5. Place backfill in uniform, level layers, not exceeding 8 inches thick measured before compaction. Bring backfill up uniformly on all sides of the structure, and on both sides of buried walls.

C. Testing: There shall be a minimum of 1 test for every 50 cubic yards of material placed or every 150 square yards of area raised 1 foot in elevation. In the case of failing tests the contractor shall perform additional tests to determine the extent of the deficiency. The Contractor shall take actions necessary to bring the fill into compliance with the specifications. The area shall be retested and reworked until the specifications are met. There shall be no additional cost to the owner for work required to meet the requirements of the specifications.

3.12 EMBANKMENTS

A. Construct earthen embankments in accordance with the Standard Specifications except compaction shall be 95% of relative density per ASTM D 1557. Dry surficial soils may require additional water to achieve near-optimum moisture contents.

3.13 COMPACTION

A. Add water to the backfill material or dry the material as necessary to obtain a moisture content within 2% of optimum. Employ such means as may be necessary to secure a uniform moisture content throughout the material of each layer being compacted.

B. After the material has been moisture conditioned, compact it with compaction equipment appropriate for the use to achieve specified compaction.

C. If the backfill material becomes saturated from rains or any other source and was not compacted to the specified density or was not backfilled and compacted to surface grade, through negligence or otherwise, remove the faulty material and replace it with suitable material compacted to the specified density. No additional payment will be made for doing such work or removal and replacement.

D. Compaction of embankment and backfill materials by flooding, ponding or jetting will not be permitted.

E. When densities of compacted materials do not meet the requirements, remove and/or recompact the material until the requirements are met. If the Engineer determines that the nature of the ground in which the trench lies precludes compaction of the backfill to the specified density, compact the backfill to the maximum practicable density. The Contractor will be responsible for the cost of
retesting all failing tests, including the initial retest. Such back-charges will be deducted from the Contractor's Progress Payments.

3.14 FINISH GRADING

A. Finish grade the site to the elevations shown on the Drawings. Finish grading shall be uniform and pleasing and shall provide drainage from all areas to collection points. The finished surfaces shall be smooth and compacted.

3.15 DISPOSAL OF EXCAVATED MATERIAL

A. Dispose of unsuitable material or excavated material in excess of that needed for backfill or fill offsite in accordance with the requirements of Section 01140.

B. Excess material shall be removed from the project site and not allowed to be stockpiled on site.

C. Excess materials shall be disposed of in a designated location (e.g., fill areas) as directed by the Owner.

END OF SECTION
SECTION 02700
PAVING AND SURFACING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes new paving and surfacing and the repair and replacement of all surfacing on roadways, driveways, or parking areas that are removed or damaged by the Contractor's operations, in accordance with the Drawings and these Specifications.

1.02 REFERENCES

A. Nevada State Department of Transportation Standard Specifications (Standard Specifications) latest edition.

1.03 PAVEMENT

A. Unless noted otherwise on the Drawings or directed by the Engineer, damaged or removed pavement shall be restored as follows:
   1. Existing bituminous surface treatment will be restored with asphalt concrete pavement.
   2. Existing asphalt and cement concrete pavement will be restored in kind as specified herein.
   3. Provide full width asphalt concrete overlay where required by permits, as shown on the Drawings, or as directed by the Owner.
   4. Unimproved public roads and road shoulders will be restored with crushed surfacing top course as specified herein.
   5. Other traveled surfaces will be restored to the satisfaction of the Owner and/or property owner in a manner to match the existing surface.

1.04 LIMITS OF RESURFACING

A. The Contractor shall avoid damaging existing pavement which is to remain or pavement outside the removal limits as shown on the Drawings, and will be responsible to repair such at his own cost and to the satisfaction of the Owner.

1.05 MAINTENANCE OF ROADWAYS PRIOR TO RESURFACING

A. The Contractor is responsible for the temporary maintenance of roadway surfaces prior to repaving. This responsibility includes the application of temporary crushed surfacing top course and dust palliatives as required, and maintaining the roadway surface in a level and passable condition.

1.06 SUBMITTALS

A. Submit as Product Information manufacturer's or suppliers' certifications that all materials in Part 2 - PRODUCTS, meet these specifications.
PART 2 - PRODUCTS

2.01 BACKFILL, GRAVEL BASE AND CRUSHED SURFACING

A. Backfill shall be undisturbed earth or shall be material conforming to the requirements for structural backfill in Section 02301, 2.01, D.

B. Gravel Base shall conform to the requirements for Type 2, Class B Aggregate Base.

C. The material for crushed surfacing shall conform to Section 02301-2.01-A. Not anticipated as part of this project.

2.02 ASPHALT CONCRETE

A. Asphalt concrete shall conform to the requirements for AC20P, Standard Specification Section 703.03.02.

B. Aggregate for asphalt concrete shall conform to the requirements for Plant-mix Bituminous Surface Aggregate, Standard Specification Section 705.03.01.

B. Asphalt prime coat shall be Liquid Asphalt MC70, Standard Specifications Section 703.03.03.

2.03 ASPHALT CONCRETE SURFACE SEALER

A. Asphalt concrete surface sealer is not required.

PART 3 - EXECUTION

3.01 GENERAL

A. All valve boxes, manhole frames, catch basin gratings, and other utility appurtenances located within paved areas shall be set or raised to finish grade, unless otherwise noted. Utility appurtenances located in asphalt concrete pavement shall be raised to finish grade after the surfacing is completed.

B. Unless directed otherwise by the Engineer, new pavement in a previously paved area shall have the same plan dimensions and grade as the pavement that existed prior to construction.

C. Patches shall conform to adjacent existing pavement and provide a smooth, continuous surface.

3.02 GRAVEL BASE AND PRIME COAT

A. Provide gravel base under all new AC pavement as shown on the Drawings. Construction of gravel base shall meet the requirements of the Standard Specifications. Crushed surfacing is not anticipated on this project.
B. Apply prime coat to entire surface of gravel base at a rate of 0.28 gal/sf.

3.03 ASPHALT CONCRETE PAVEMENT

A. The construction of asphalt concrete pavement shall conform to the requirements of Standard Specifications. Typical sections shall be as shown on the Drawings. The compacted depth of any one lift will not exceed 3 inches.

B. After placing the new asphalt concrete, seal the meet line with asphalt and cover with clean, dry sand before the asphalt solidifies.

3.04 ASPHALT CONCRETE SURFACE SEALER

A. Asphalt concrete surface sealer is not required.

END OF SECTION
SECTION 02775

CONCRETE CURBS, SIDEWALKS AND CATCH BASINS

PART 1 - GENERAL

1.01 SUMMARY
   A. Section includes: Provide sidewalks and catch basins as shown on the Drawings and as specified herein.

1.02 REFERENCE SPECIFICATIONS
   A. Wherever the words "Standard Specifications" are referred to, the reference is to the Standard Specifications for Public Works Construction, Washoe Co., et al.

1.03 SUBMITTALS
   A. Submit in accordance with Section 01300.
   B. Submit certificate of compliance indicating that the concrete complies with the specifications.

PART 2 - PRODUCTS

2.01 CONCRETE
   A. Comply with the Standard Details for Public Works Construction Details W-17 (Type 1 P.C.C. Median Curb) and W-16.2 (P.C.C. Sidewalk) for Washoe County.

2.02 PRECAST CATCH BASINS
   A. Comply with City of Reno catch basin type 3-R, Drawing No. R-205.

PART 3 - EXECUTION

3.01 INSTALLATION
   A. Curb: Shall be as shown on the Drawings and comply with the Standard Detail for Public Works Construction, Washoe Co. No. W-17.
   B. Sidewalks: Shall be as shown on the Drawings and comply with the Standard Detail for Public Works Construction, Washoe Co. No. W-16.2.
   C. Catch Basins: Shall be located where shown on the Drawings and shall comply with the Standard Specifications.
C. Structures in the sidewalk such as valve boxes, manhole frames and covers, electrical vaults, valve vaults, etc. shall be installed at grade so that the finished grade of the sidewalk will be flush with the tops of these structures.

END OF SECTION
SECTION 02820
FENCING AND GATES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Furnishing and installing chain link fence, barbed wire, gates, gate operators, and appurtenances as shown on the Drawings and specified herein.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. A53 Specification for Pipe, Black Steel and Hot-Dipped, Zinc-Coated, Welded, and Seamless
   2. A121 Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
   3. A123 Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products
   4. A153 Specification for Zinc Coating (Hot-Dipped) on Iron and Steel Hardware
   5. A702 Specification for Steel Fence Posts and Assemblies


C. Underwriters Laboratories
   1. UL325 Standard for Door, Drapery, Gate, Louver and Window Operators and Systems,
   2. UL 991 Tests for Safety-Related Controls Employing Solid-State Devices

1.03 SUBMITTALS

A. Submit Product Data for review, including catalog cuts of the fence, gate, and appurtenances.

B. Submit sufficient information to show conformance with the requirements of this specification and the referenced Standard Specifications. This information shall include, but not be limited to, the following:
   1. Dimensions and weights of all fence posts, gate posts, rails, truss rods, and gate frame.
   2. Dimensional cross-sections of posts and rails.
   3. Typical arrangement drawings showing fence, barbed wire, gatepost lengths, and post spacing.
   4. Materials and coatings.
   6. Applicable ASTM standards.
   7. Applicable Underwriters Laboratories standards
PART 2 - PRODUCTS

2.01 FABRIC

A. Chain link fence fabric shall be 6 feet in height and shall conform to the Drawings. Fabric shall have a knuckled finish on top and bottom selvages.

B. Chain link fabric shall conform to the requirements in AASHTO Designation: M 181 for Type I zinc coated fabric with a Class C coating. The wire used in the manufacture of the fabric shall be 11-gage for fence 2.1 m or less in height and shall be 9-gage for fence over 2.1 m in height. Chain link fabric shall be 9-gauge wire with 6-gauge vinyl coating to match existing fence fabric.

C. Chain link fence fabric shall be woven into approximately 50-mm mesh such that there shall be at least 6 meshes in a vertical dimension of 0.5 m along the diagonals of the openings. Chain link fence fabric shall have knuckled finish on top and bottom edges.

2.02 LINE POSTS AND FITTINGS

A. Fence posts, braces, and top rails shall be Schedule 40 galvanized steel pipe in accordance with ASTM A53. Line posts shall be 2 inches in diameter. Corner and end posts shall be 2-1/2 inches in diameter. Gateposts shall be a minimum of 6 inches in diameter. Braces and top rails shall be 1-1/4 inches in diameter. Posts shall have galvanized caps to exclude moisture. Truss rods shall be 3/8 inch diameter galvanized steel.

B. Between posts, chain link fabric shall be fastened to a top and bottom tension wire. The tension wire shall be at least 7-gage (4.50-mm dia.) coil spring steel of good commercial quality and shall be galvanized in conformance with the requirements in ASTM Designation: A 116, Coating Class 3.

C. Tie wires and hog rings shall be at least 9-gage (3.76-mm dia.) steel and post clips shall be at least 6-gage (4.88-mm dia.) steel; all tie wires, hog rings and post clips shall be galvanized in conformance with the requirements in ASTM Designation: A 116, Coating Class 3.

D. Turnbuckles and truss tighteners shall be fabricated of commercial quality steel, malleable iron or wrought iron and shall be galvanized as provided in Section 75-1.05, "Galvanizing." The truss tighteners shall have a strap thickness of not less than 6 mm.

2.03 BARBED WIRE

A. The fence shall have outbound extension arms with three strands of barbed wire.

B. Barbed wire shall conform to ASTM A121, Class 3, 12-1/2 gauge wire with 4-point round barbs.
2.04 CONCRETE FOUNDATIONS

A. Concrete foundations for fence posts shall be as shown on the Drawings and shall conform to Section 03300 of these specifications and shall contain not less than 275 kg of cement per cubic meter.

2.05 GATE

A. General: Gates shall be installed in the sizes and at the locations as shown on the Drawings.

B. Unless shown otherwise on the Drawings, gates in chain link fences shall be of the same height as the adjacent fence. Fabric shall be the same as the fabric used for the fence. Gate frames shall be of all welded construction and shall be hot-dip galvanized after construction. Top and bottom horizontal rails and vertical end members shall be 1-7/8-inch diameter Schedule 40 steel pipe. On gates more than 8 feet wide, equally spaced interior vertical members of 1-7/8-inch-diameter Schedule 40 steel pipe shall be added such that no gate frame panel will be more than 8 feet wide. Gate frames shall have 3 strands of barbed wire across the top. Gates shall be furnished complete with all necessary hardware, including latches and stops.

1. Rolling Gates: All gate frames shall have 1-inch Schedule 40 steel pipe diagonal braces inside each gate panel. Diagonal braces shall be installed such that the high end of the braces shall be toward the forward end of the gate as the gate rolls closed (i.e., high end of the braces toward the end of the gate that rolls on the ground and low end of the braces toward the end of the gate that is supported on the adjacent stationary fence). Gates shall have two wheels that travel on two 1-5/8-inch diameter Schedule 40 galvanized steel pipe rails attached to the adjacent stationary fence. These rails shall have stops to prevent the gate wheels from rolling off the back end of the rails when the gate is fully opened. The opposite end of the gate shall have a rubber wheel on grade and a grooved wheel that travels on a 2-inch by 2-inch steel angle inverted and set in the pavement. A 1-inch by 1-inch galvanized steel angle shall be welded to the back of the gate frame to support the operator drive chain. Coordinate with the gate operator manufacturer.

2.06 GATE OPERATOR

A. Gate operator shall be capable of moving 37’ maximum gate length with a maximum weight of 1000 pounds at a speed of 12 inches per second. It must be designed for high traffic applications.

B. Gate operator motor must be a continuous duty rated motor, rated at 1/2HP, 120 VAC, 4 A, 1625-RPM, with high speed ball bearings. Output shaft shall be 1” diameter cold rolled steel. Motor drive must be solid state.

C. Gate operator must meet the following electrical, controls and mechanical and warranty requirements:

1. Built-in 120 VAG power receptacle (NEMA 5-15).
2. System shuts down and alarms for five minutes when the gate hits an object twice while opening or closing.
3. Alternate inputs for three push button command control, burglar alarm input and output and Quick Close Circuit (QCC).
5. Digital Motor Protection with entrapment sensor that shuts off the motor after it reaches the stall amp for 3 seconds reverses direction for 24 inches and stops.
6. Electronic Inputs for radio receiver, key switch, hold open loop, center loop, telephone entry system, computer input, fire department key switch, and 3-push-button station.
7. ERD Sensor that will initiate gate reversal for 6 inches and stops when the gate hits a vehicle while closing.
8. Adjustable Gate Traveling Time using electrical limit switch.
9. Integrated Traffic Loop Detectors modular inputs for exit loop, center loop, and hold open loop.
10. Intelligent Master/Slave that provides precise, synchronized movement and communication between two gate operators using three wire RS-485 bi-directional technology.
11. Magnetic lock system.
12. Modular Board utilizing LEDs to indicate all input and output functions of the gate operator.
13. Motor Drive Solid state electronic motor drive system incorporated into the board.
14. Power Input controls power input to the board with convenient switch.
15. Power Management Board includes electronic power management with over current shutdown and automatic recovery.
16. Soft Stop provides gate travel through the cycle at normal speed and comes to a stop slowly for more accurate gate cycle and integrated time.
17. Spike Suppressors that provide protection for 20,000 Amps and near lightning protection with modular omni surge suppressor. Initial response time: 0.000000000001 seconds.
18. Three Push Button Control On board gate operator control for close, stop and open.
19. Timer with adjustable timer can be set from 0-60 seconds.
20. Chassis Constructed with .25 inch sanded, welded, and gold zinc plated sheet metal.
21. Cover constructed of High density polyethylene plastic and stainless steel for heat and corrosion resistance.
22. Cycles 75 cycles per hour with a 600 pound gate.
23. DC power back up capable of opening or closing gate in the event of power failure. A manual Emergency Release Handle must also be included.
24. Finish of all metallic parts shall be gold zinc plated for rust proof protection.
25. Warranty (5) years.
26. Worm Gear Reduction 30-to-1 worm gear reduction in an oil bath.

D. The Gate operator shall be an Elite SL-3000_UL with DC 1000 power back up or approved equivalent meeting specifications stated above.

2.07 GALVANIZING

A. Hot-dip galvanized all fittings and hardware per ASTM A153. Hot-dip galvanize all frames, and fabrications with a 2.0 ounce per square foot coating, per ASTM A123.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Install chain link fencing and gates at the locations shown on the Drawings. Chain link fabric and barbed wire shall be stretched with mechanical equipment. Tension fence in accordance with manufacturer’s recommendation prior to tying fabric to posts and rails.

B. The area to be fenced shall be uniformly and smoothly finish graded before beginning the fence installation. Fence shall be installed after roadway surfacing has been completed. The finish grade shall not deviate from a straight line by more than 3 inches. Posts shall be long enough to overlap the fabric by 12 inches, and each post shall be fastened to the fabric by a minimum of three tie bands. Set fence to conform to ground profile.

C. Corner and end post assemblies and the panels on each side of all gates shall be as detailed on the Drawings. Line posts shall have top braces and cross truss rods with tumbuckles even though fabric is stretched with mechanical equipment. Top brace shall remain in place after fence is completed.

D. All posts shall be embedded into the ground in concrete footings as shown on the Drawings. The tops of post footings shall be trowel finished to slope away from the posts. Allow concrete footings to cure for seven days before installing fence.

E. Fence fabric shall be securely fastened to the outward side of the posts with the lower edge at the ground level. Fencing and gates shall be properly braced to prevent sagging.

F. Demonstrate that all gates swing smoothly or roll freely without binding or dragging, that all gates are lockable, and that all gate hardware operates properly. Demonstrate that all automatic gate operators function properly.

G. Install gate operator and exit traffic loop per manufacturer’s instructions. Fencing coordinator must coordinate installation and testing with electrical and security management system contractors.

H. Install High Security Key Box on post supporting keyless access controller at gate entrance. Access code will be maintained in security box for emergency access. Knox Box 3200 or approved equivalent.

END OF SECTION
# Division 3

## Concrete

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<td>Reinforcing Steel</td>
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<tr>
<td>03300</td>
<td>Cast-In-Place Concrete</td>
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**Final**

January 2004

037012.10

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PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Reinforcing work, complete as indicated, specified and required.

1.02 REFERENCES

A. American Society for Testing and Materials Standard Specifications:
   1. ASTM A82: Steel wire, plain, for concrete reinforcement.
   2. ASTM A143: Practice for safeguarding against embrittlement of hot-dip galvanized structural steel products and procedure for detecting embrittlement.
   3. ASTM A185: Steel welded wire fabric, plain, for concrete reinforcement.
   5. ASTM A615: Deformed and plain billet - steel bars for concrete reinforcement.
   6. ASTM A706: Low-alloy steel deformed bars for concrete reinforcement.
   7. ASTM A767: Zinc-coated (galvanized) steel bars for concrete reinforcement.

B. American Concrete Institute:
   1. Details and Detailing of Concrete Reinforcement (ACI 315).
   2. Building Code Requirements for Reinforced Concrete (ACI 318).


D. International Conference of Building Officials: Evaluation Reports (ICBO Reports).

E. American Welding Society: D1.4 Structural Welding Code - Reinforcing Steel (AWS D1-4).

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data:
   1. Bar supports and chairs.
   2. Mechanical bar connectors, including ICBO Reports.
   3. Certified mill test results on reinforcement.
   4. Tests on unidentified bars.

C. Shop Drawings:
   2. Bar bending diagrams.
3. Assembly diagrams, including bar lap and splice locations and mechanical connector layout.
4. Accessories and inserts layout.
5. Bar supports and chairs layout.

1.04 QUALITY ASSURANCE

A. Material Tests: Not required for bars, wire fabric rolls or sheets delivered in bundles from the mill and tagged with valid Identification Certificate.
   1. Unidentified Bars: Test samples from each five tons or fraction thereof for each size. If already delivered to site, test additional samples from each day of planned concrete placement. Perform one tension and one bend test from each sample for each size.
   2. Test standard: ASTM A615.
   3. Testing Laboratory: Selected by Engineer, to take samples and perform tests. Costs paid by Contractor.

B. Standard: CRSI Manual, except as otherwise indicated or specified.

1.05 DELIVERY, STORAGE AND HANDLING

A. Bundle reinforcement and tag with suitable identification to simplify sorting and placing. Transport and store at site so material is not damaged. Store reinforcement off ground, place under cover and keep clean. Store welded fabric in flat sheets, not rolls. Keep an adequate supply of reinforcement at site to avoid delays.

PART 2 - PRODUCTS

2.01 REINFORCING BARS

A. General: Deformed bars, ASTM A615, Grade 60.

B. Low-Alloy: Deformed bars, ASTM A706, Grade 60, where welded bars are shown on the Drawings or allowed by the Engineer.

C. Dowels:
   1. Deformed bars: ASTM A615, Grade 60.
   2. Smooth bars: ASTM A615, Grade 60.
   3. Threaded bars: ASTM A572, Grade 50.

D. Spiral Reinforcement: Cold-drawn steel wire, plain, ASTM A82.

2.02 WELDED WIRE FABRIC

A. Smooth Wire: ASTM A185; sheets.
2.03 TIE WIRE
A. Annealed steel, 16-gauge minimum.

2.04 MECHANICAL CONNECTORS
A. Type: Tension-compression.
B. Strength: Develop 125% of the reinforcing yield strength in tension and compression.
C. Manufacturer:
   2. Tension-only: Quick-Wedge by Erico Products, Inc., or equal.

2.05 SUPPORTS AND ACCESSORIES
A. Conform to CRSI Manual Chapter 3, for Types SB, BB, BC, JC, HC, CHC, and others of standard types as required.
B. Use Class "1" plastic-coated chairs and spacers at waterbearing surfaces, roofs of waterbearing structures, and at all interior or exterior surfaces exposed to view or weather in the completed structure.
C. Use precast concrete block supports with embedded wire ties or dowels for placement on grade or on membranes. Cast the blocks with concrete equal in strength, cement type and aggregate to the parent concrete.
D. Do not use aluminum or stainless steel supports or accessories.

2.06 FABRICATION
A. General: CRSI Manual Chapters 6 and 7, including tolerances.
B. Splice, development and embedment lengths: Furnish bars with lap lengths equivalent to ACI 318, Section 12, Class B splices for the specified concrete strength, bar size and location, unless noted otherwise.
C. Bending and Forming: Fabricate bars of indicated size and accurately form to shapes and lengths indicated and required. Fabricate by methods not injurious to materials. Do not heat reinforcement for bending. Reject bars with kinks or bends not scheduled.
D. Concrete Cover: Detail and fabricate the reinforcement to provide specified cover to outer edge of rebars and other installed items.
E. Dowels:
1. Provide deformed reinforcing bar dowels at all construction joints, unless noted otherwise.
2. Provide smooth or threaded dowels where specified.
3. Provide same dowel size and spacing as the reinforcing to which they are spliced, unless noted otherwise.

2.07 SOURCE QUALITY CONTROL

A. Verify bend tolerances are not exceeded.

B. Verify bar end cuts are within tolerance when mechanical connectors are to be used.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: CRSI Manual Chapter 8 including placement tolerances. No reduction of concrete cover is allowable for bars at concrete surfaces exposed in liquid or water-containing structures.

1. Cleaning: Before placing reinforcing, and again before concrete is placed, clean reinforcement of loose mill scale, dried concrete, oil, or other coating that might destroy or reduce bond. Do not allow form coatings, release agents, bond breaker, or curing compound to contact reinforcement.

2. Concrete coverage: For tanks and other water-containing concrete structures, provide coverage to the outer edge of ties, stirrups, bar spacers, hangers, and like items.

3. Securing in place: Accurately place reinforcement and securely wire tie in position, at an adequate number of points, where bars cross so as to prevent displacement. Tie stirrups to bars at both top and bottom. Bend ends of tie wire inward allowing no encroachment into the concrete cover.


5. Field bending: Not permitted, except where specifically shown, or approved.

6. Bar spacing: Between parallel bars, no less than 1-1/2 times the maximum aggregate size and in no case less than 1-1/2 inches. At splices, bundle and wire together bars to accomplish this.


8. Welding of reinforcing: Proceed after continuous inspection has been authorized. Welding procedure: Satisfy AWS D1.4.

3.02 FIELD QUALITY CONTROL

A. Inspect all reinforcement installations. Provide 48 hours' notice for inspection before concrete placement.

B. Verify placement tolerances are not exceeded.
C. Mechanical Connectors: Install favorably reviewed products, following the Manufacturer's recommendations, under continuous inspection.

D. Welding Reinforcement: Perform only when approved and only under continuous inspection. Notify the Engineer at least 48 hours in advance of any procedure involving welding.

END OF SECTION
SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. All cast-in-place concrete including bases for mechanical and electrical equipment, sidewalks and walkways, and all manholes not specified to be precast.
   2. Concrete shoring, formwork, patching, grouting, sealants and crack repair.
   3. Concrete curing.

B. Related Sections:
   1. Section 03200: Reinforcing Steel
   2. Section 03350: Concrete Finishes
   3. Section 07900: Joint Sealants

1.02 REFERENCES

A. American Concrete Institute (ACI):
   ACI 117 Standard Tolerances for Concrete Construction and Materials
   ACI 301 Specifications for Structural Concrete for Buildings
   ACI 347 Guide to Formwork for Concrete
   ACI 350 Environmental Engineering Concrete Structures

B. American Society for Testing and Materials (ASTM) Standard Specification or Test Method:
   ASTM C31 Making and Curing Concrete Test Specimens in the Field
   ASTM C33 Concrete Aggregates
   ASTM C39 Compressive Strength of Cylindrical Concrete Specimens
   ASTM C40 Organic Impurities in Fine Aggregates for Concrete
   ASTM C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
   ASTM C87 Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
   ASTM C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
   ASTM C94 Ready-Mixed Concrete
   ASTM C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
   ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
   ASTM C142 Clay Lumps and Friable Particles in Aggregates
   ASTM C143 Slump of Hydraulic-Cement Concrete
   ASTM C150 Portland Cement
   ASTM C156 Water Retention by Concrete Curing Materials
   ASTM C157 Length Change of Hardened Hydraulic-Cement Mortar and Concrete
   ASTM C171 Sheet Materials for Curing Concrete
   ASTM C172 Sampling Freshly Mixed Concrete
C. Corps of Engineers (COE) Specifications:
   COE CRD-C-572 Polyvinylchloride Waterstop

D. Uniform Building Code (UBC)

   1.03 SUBMITTALS

   A. Submit in accordance with Section 01300:

   B. Product Data:

   1. Concrete mix product certification: Submit certified laboratory test results that
      the mix proportions and materials comply with these Specifications.
      a. Cementitious materials.
      b. Coarse and fine aggregates.
      c. Admixtures.
      d. Water.
      e. Ready-mix plant certification.
      f. Mix designs.
      g. Mix test results.

   2. Formwork products:
      a. Forms, if fabricated off construction site.
      b. Form ties or through-bolts.
      c. Form coatings.
      d. Waterstop, including waterstop joints.
3. Miscellaneous products: Submit technical data including installation instructions, independent laboratory test reports (ICBO), and handling and storage instructions.
   a. Curing materials and curing program.
   b. Joint fillers.
   c. Sealants.
   d. Epoxy compounds, including adhesives and grouts.
   e. Non-shrink grouts.
   f. Methods and materials for concrete repairs.

C. Shop Drawings:
   1. Construction joint layout, including waterstop placement.
   2. Sequence of concrete wall and slab pours.

D. Samples: Submit any item of Product Data not fully assembled by a single Manufacturer.

1.04 QUALITY ASSURANCE

A. Contractor Qualifications: 10 years of experience on similar water containment facilities.

B. Construction Standard: Applicable requirements of the UBC, ACI 301, and recommendations of ACI 350.

C. Concrete Products and Materials Tests: Certified by independent commercial testing laboratories. Submit certification on cementitious products and aggregates performed within the past 6 months.

D. Concrete Mix Designs: By an independent commercial testing laboratory, complying with ASTM C1077 and favorably reviewed by the Engineer. Concrete mix design proportions shall be established on the basis of field experience and trial mixtures with the materials to be employed in accordance with UBC Section 1905.

E. Concrete Mix Test Results:
   1. Submit result statistics of satisfactory mix designs if available from prior projects. Comply with UBC Section 1905.3.
   2. Submit test results of trial batches prepared for this project. Comply with UBC Section 1905.3.
   3. Allow adequate time for review of submittals and adjustments to comply with the Specifications.

F. Preconstruction Meeting:
   1. Attend meeting with Owner and Engineer, bringing representatives of concrete supply, pumping, placement and finishing subcontractors plus testing laboratories.
   2. Review preliminary concrete placing plans for walls and slabs, prior to the product submittals, to establish agreement on the requirements.
   3. Meeting agenda includes:
a. Mix design.
b. Placing methods.
c. Construction joint layout.
d. Sequence of and intervals between concrete placements.
e. Finishes required.
f. Curing and protection methods.
g. Testing.

4. Resolve any difficulties foreseen by any interested party.

G. Concrete Tests, as Placed: Performed by an Independent Testing Laboratory provided by the Contractor and favorably reviewed by the Engineer:

1. Test frequency: Each mix type placed, each day placed.
2. Concrete sample: ASTM C172. Provide all material required.
3. Compressive strength: A set of four standard 6 inch x 12 inch concrete cylinders will be cast for each 100 cubic yards or fraction thereof.
   a. Making, storing and initial cure of cylinders: ASTM C31. Provide site storage and initial cure, 16 hours minimum and 24 hours maximum.
   b. Testing laboratory: Provided by Owner.
   c. Final cure and tests of cylinders: ASTM C39. Testing laboratory will transport cylinders from site, cure, test and provide report. Test two cylinders at age of 7 days, two at 28 days.
4. Slump: Test will be performed on each 50 cubic yards or fraction thereof. Test each sample used for strength tests.
   b. Results outside the limits indicate possible cause for rejection of concrete. The Engineer shall be the sole judge.
5. Air content: Test will be performed on concrete samples used for strength tests. Furnish calibrated equipment required to perform the test.

H. Additional Tests:

1. General: Provide and pay for additional material and strength tests on new specimens, when test results fail to meet the specified requirements. Strength tests shall be considered satisfactory if the requirements of UBC Section 1905.6.2.3 are satisfied. If in the opinion of the Engineer, results of tests on concrete cylinders indicate the possibility of substandard concrete in the structure, cored samples may be required to be taken from the concrete.
2. Coring and testing: ASTM C42. The Engineer will investigate low-strength test results in accordance with the requirements of UBC Section 1905.6.4.; however, the requirements of Section 1905.6.4.4 are not applicable. If, in the opinion of the Engineer, the results of the core tests indicate that concrete has been placed which does not meet this specification, the Owner may require defective concrete strengthened by means of additional concrete, reinforcing steel or replacement of the defective concrete at no additional cost to the Owner.
3. The Owner will pay costs of additional tests if the concrete is accepted by the Engineer.
1.05 DELIVERY, STORAGE AND HANDLING

A. Cementitious Materials: If required at site, store immediately after delivery in a dry, weather-tight, properly ventilated structure, with adequate provisions for prevention of moisture absorption and overheating of the cement.

B. Aggregates: If required at site, store in piles which afford good drainage and which are protected to prevent the inclusion of foreign material. Stockpile the various sizes or gradations of aggregates separately.

C. Lumber: Store all lumber, including plywood for forms, to prevent direct contact with the ground. Protect the stored lumber from the elements by a suitable covering, such as polyethylene film or waterproof building paper, suitably held in place.

D. Waterstop: Reject any cracked material, any joints with offsets between ribs or incomplete bond. Protect material from oil, grease and dirt and cover against direct sunlight.

PART 2 - PRODUCTS

2.01 GENERAL

A. Obtain materials from an established and experienced manufacturer or supplier. Provide new materials of first-class ingredients guaranteed to perform the service required.

2.02 CONCRETE MATERIALS

A. Cementitious Materials:
   1. General: Use only one brand of each cementitious material. The color shall not significantly alter the typical grey concrete color.
   2. Portland Cement: ASTM C150, Type V. Comply with the requirements for low alkali cement in Table 2.
   3. Pozzolan: ASTM 618, Mineral Admixture Class N.
   5. Flyash: ASTM C618, Class F, with the following restrictions:
      a. Loss on Ignition: 4% maximum
      b. SO\textsubscript{3} Content: 3% maximum
      c. Moisture Content: 1% maximum

B. Concrete Aggregates:
   1. General: ASTM C33:
      a. Provide free from organic materials, waste products, clay balls, shale, and mica and thoroughly washed before use.
      b. Provide 1-1/2-inch maximum size for all concrete on the project. For thin sections, such as slabs or walls 10 inches thick or less, or for sections that require special placement due to shape, form or congestion of reinforcing, provide 1-inch maximum size.
c. Provide aggregates that do not deleteriously react with the alkalies in the cement.
e. Reactivity: ASTM C289. Submit graphical data showing compliance.

2. Coarse Aggregates:
a. Provide clean, hard, durable gravel, crushed gravel, crushed rock, or combinations.
b. Deleterious substances: Submit compliance with ASTM C33, Table 3 and as follows:
   1) Clay lumps and friable particles: ASTM C142. Not more than 5%.
   2) Abrasion: ASTM C131. Not more than 45%.
   3) Soundness: ASTM C88. Not more than 10%.
c. Do not use aggregate containing more than 10% of inferior materials, flat or elongated particles, cracked or laminated rock, or rock that can be readily broken after immersion in water for one hour.

3. Fine Aggregate:
a. Provide natural sand or a combination of natural and manufactured sand, of siliceous, granitic or igneous origin, hard and durable.
b. Deleterious substances: Submit compliance with ASTM C33 Table 1 and as follows:
   1) Organic impurities: ASTM C40 and C87. Not less than 95% relative strength by ASTM C87.
   2) Sand equivalent: ASTM D2419.

c. Combined Aggregates: Provide a mixture of fine aggregate and coarse aggregate uniformly graded between the screen sizes specified below:

<table>
<thead>
<tr>
<th>Percentage Passing</th>
<th>Sieve Size</th>
<th>1-1/2-Inch Maximum</th>
<th>1-inch Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>90-100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>50-96</td>
<td>90-100</td>
<td></td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>45-80</td>
<td>55-100</td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>38-55</td>
<td>45-75</td>
<td></td>
</tr>
<tr>
<td>No. 4</td>
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<td>35-60</td>
<td></td>
</tr>
<tr>
<td>No. 8</td>
<td>23-38</td>
<td>27-45</td>
<td></td>
</tr>
<tr>
<td>No. 16</td>
<td>17-33</td>
<td>20-35</td>
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</tr>
<tr>
<td>No. 30</td>
<td>10-22</td>
<td>12-25</td>
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</tr>
<tr>
<td>No. 50</td>
<td>3-10</td>
<td>3-15</td>
<td></td>
</tr>
<tr>
<td>No. 100</td>
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<td>0-5</td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td>0-2</td>
<td>0-2</td>
<td></td>
</tr>
</tbody>
</table>

2.03 WATER

A. Provide water for washing aggregates, for mixing concrete, for patching grout and for curing that is free from oil and contains not more than 1,000 parts per million (ppm) of chlorides as Cl, nor more than 1,300 ppm of sulfates as SO₄. Do not allow
impurities that will cause a change in the setting time of the portland cement of more than 25%, nor a reduction in the compressive strength of mortar at 14 days of more than 5%, when compared to the results obtained with distilled water.

B. Do not allow impurities that cause discoloration of the concrete or produce etching of the surface.

C. The Engineer may require tests of the water should there be a question of the quality. Costs of such tests would be borne by the Owner.

2.04 ADMIXTURES

A. Air Entraining: ASTM C260.

B. Accelerating: ASTM C494, Type C or E.

C. Retarding: ASTM C494, Type D.

D. Water Reducing: ASTM C494, Type A.

E. High Range Water Reducing: ASTM C494, Types F or G, second or third generation type. Add at the batch plant, after all other ingredients have been mixed and initial slump has been verified.

F. Shrinkage Reducing: Eclipse by W.R. Grace, Tetrugard AS20 by Master Builders, or equal.

G. Corrosion Inhibition and Permeability Reduction (Silica Fume): Force 10,000 or 10,000D (dry) by W.R Grace, Rheomac SF 100 (dry) or 110 by Master Builders, or equal.

H. Controlled Low Strength Material (CLSM) Admixture: DaraFill by W.R.Grace, Rheocell by Master Builders, or equal.

I. When two or more admixtures are used, they must be added to the mix separately (through dispensers or manually) and must not be mixed with each other prior to adding to the concrete mix. Add admixtures to concrete mix ingredients in liquid form by a special dispensing unit, approved by the manufacturer of the admixture as suitable for accurately dispensing the admixture. Install an alarm or indicator, which will immediately inform the batch plant operator if the dispensing unit malfunctions. Dispense admixtures uniformly into the mixing water as it is added to the concrete batch.

J. No admixture containing any chloride ions is acceptable.


2.05 CONCRETE MIX DESIGN

A. General:
1. Employ an independent commercial testing laboratory complying with ASTM C1077 and favorably reviewed by the Engineer to design all concrete mixes and carry out all necessary testing. Concrete mix design proportions shall be established on the basis of field experience and trial mixtures with the materials to be employed in accordance with UBC Section 1905.3.

2. If the testing laboratory has satisfactory mix designs available from prior projects, submit test record statistics to demonstrate compliance with the requirements of this Section and UBC Section 1905.3. Include calculations for f'cr based on source quality test records.

3. If new mix designs are required, prepare a range of trial batches for each design and submit the mixes that demonstrate satisfactory test results in accordance with UBC Section 1905.3.

4. Allow for the variability of concrete strength from test to test by increasing the required average compressive strength over the specified strength as specified in UBC Section 1905.3.

5. Design the mixes far enough ahead of concrete placement to allow completion of trial batch testing and submittal of the test results and mix design to the Engineer for review.

6. Take sole responsibility for selection of laboratory, submittal of materials to laboratory in time for all tests, and overall timing of all aspects of testing program, including submittals.

7. Prepare mix designs for concrete placement by the batch process and/or by pumping, as required, and state the process on the design submittal.

8. Allow for the hot or cold weather and the time required to transport the concrete from the mixer to the site and to place within the forms. If accelerating or retarding admixtures will be required for only a proportion of the concrete placements, submit test results that include the full range of options.

9. Do not exceed the water-cementitious material ratios. Vary the water-reducing admixtures to accomplish an increase in slump or workability time.

10. Proportion cementitious materials, aggregates, and water by weight.

11. Check periodically the weight of moisture contained within the stockpiled aggregates. Compensate for this water when proportioning the concrete mix and adjust when change occurs.

12. Do not use chlorides in any concrete mix.

B. Mix Proportions: Unless indicated otherwise on the Drawings, concrete shall be of the following types, each meeting the mix and compressive strength requirements as specified hereafter, and shall generally be used as follows:

1. Type "B": Environmental structures where wastewater will be in contact with the concrete including the Headworks Structure, Oxidation Ditch, Secondary Clarifier and flow control structures and manholes.

2. Type "D": Building concrete including slabs on grade, wall footings and pipeline encasements for the Operations Building and the Solids Processing Building.

3. Type "E": Concrete for pipeline thrust blocks, concrete for equipment pads, and all miscellaneous site work concrete including sidewalks, curbs, gutters, etc.
### Concrete Type

<table>
<thead>
<tr>
<th>Concrete Type</th>
<th>B</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specified 28-Day Compressive Strength (lb/in²)</td>
<td>4,500</td>
<td>4,500</td>
<td>3,000</td>
</tr>
<tr>
<td>Maximum Coarse Aggregate Size (in)</td>
<td>1-1/2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Air Content at Point of Placement (%)</td>
<td>5-1/2</td>
<td>4-1/2</td>
<td>1</td>
</tr>
<tr>
<td>Maximum Water-Cementitious Material Ratio</td>
<td>0.40</td>
<td>0.45</td>
<td>0.55</td>
</tr>
<tr>
<td>Minimum Cementitious Material Content (lb/yd³)</td>
<td>590</td>
<td>570</td>
<td>510</td>
</tr>
<tr>
<td>Maximum 28-Day Drying Shrinkage (%)</td>
<td>0.05</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

C. Cementitious Material: Either portland cement, cement with fly ash, cement with natural Pozzolan, or blended cement.

D. Pozzolan or Flyash: Optional. Not less than 10%, nor more than 20% of the weight of the cementitious materials. Do not use pozzolan or flyash as an admixture in concrete made with portland-pozzolan cement.

E. Mix Test Requirements:
   1. Compression: ASTM C192 for cylinder preparation. ASTM C39 for cylinder tests. Perform three tests after 7 days and three more after 28 days curing.
   2. Shrinkage: The mix tests requirements shall be in accordance with ASTM C157, except as described below. NOTE: the following requirements differ from ASTM C157 and must be strictly followed in order to obtain favorable review for a concrete mix design. One set of three test specimens shall be prepared.
      a. Moist curing: Specimens shall be removed from molds at 23±1 hours after batching and shall be placed in water for at least 30 minutes and shall be measured within 30 minutes to determine original length. Specimens shall be submerged in saturated lime water until 7 days after batching.
      b. Measurements: Measurements to determine shrinkage shall be made after 7, 14, 21, and 28 days of drying after 7 days of moist curing. Compare to the preliminary measurement made after 1 day and the basic measurement made after 7 days curing, which will be used for calculations.
      c. Test prism size: 4x4x11 inches.
      d. Report all test results, with the 28-day tests results governing acceptance. Plot the results at other time intervals as a test of validity of the readings.
   3. Slump: ASTM C143. Slump range is 3 to 4 inches. After high-range water reducer added, range is 6 to 9 inches.
   4. Air Content: ASTM C231. Air content range is ±1%.
   5. After favorable review of the mix design, no variations of the constituents are permitted during the project without prior submittal and favorable review.
2.06 READY-MIX CONCRETE

A. Supply concrete for the project using truck mixers and a ready-mix plant certified by the National Ready-Mix Concrete Association. Submit certification.

B. Alternatively, qualify the supplier according to ASTM C94 Sections 8 through 11, inclusive.

2.07 DRY PACK GROUT

A. Very stiff mix grout; one part Portland cement to two parts sand (by weight) and water. Wet the mixture only sufficiently to moisten the materials to the point where they will ball when squeezed by hand.

2.08 CEMENT MORTAR

A. For Repairs and Patching Concrete.

B. One part Portland cement, two parts fine sand (by weight) and water. Use only the amount of water needed to make the mix workable for the intended use.

C. Provide a mixture of white and regular cements as required to make a mortar that after curing 28 days will match the adjacent concrete. Prepare several trial batches and make test samples in an inconspicuous location for review.

D. When a mix has been selected for color match, batch all mortar by weight in accordance with the formula for the selected mix.

2.09 NON-SHRINK GROUT

A. ASTM C1107, Grade C (precision) with no shrinkage as measured by ASTM C827. Furnish a premixed product, consisting of properly proportioned amounts of non-metallic, dimensionally stable material to which water is added.

2.10 SWEPT-IN GROUT

A. As recommended by the equipment manufacturer, but meeting following minimum mix requirement:
   1. Sand: 3 parts by weight, maximum.
   2. Cement: 1 part by weight.
   3. Clean Water: Enough to provide reasonable slump for ease of distribution of the grout by the equipment during screening.

B. Sand Gradation: 100% passing a 20-mesh sieve and not more than 30% retained on a 30-mesh sieve.
2.11 EPOXY BONDING SYSTEM

A. General: ASTM C881:
   1. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete.
   2. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces.
   3. Provide Class A if placement temperature is below 40°F; Class B if placement temperature is between 40 and 60°F; or Class C if placement temperature is above 60°F.

B. Products: Sikadur Epoxy adhesives manufactured by the Sika Chemical Corporation; Concresive compounds manufactured by Master Builders, Inc., or equal.

C. For bonding new to pre-existing concrete, provide Sika Armatec 110, or equal. Specifier knows of no equal.

2.12 PREFORMED JOINT FILLER

A. Structures Retaining Water or Earth: ASTM D1056, Type 2, Class C, Grade 5. Neoprene sponge rubber, closed cell, resistant to oil, medium swell, firm. Supply premolded product, Rubatex R-8409-S or R-8407-S, manufactured by Rubatex Corporation; or equal.

B. Miscellaneous Structures Above Grade: ASTM D1752. Supply Bondex 941 by Rubatex Corporation; or equal.

2.13 SEALANT

A. General: ASTM C920, of type, grade and class appropriate for use.

B. Water Exposure: Sikaflex-1a, by Sika Corp., Select Seal U-227 reservoir grade by Select Products Corp., or equal.

C. Exterior Exposure: Sikaflex-2c, by Sika Corp., Select Seal U-200 by Select Products Corp., or equal.

D. Prepare surfaces and provide primer and sealants in strict accordance with manufacturer's recommendations.

E. Backing Rod: Extruded, closed cell, polyethylene foam rod, compatible with sealant. Provide 5/8-inch-diameter rod for 1/2-inch joint, 1-1/4-inch rod for 1-inch joint.

F. Bond Breaker Tape: Resilient, non-staining, 100% vulcanized butyl rubber, scrim reinforced, self-adhering, extruded sealant tape containing no asphalts.
2.14 CURING MATERIALS

A. Cure by fog spray or by one of the following methods after discontinuance of the fog spray. Slabs shall be continuously wet cured with sheet materials or wet blankets after discontinuance of the fog spray; liquid curing compound alone is insufficient.

B. Liquid Curing Compound: A water-based membrane-forming resin suitable for exterior or interior use as a curing and hardening compound on freshly placed concrete.
   1. Provide an emulsion of synthetic resinous solids dispersed in water containing no waxes, paraffin's or oils. Provide the fugitive type that will oxidize and disintegrate completely within 60 days when exposed to sunlight in exterior applications or that can be removed by washing with dilute muriatic acid or TSP in interior applications.
   2. Water retention requirements: ASTM C309, Type I or II, Class B, when tested in accordance with ASTM C156.
   3. Use white pigmented material for exterior applications and clear material for interior applications.
   4. Comply with the applicable local air quality district.
   5. Exterior surfaces: Aqua Resin Cure-White by Burke; 1200-White by W.R. Meadows; or equal.
   6. Interior surfaces: Spartan-Cote by Burke; Vocomp 20 by W.R. Meadows; or equal.

   1. Plastic sheeting: fungus-resistant, minimum 4 mil thick, clear and free of defects, having ASTM E96 perm rating of not more than 0.5.
   2. Waterproof paper: Two layers of non-staining kraft paper laminated with latex adhesive and reinforced with glass in both directions. Seal joints with 2-inch-wide tape with water resistant adhesive.

D. Wet Blankets: Clean cotton mats (burlap is unacceptable). Provide material free from any substance that will have a deleterious effect on the concrete. Use a thickness sufficient to retain moisture between programmed applications of water.

E. Evaporation Retardant: Eucoabar by the Euclid Chemical Company; E-CON by L&M Construction Chemicals, Inc.; or equal.

2.15 FORMS

A. Provide forms for exposed concrete surfaces with a clean, smooth plywood or metal face. Exposed concrete surfaces include beams, columns, slabs, interior and exterior walls, and surfaces of tank, chamber and tunnel walls except those in contact with earth.

B. Furnish plywood with a waterproof, synthetic resin bonded face manufactured for formwork. Furnish steel forms that incorporate reinforcement, inserts, pipe fittings, box-outs, and other details shown on the Contract Drawings without modification to these details.
C. Alternatively, for circular tank walls, furnish a series of straight panels not more than 2 feet wide, with angle change not more than 3-1/2° per panel.

2.16 FORM TIES

A. Provide commercially manufactured steel rods or through-bolts, not wire, capable of withstanding applied pressures.

B. Furnish ties adjustable in length or of proper fixed length, with no metal closer than 1-1/2 inch to the finished concrete surface. Leave no holes larger than 1-inch-diameter at the surface. Use a plastic cone spacer at each end of the form tie to allow a full 1-1/2-inch breakback.

C. In walls resisting water or earth pressure, provide ties with waterstop washers of diameter 3/4-inch greater than the rod, bonded to rods at the wall centerline, or with other favorably reviewed water seal devices. Alternately, furnish through-bolts with a manufactured neoprene or polyurethane tapered plug to be installed at the wall centerline.

2.17 FORM COATING COMPOUNDS

A. Do not stain or impart any material or residue to the concrete surface detrimental or incompatible with any specified paint or coating system to be applied later, or unacceptable for contact with drinking water.

2.18 WATERSTOPS

A. Polyvinyl Chloride (PVC) Waterstops: Provide for construction or expansion joints in new concrete.
   1. Material: Extruded polyvinylchloride (PVC), manufactured from virgin materials.
   2. Physical properties: COE CRD-C-572.

B. Waterstop Types:
   1. Serrated (Ribbed) Flat: Vinylex R6-38; Greenstreak Style 679.

C. Splices:
   1. Factory-made at all corners and tee, ell and cross intersections.
   2. Tensile Strength: COE CRD-C-572.

D. Provide hog rings and tie wire to rigidly locate waterstops in forms.

E. Manufacturers:
   1. Vinylex Corporation
   3. or equal.

F. Retrofit Waterstops: Includes construction joints or expansion joints where new concrete will be placed adjacent to existing concrete.
1. Thermoplastic Elastomeric Rubber (TPER): Synthetic rubber with high resistance to wide range of oils, solvents and chemicals and not readily soluble in common solvents.
2. Provide factory fabricated waterstop intersections, leaving only straight butt-joint splices for the field. Waterstop intersections and directional changes to be miter cut and heat welded with centerbulb and ribs aligned to maintain continuity. Splices to be free from defects.
3. Provide additional components including high chemical resistant epoxy gel, ½-inch 11-gauge stainless steel batten bars with ¼-inch diameter holes at 6-inches on center, and stainless steel ¼-inch by 1-¾-inch concrete anchor bolts.
4. WESTEC Type TPER, Style No. 629 or 630 Retrofit; Greenstreak Style 609; or equal.

2.19 SOURCE QUALITY CONTROL

A. Forms: Verify that components pre-assembled offsite are satisfactory for the purpose. Verify that designs, products and samples have been submitted for Product Review.

B. Concrete:
1. Verify that ready-mix batch plant delivery tickets contain all product information necessary for acceptance of the concrete delivered to site.
2. Verify that the mixing and trucking equipment have adequate capacity to deliver the concrete batches to site on time, thoroughly mixed and discharge without segregation.

PART 3 - EXECUTION

3.01 PROPORTIONING CONCRETE MATERIALS

A. Place no concrete prior to favorable review of submittals for reinforcing steel, materials specified in this Section and the mix proposed. Unfavorable results of actual pours may require a redesign of mixes.

B. Make no substitutions to the constituents tested in the design of concrete mixes without favorable review of the revised mix and the new test results.

3.02 BATCHING AND MIXING CONCRETE MATERIALS

A. Ready or Transit Mixed Concrete:
1. Deliver completely mixed to the project site.
2. Do not add mixing water during hauling. Add water after delivery only when agreed by the Engineer. Should water be added, revolve the mixing drum not less than 30 revolutions at mixing speed after adding and before commencing discharge.
3. Deliver each load at the job site accompanied by a ticket showing mix design number, volume of concrete, the weight of cement in pounds and the total weight of each ingredient in pounds. Also show the time at which the materials were batched and the reading of the revolution counter at the time the truck mixer was charged.
4. No retempering of partially hardened material is permitted. Do not use partially hardened concrete in the work.

B. Batching in Adverse Weather:
1. Cold Weather: When the atmospheric temperature is below 40°F, or is likely to fall below 40°F during the 24-hour period after placing, heat the materials before mixing, so that the temperature of the mix when deposited shall be between 65° and 80°F. Do not heat the mixing water or the cement over 160°F. Remove lumps of frozen material and ice from the aggregates before they are placed in the mixer.
2. Hot Weather: When temperatures are above 90°F, reduce the temperature of the concrete mix by using iced mixing water, and protecting aggregates and cement from direct rays of the sun. Do not place concrete exceeding 80°F.
3. Should the provisions noted in 1. and 2. above not be possible or practicable, postpone the batching until favorable weather conditions prevail.

3.03 FORMS

A. General:
1. Take responsibility for adequacy of the form, bracing, and shoring. Satisfy ACI 347.
2. Form all concrete unless specified otherwise.
3. Construct forms confirming to the shape, line and grade specified.
4. Provide tight seams, or seal with tape, to be mortar-tight.
5. Brace and shore all forms properly to ensure stability against pressure from any source, without failure of any component part.
6. Keep the deflection of wall or slab form sheathing or framing for beams within 1/270 of the span. Consider camber in designing the supports of beams and slabs.
7. If inadequate support is provided by the forms, remove all placed concrete and replace, as directed.
8. Provide for temporary openings for cleaning out, observation, pouring and vibration of concrete.
9. If the concrete mix design includes a high-range water reducing additive, design the forms with enough strength to resist the high liquid concrete pressure without distortion.

B. Chamfers: 3/4-inch at all exposed outside corners, including the top edges of all walls, machinery bases and curbs. Use mill run chamfer strips surfaced all sides. Provide rounded top edges of sidewalks, walkways and where directed.

C. Formed Surfaces:
1. Ensure that the reinforcement has been favorably reviewed before closing up the wall forms.
2. Provide exposed, unpainted concrete surfaces that are uniform in appearance and color. Apply non-staining mineral oil, form coating or form release compound before placing the forms. Remove any excess coating with cloths. Scrape and clean any reused forms before coating again.
3. Provide flush fitting caps over any unused form tie holes.
4. Do not use mineral oil on formed surfaces that are to be painted, coated, or bonded to other concrete.

D. Form Ties and Through-Bolts:
1. Provide sufficient number and strength to prevent spreading of forms while placing concrete.
2. Remove the removable portion immediately after stripping the forms. Avoid spalling the exposed concrete surfaces.
3. Locate tapered ties, if used, with the larger diameter on the water side of the form.
4. Provide a separate support system for the curtains of reinforcing, with a minimum 1 inch clearance between rebar and form ties or bolts.

E. Construction Joints:
1. At ends of the first concrete pour, provide forms that positively locate any waterstop. Ensure the end forms of walls are removable without releasing the side forms. Provide seals around reinforcement and waterstop to prevent mortar leaks.
2. Overlap the hardened concrete of the first pour with forms for the second pour. Brace the ends of the forms against the hardened concrete to prevent joint offsets and mortar leakage. Align any exterior features required on the finished surface.

3.04 ALLOWABLE VARIATIONS FOR FORMED SURFACES

A. Tolerances: ACI 301 and the relevant subsection of ACI 117 and as noted below:

B. Variations in Size or Thickness:
1. Footings:
   a. Length and width: ..............................................±1/2 inch
   b. Reduction in thickness: ......................................5%
2. Slabs and walls:
   a. Thickness of 6 inches or less: .........................0 inch
   b. Thickness of more than 6 inches: ....................±1/4 inch

C. Allowable Tolerances (Location, Lines and Grades):
1. Horizontal misplacement or eccentricity ..................2% of footing width of footings but not more than 1 inch
2. Variation of horizontal dimensions at all floor levels from specified position: ................................±1/2 inch per 100 foot
3. Variation of vertical dimensions from specified position: .................................................................±1/4 inch
4. Variation from level or from slopes specified for floors, ceilings, water channels and conspicuous lines: ..............................................±1/4 inch per 20 feet
5. Variation in location from specified position for sleeves, pits, floor and wall openings .........................±1/4 inch

D. General: Set and maintain concrete forms to ensure that, after removal of the forms and prior to patching and finishing, no portion of the concrete work will
exceed any of the tolerances. Measure variations in floor levels before removal of supporting shores. Accept responsibility for variations due to deflections resulting from concrete quality or curing other than that specified. The specified variation for one element of the structure will not be applicable when it will permit another element of the structure to exceed its allowable variation.

3.05 REMOVAL OF FORMS

A. General: Comply with the recommendations of ACI Committee 347. Remove without damage to the concrete and with complete safety of the structure. Ensure that the concrete has hardened sufficiently and the members have attained sufficient strength to safely support the imposed loads.

B. Removal Time: Minimum duration after completion of concrete placement:
   1. Walls and wall or slab construction joints ........... 12 hours
   2. Sides of beams and girders.......................... 12 hours
   3. Columns............................................. 12 hours
   4. Underside of suspended one-way slabs, .......... 21 days, and full design walkways, beams and girders compressive strength verified by data from additional field cured cylinders, if removed at less than 28 days.

C. Cold Weather: Engineer may increase the minimum form removal times if the temperature is 50°F or lower.

D. Reshoring: Submit for favorable review, any requirement for accelerated partial stripping and reshoring of forms that may be necessary to maintain the construction program. Removal times for two-way suspended slabs are contingent on reshoring and shall be favorably reviewed by the Engineer.

3.06 REUSE OF FORMS

A. Between concrete placements, inspect all form surfaces and repair to uniform texture for all concrete surfaces to be exposed. Fill all unused holes, cracks and defects.

3.07 PLACING CONCRETE AND GROUT

A. Preliminary Work:
   1. Remove hardened concrete and foreign materials from the inner surface of the mixing and conveying equipment. Remove all debris from the space to be occupied by the concrete.
   2. Remove water from the space to be occupied by the concrete before concrete is deposited. Divert any flow of water into an excavation through proper site drainage to a sump, or by other methods. If required by the Engineer, grout up any water vent pipes and drains after the concrete has thoroughly hardened.
   3. Provide satisfactory redundancy in the delivery system so that work can continue in the event of a breakdown.
4. Do not use aluminum materials in pumping lines, transfer hoppers or chutes longer than 12 feet. Provide conveyor belts instead of chutes when the distance is longer than 50 feet. Use a storage hopper at the start of the line.

5. For pumped concrete, provide a hose with an angle-change, to create a back-pressure at the outlet.

6. Provide illumination if necessary inside the forms, so that the placed concrete will be visible from the deck at top of formwork.

7. Provide thermometer for measuring concrete temperature when weather conditions are predicted to go beyond the range 50°F to 80°F.

B. Embedded Items:
1. Place all equipment, bolts, anchors, sleeves, inserts, structural steel members, angles and similar items which require embedment in the concrete.
2. Hot-dip galvanize all ferrous metal sleeves, inserts, anchors, and other embedded ferrous items unless shown otherwise. Set anchor bolts for equipment in templates, carefully plumbed and checked for location and elevation with an instrument, and held in position rigidly by double nutting to the template to prevent displacement while concrete is being poured.
3. Ensure that any aluminum items inserted in the concrete are isolated by a coating of coal-tar or equivalent.
4. Move reinforcement bars as necessary to avoid interference with other reinforcing steel, conduits, or embedded items, but not so as to impair design strengths of the member. If bars are moved more than two bar diameters, submit the resulting arrangement of bars for review.
5. Inspect the installation of all embedded items and reinforcing.

C. Placing:
1. Transfer the concrete to the place of final deposit as rapidly as practicable by methods that prevent the separation or loss of ingredients. Under no circumstances deposit partially hardened concrete in the work. Deposit concrete in the forms as nearly as practicable in its final position to avoid rehandling. Maintain, until the completion of the pour, a plastic concrete surface, approximately horizontal.
2. Deposit concrete without segregation of the aggregate and without displacement of the reinforcement.
3. Maximum height of free fall for concrete during placement:
   a. Concrete with maximum 4-inch slump: ...................................4 feet
   b. Concrete with high-range water reducing admixture and minimum 6-inch, maximum 9-inch slump: .............................8 feet
4. Deposit concrete continuously or in layers 12 to 20 inches in depth so that no concrete will be deposited on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously as originally planned, locate construction joints during the placement.
5. Use every means to secure a dense, impervious, homogeneous concrete, free from voids or pockets. If honeycomb, air, or rock pockets occur, repair the structure to the complete satisfaction of the Engineer, and modify the placing method or mix design, to prevent recurrence of deficient concrete. Provide such repairs and modifications at no additional cost. Extensive honeycomb or pockets may be cause for rejection of the work.
D. Time Limit: Place all concrete in its final position in slab or forms within 1-1/2 hours of batching. Alternatively, as part of the mix design, provide admixtures that delay the initial set and state the proposed length of time in the submittal.

E. Temperature Limits: Place all concrete in its final position in slab or forms at:
   1. Less than 90°F, measured in the mix.
   2. More than 40°F, measured both in the mix and in the air, with air temperature predicted to rise above 50°F.
   3. More than 50°F, measured in the mix, 40°F measured in the air, with air temperature falling.

Refer to the vibration, concrete joints and curing sections for other requirements.

F. Precast Items:
   1. Items may be cast on or off the site.
   2. Apply all applicable portions of Section 03300, including materials, forms, placement, finish and curing.
   3. Take particular care when handling and placing the precast items. Lift or move after a minimum of 90% of the specified compressive strength has been attained. Use the average compressive strength of two test cylinders.

3.08 VIBRATION

A. Compact the concrete with high frequency, internal mechanical vibrating equipment, and when required, supplement by hand spading and tamping. Consolidate slabs 6 inches or less in depth by hand tampers, spreading and settling with a heavy leveling straightedge.

B. Operate vibrators with vibratory element submerged in the concrete, with frequency between 8,000 and 12,000 impulses per minute when submerged.

C. Furnish sufficient vibrators to complete the compaction as specified without causing delay in the depositing of concrete. Provide at least one spare unit for each structure when concrete is being placed and at least one vibrator for each 25 cubic yards per hour of concrete placement.

D. Vibrate by direct action in the concrete for approximately 10 seconds at approximately 12-inch intervals, not against forms or reinforcements. Do not move concrete horizontally by vibration. Work the concrete around the reinforcement, and around embedded fixtures and into the corners of the forms. Penetrate 6 to 12 inches into previously poured layers as new layers are poured, provided the running vibrator penetrates by its own weight. To secure even and dense surfaces, free from aggregate pockets, honeycomb, or air pockets, supplement vibration when required by forking or spading by hand or hammering the forms lightly opposite the freshly deposited concrete. Revibrate the final layer. Stop vibrating when concrete is thoroughly compacted and has ceased to decrease in volume and give off air bubbles.
E. When placing concrete with 8-inch or more slump, reduce the time of vibration to 5 seconds and follow the admixture manufacturer’s recommendations for technique.

3.09 CONCRETE JOINTS

A. General:
1. Provide joints:
   a. As shown on the Drawings and as noted below in these Specifications.
   b. As required for constructability.
   c. After favorable review of layout, sequence and concrete placement program.
2. Provide minimum curing times before the second placement:
   a. 2 days after the first concrete placement at the joint.
   b. 10 days after each adjacent concrete placement, for infill pours or checkerboard placement pattern.
3. During placement of the new concrete, ensure there are no interruptions to the 14-day curing time and 14-day load restriction plan for the adjacent pours.

B. Control Joints:
1. Space typical control joints in slabs on grade or suspended slabs not exceeding 10 feet, or as shown on the Drawings. Control joints shall not be provided in water containment structures.
2. If cast-in with the concrete, positively locate the preformed joint filler and hold rigidly in place during concreting.
3. If saw-cut, use a wheeled power saw as soon as the concrete surface is firm enough. Saw-cut control joints must be constructed within 12-hours after concrete placement. Fill the groove with sealant over a backer rod.

C. Construction Joints:
1. Produce quality concrete, with full continuity of reinforcing and water tightness across the joints.
2. Space typical slab joints not exceeding 20 feet in the direction of the transverse or secondary reinforcing, typically the smaller reinforcing nearer to the center of the slab thickness. Space typical vertical wall joints no more than 30 feet apart.
3. Provide all joints in walls and slabs retaining liquids or earth with 6-inch waterstops. Continue all reinforcing through the joint unless otherwise noted.
4. After the first concrete placement at the joint, do not walk on or disturb any reinforcing extending into the second placement area for at least 48 hours.
5. Before depositing new concrete on or against concrete that has hardened, clean and roughen the entire surface of the joint exposing clean coarse aggregate solidly embedded in mortar matrix. Provide typically 1/4-inch roughness or amplitude of the concrete surface measured from the top of the exposed aggregate to the bottom of pockets between stones.
6. Drench the prepared joint with clean water and remove prior to the concrete pour.
7. Cover horizontal wall and wall-to-slab joints with a minimum thickness of 2 inches and a maximum of 6 inches of the modified concrete mix, consisting of the designated concrete mix with one-half of the coarse aggregate removed.
8. Use special care in vibrating adjacent to construction joints to ensure thorough consolidation of the concrete around the waterstops and against the hardened portion of the joint. Additional hand tamping may be required.

9. For joints that are shown on architectural drawings as having a continuous reveal or recess, leave the wood form or pour strip used to create the reveal or recess in place or re-insert before roughening. Prevent the next concrete placement from filling the reveal or recess.

D. Expansion Joints:
1. Stop all steel reinforcing clear of the joint at each side.
2. Provide 9-inch centerbulb waterstop continuously around the joint in walls and slabs retaining liquids or earth.
3. Prepare a smooth first concrete surface with all voids filled.
4. Provide preformed joint filler, securely fastened to the existing concrete as directed by the Manufacturer.
5. Install bond breaker and sealant after curing is completed and when directed.

E. Bonding to Pre-existing Concrete: Mechanically roughen the old surface to a 1/4-inch amplitude, as defined in construction joint paragraph above. Apply epoxy bonding material prior to concreting, as recommended by the manufacturer.

F. Waterstop:
1. Restrict field splices to butt joints in straight runs. For PVC type, make by heat welding, using a splicing iron. For rubber, provide sleeve joints and glue. Follow the manufacturer's specifications.
2. Positively locate and support in the forms so that concrete may be placed, consolidated, and vibrated on both sides of the embedded portion without displacement of the waterstop and without causing voids in the concrete. Protect the outstanding portion from damage during the first concrete pour and clean and positively support prior to the second pour. Place, consolidate and vibrate the second pour without displacement of the waterstop and without causing voids in the concrete.
3. For retrofit waterstops between new and existing concrete prepare existing concrete by grinding away irregularities. Clean concrete to ensure good epoxy bond. Apply continuous bed of epoxy to concrete. Embed retrofit waterstop in uncured epoxy. Mechanically fasten waterstop to concrete using stainless steel batten bars and anchor bolts staggered 6-inches on center maximum. Use batten bars on top and bottom. Tool continuous layer of epoxy over batten bars and bolts to protection from corrosion. Use expansion joint filler at moving joints to minimize shear stress. Allow retrofit waterstop system to cure for 24 hours before placing new concrete. Follow all manufacturer's preparation and installation instructions.

3.10 REPAIR OF DEFECTIVE CONCRETE

A. Inspect all concrete surfaces immediately after carefully removing forms. Defective work includes concrete out of line, level or plumb; cracks; poor joints; rock pockets; honeycomb; voids; spalls and exposed reinforcing. Patch all minor defects, including form tie holes, before the concrete is thoroughly dry. Do not interrupt the
curing program. Ensure that repairs match the existing surface for color and texture.

B. Minor Defects:
1. Clean thoroughly, including removal of any curing compound. Cut out to solid concrete but to a depth of not less than 1 inch. Prepare the edges of the cut slightly more than perpendicular to the surface of the concrete, so as to form a key.
2. Repair with cement mortar. Use minimum water, consistent with the requirements of handling and placing. Thoroughly compact the material into place and screed off to leave the patch flush with the surrounding surface.
3. Keep the surface damp for at least 48 hours.

C. Major Defects:
1. Large areas involving voids or rock pockets extending through the section may be cause for rejection of the work.
2. If acceptable repairs can be made without adversely affecting the structural integrity of the work, cut out the section and either dry pack, or reform and repour to match the adjacent concrete. Do not cut the reinforcing but cut keyways into the adjacent sound concrete to securely fasten the patch to the original work. Prepare edges of the damaged area with a minimum of a 1 inch cut perpendicular to the concrete surface.
3. Coat all surfaces with epoxy bonding compound immediately prior to patching. Place the concrete patch before the epoxy has set. Follow the epoxy bonding manufacturer's recommendations.
4. Provide a patch with strength and modulus of elasticity compatible with the parent concrete. Cure in accordance with the following article.

3.11 CURING AND PROTECTION

A. General: Maintain concrete above 50°F and below 90°F in a moist condition and without external loadings for 14 days after placement. For slabs, after the specified initial moist cure, provide further moist curing, utilizing sheet materials or wet blankets for 14 days after placement. Apply liquid membrane curing after the 14-day wet curing period. For walls after the specified initial moist cure, provide further moist curing, impervious-sheeting curing, or application of liquefied membrane-curing compound, as noted.

B. Slabs:
1. Initial moist cure: Provide a 36-hour uniform spray treatment immediately following final troweling and before the surface can dry out, but after bleeding has stopped. Use clean water and special fog spray nozzles of type and number required to keep entire surface moist. Keep all traffic off the floor surfaces.
2. Continued cure: After 36 hours, continue fog curing, or before the surface dries out, continue curing by utilizing sheet materials or wet blankets in order to keep the surface of the slab continuously wet for the balance of the 14 days. After 14 days apply a liquid membrane curing compound:
   a. Place waterproof curing paper smoothly upon the moist concrete surface with all joints and edges lapped a minimum of 4 inches and continuously...
sealed with tape. Do not use paper that will leave an impression on the finish. Repair, replace and reseal, torn or scuffed sheets.

b. Install polyethylene plastic sheeting and maintain in the same manner as for curing paper.

c. Apply liquid membrane curing compound, if favorably reviewed for this purpose. Apply while slab is still damp from the fog spray.

1) Agitate compound thoroughly by mechanical means during use and apply uniformly in a two coat continuous operation by appropriate power-spraying equipment. Apply the two coats at right angles. Apply between 150 and 200 square feet per gallon of undiluted compound, total coverage. Form a uniform, continuous, coherent film that will not check, crack, or peel and free from pinholes or other imperfections.

2) Keep alternate specified covering readily available for use in the event conditions occur which prevent correct application of the compound at the proper time.

3) Respray surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied (when slab reaches a moist condition and there is no standing water) with two additional coats of curing compound by the foregoing method and coverage.

4) Allow foot traffic only after 36 hours of cure time and only when slab is protected with paper or sheeting.

5) Allow building material storage only after 14 days of cure time and only on plywood sheets and wood sleepers that spread the load and protect the finish.

C. Walls:

1. When forms are in place, keep concrete damp by spraying the outside and top of the forms with water.

2. When forms are in place, but loosened, keep concrete damp by streaming water down inside the forms.

3. When forms are removed, continue curing by one of the following methods for the balance of the 14 days.

   a. Provide continuous perforated hose sprays at the top of wall covering the entire wall, both sides, with water.

   b. Place water-retaining blankets continuously over the wall surfaces and hose periodically with water, 24 hours a day.

   c. Apply liquid membrane curing compound, if favorably reviewed for this purpose. Follow the procedures for slabs contained in paragraph above.

D. Other Surfaces:

1. Provide a curing program equivalent to either slab or wall system, as appropriate.

2. Include construction joint surfaces when applying curing compound.

3. Cover, or protect joint openings, exposed reinforcing, surfaces to be painted and other areas where curing compound may enter and interfere with a special finish.

4. Remove curing compound sprayed on reinforcing or construction joints by sandblasting after curing is completed, or before placing the next pour. If the
cones of tie holes are sprayed with curing compound, lightly ream prior to patching.
5. For curing of certain interior and other slabs using hardening or coloring compounds, refer to Section 03350.

E. Cold Weather Requirements: Provide adequate equipment for heating the placed concrete during freezing or near freezing weather:
1. Whenever the surrounding air temperature is below 40°F, or may fall below 40°F within the 24-hour period after pouring of concrete, maintain all freshly poured concrete at not less than 50°F for 5 days.
2. Keep the housing, covering, or other protection in place and intact at least 24 hours after the artificial heating is discontinued.
3. Do not use manure, salt, calcium chloride, or other chemicals on the concrete to prevent freezing.

F. Hot Weather Requirements: Provide additional cooling to concrete when temperatures rise above 90°F, or low humidity, wind and temperature combine to cause high surface evaporation, over 0.2 lb/sq. ft./hour:
1. Provide additional water if curing by fog spray or ponding or saturated blankets.
2. Provide shade to surfaces exposed to direct sunlight.
3. Apply an evaporation retarder during the finishing operation, following the manufacturer's recommendation.

3.12 CONCRETE FINISHES
A. Refer to Section 03350.

3.13 SWEPT-IN GROUT
A. General: Provide for tanks and clarifiers, where shown on the Drawings. After construction of the concrete slab, and after all scraping equipment has been installed and leveled, and before painting has commenced, sweep a cement mortar grout over the slab to the thickness required on the Drawings, screeded by the equipment.

B. Preparation of Base Slab: Roughen by light sandblasting or hydroblasting to remove laitance, clean, and favorably review before grout is placed. Do not acid etch the slab.

C. Method:
1. Provide a knowledgeable representative of the equipment manufacturer to supervise the entire grouting process.
2. Install metal edged and lined wood 2 x 10 screeds on two arms of the mechanism, 180° apart. Set the metal edge location on the bottom of screed at the average level of the squeegees or scrapers to be installed after the completion of the grouting operation. Extend the metal lining of wood screeds at least 2 inches up both sides from the bottom edge and cover the bottom edge.
3. Moisten the surface, then broom a neat cement and water paste into the roughened concrete immediately ahead of placing the grout. Then place and screed grout specified in Part 2.

4. Attach saturated burlap strips to the trailing side of screed to serve as a float.

5. Ballast the screed arms, as required, and adjust the ballast, if necessary, to compensate for temperature changes.

6. Set equipment speed to assure a reasonable screeding and finishing period. Spray the completed grout floor with an acceptable curing compound as soon as it is hard enough to permit access.

3.14 FIELD QUALITY CONTROL

A. Concrete Placement:
1. Verify that forms and reinforcement are accurately placed and secured in position. Confirm that both forms and reinforcement have been favorably reviewed.
2. Verify that tie wire ends have been bent back away from the forms.
3. Verify that all sleeves, castings, pipes, conduits, bolts, anchors, and any other items required, are accurately and securely placed within or on the forms.
4. Verify waterstop is correctly in place and that splices are watertight.
5. Verify adequate vibrators are available.
6. Verify construction and expansion joint faces have been prepared for the next concrete placement.
7. Check that the mix design is compatible with the method of placement of the concrete, by pump or by batch.
8. For wall placements, verify that the modified concrete mix required at construction joints is to be delivered.
9. Verify the concrete delivered to site is satisfactory, including checks on the batch tickets, quality assurance tests and direct observation of the batches.

B. Concrete Curing:
1. Verify procedures and equipment are available for controlling concrete temperature during hot and cold weather conditions.
2. Verify actual time of application of evaporation retardant, fog spray and curing materials for each placement.

3.15 TESTING OF HYDRAULIC STRUCTURES

A. General: Test all concrete tanks, hydraulic channels, sumps, basins and other structures designed to contain water, after concrete has reached the design strength, prior to backfilling, and application of any coating system. Test by filling the structure with water.

B. Preparation: Provide the following:
1. All water necessary for testing, of acceptable quality.
2. All evaporation and level measuring devices required.
3. All pumps, power, piping and any other equipment required and make all hook-ups necessary to fill tanks for testing.
4. The water disposal method after testing complete, including pumping if necessary.
5. Fill the structure with water to the extreme high operating water surface level or to overflow weir level. Furnish and install temporary bulkheads, if required.
6. Maintain full for 48 hours before beginning the test period to permit concrete absorption and adjustment of valves, slidegates, or temporary bulkheads.
7. At completion of tests remove all temporary piping and connections. Dispose of wastewater without creating a nuisance or damage to adjacent property.

C. Test Period: Five consecutive 24-hour periods totaling 5 consecutive days. Take daily measurements of air and water temperature, rainfall and water level.

D. Test Procedure:
1. After test period, measure water level at each side of the tank to determine leakage and loss from evaporation.
2. Determine evaporation loss, using a standard 48-inch evaporation pan and level measuring device located adjacent to the tank.
3. Mark all observed damp areas, running or dripping leaks on exposed surfaces that have not healed autogenously during the test. Repair all those areas.
4. If leakage from the structure exceeds that permitted for the types of mechanical equipment providing closure plus .08% of the storage capacity, in each 24-hour period over a period of five consecutive days, perform a retest after completing repairs.
5. Provide acceptable procedures prior to repairs. Repairs by painting or surface treatment will not be acceptable.
6. Continue the test and repair procedure until the structure satisfies both the leakage calculation requirement and the visible leakage requirement.

3.16 CLEANUP

A. Upon completion of all work performed under this Section, remove from the site all excess materials, storage facilities and temporary facilities. Smooth and clean of debris all areas that were used or occupied during concrete construction operations and leave in first-class condition.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Concrete finishes for all horizontal and vertical concrete surfaces.
   2. Sealers and hardeners for concrete.

B. Related Sections:
   1. Section 03300: Cast-in-Place Concrete

1.02 REFERENCES

A. American Society of Testing and Materials (ASTM):
   1. ASTM C156 Test Method for Water Retention by Concrete Curing Materials
   2. ASTM C171 Specifications for Sheet Materials for Curing Concrete
   3. ASTM C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
   4. ASTM C1028 Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
   5. ASTM D882 Test Method for Tensile Properties of Thin Plastic Sheeting
   6. ASTM E96 Test Methods for Water Vapor Transmission of Materials


C. “Evaluation Reports” published by the International Conference of Building Officials.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Qualifications: A list of five projects completed by the proposed subcontractor within the most recent 3 years that have concrete finishes similar to those specified for this project and evidence of compliance with paragraph 1.04A, Quality Assurance, in this Section.

C. Product Data: Describe all products proposed for use.

D. Field Samples:
   1. 2-foot-square job-prepared samples of each finish and color specified for selection and use as Control Samples.
      a. Medium sandblast: One sample each with No. 60 grit and No. 30 grit sand.
         1) On smooth concrete.
2) On textured concrete.
   b. Fine broom finish.
   c. Coarse broom finish.
   d. Swirl float finish.

2. Samples of mortar for filling voids and form tie holes and grout for all finishes for formed surfaces, applied to an inconspicuous area for selection of color match prior to proceeding with finishes.

1.04 QUALITY ASSURANCE

A. Contractor Qualifications: Five years of experience exclusively providing decorative concrete finishes on flat work and formed surfaces including: Cement Finishers Finish and Sacked Finish on formed surfaces of the type required on this project. Use skilled cement finishers to perform all work.

B. Regulatory Requirements: Comply with applicable requirements in the Uniform Building Code, adopted edition, including without limitation Chapters 10, 11, 11A and 11B.

PART 2 - PRODUCTS

2.01 CURING, SEALING, HARDENING, AND DUSTPROOFING COMPOUND

A. Curing, Sealing, Hardening and Dustproofing Compound:
   1. Water-based acrylic polymer curing, sealing, hardening and dustproofing compound.
   2. Leave a protective clear transparent film on the concrete surface that is non-yellowing and resistant to deterioration due to exposure to ultraviolet light.
   3. A good primer for paints, mastic adhesives and coatings.
   5. ASTM C-309, Type I, Class B.
   6. AASHTO M-148, Type I, Class B.

B. Manufacturers:
   1. First coat Vocomp 20, second coat Vocomp 25 by W. R. Meadows Inc.;
   2. Burke Spartan-Cote WB Cure/Seal/Hardener;
   3. or equal.

2.02 GROUT FOR A SACKED FINISH ON FORMED SURFACES

A. Grout for a Sacked finish: Conforms to the requirements for mortar for filling voids, except mix one part of cement with 1-1/2 parts fine sand and add water to make a grout having the consistency of thick cream. A mixture of white and grey Portland cement is required for color match. Add mineral oxide colors as required to match colored concrete. Test samples for color match and obtain favorable review prior to proceeding.
PART 3 - EXECUTION

3.01 CONCRETE SURFACE FINISHES FOR SLABS AND PAVING

A. General:
1. Provide a surface finish on all exterior and interior horizontal concrete slabs that has a coefficient of friction when measured in accordance with ASTM C1028 not less than 0.60 for level surfaces and 0.80 for surfaces sloped 1:20 or more.
2. For all exterior paving surfaces provide a minimum slope of 1% (1/8-inch per foot) to drain surface water to catch basins, drains or edges of pavement adjacent to landscaping and drainage swales. Review grades shown and recommend any adjustments necessary to achieve minimum specified slope.
3. Slope interior floor surfaces containing floor drains to drain water to the drains. Review elevations shown on Drawings for adequate slopes before setting grades. Report any conditions that will not provide adequate drainage or that will produce excessively steep slopes before proceeding.
4. Finish slabs so they do not deviate more than 1/4-inch (6.3 mm) in 10 feet from a straight edge. Finish elevations to within 1/8-inch (3.2 mm) elevations shown or required to match adjacent existing conditions. Provide "as-built" slopes for drainage no less than those shown or specified.
5. Allowed Tolerance for individual risers and treads in any flight of stairs:
   a. 1/4-inch (6.3 mm) between the lowest and highest riser.
   b. 3/8-inch (9.5 mm) between the deepest and shallowest tread measured in the direction of travel.
6. Slope all treads 1/8-inch (3.2 mm) down toward the nosing for drainage.
7. Finish edges and surfaces smooth, true and clean.
8. Apply finish to slabs as soon as the concrete can support the weight of the workmen.
9. Increase the humidity of the air directly above the concrete surface, prior to and during finishing operations by adding a fine fog mist of water to the air with mist nozzles when atmospheric conditions (temperature, humidity, and wind) are such that rapid evaporation of mixing water from the concrete is likely to occur.

B. WOOD OR MAGNESIUM FLOAT FINISH AND PRELIMINARY STEPS FOR OTHER FINISHES:
1. Applies to slab surfaces indicated to have a wood or magnesium Float finish. This finish is also the initial step for all other finishes.
2. Place and consolidate concrete.
3. Screed to grade using a strike-off board guided on accurately set screeds.
4. Work the surface with a bull or darby float to embed large aggregate, consolidate surface mortar and create a smooth true surface.
5. Do not overwork the surface or add dry materials such as sand or cement except as Dust-on Color Hardener finishes.
6. When surface has taken initial set and bleed water has disappeared work surface with wood floats followed by magnesium floats (if a magnesium float finish is called for) to even out slight irregularities and further consolidate surface.
7. When concrete has set further so that excess water and fine material will not be brought to the surface, either begin the first steel troweling if this is the
preliminary step for other finishes or work the surface with magnesium or wood float if this is the final step in a Float finish. Work the surface sufficiently to consolidate the mortar and produce a finished surface at the proper grade that is free of voids, ripples or other defects. Apply a final swirl texture finish in a fan pattern with the wood or magnesium float. Retool slab edges and control joints. Leave a uniform smooth border around all slab edges and each side of control joints.

C. BROOM FINISH:
1. Applies to all slabs indicated to receive a Broom finish.
2. Complete work required under "Preliminary Steps for Other Finishes."
3. Apply a second and third steel troweling after the concrete has set sufficiently so mortar does not adhere to the edge of the trowel and sufficient pressure can be applied to further consolidate the surface.
4. Broom texture the surface of the slab at right angles to the normal direction of traffic. Use a stiff fiber bristled broom for Coarse Broom Finish and a fine hair broom for Fine Broom Finish. Match selected control sample.

D. TROWEL FINISH:
1. Applies to all slabs indicated to receive a Trowel finish.
2. Complete the work required under "Preliminary Steps for Other Finishes."
3. Apply a second steel troweling after the concrete has set sufficiently so mortar does not adhere to the edge of the trowel and sufficient pressure can be applied to further consolidate the surface.
4. Apply a third steel troweling when the concrete has set sufficiently so the trowel produces a ringing sound. Apply sufficient pressure so the trailing edge of the trowel will produce a dense smooth surface without burning.
5. Apply a fourth troweling and additional trowelings as required to produce a dense smooth finish.

E. DETAIL WORK: Applies to all concrete flatwork and to exposed top edges of all formed concrete.
1. Edging Slabs: Tool a 3/8-inch radius on all exposed edges of slabs, curbs and other exposed horizontal edges unless a formed chamfered edge is called for. Repeat tooling with each floating or troweling operation.
2. Apply a Trowel finish to the top of the formed walls, curbs and machine bases.
3. Control Joints and Feature Grooves:
   a. Cut 1-inch-deep control joints with rounded edges in all paving slabs where indicated but not more than 8 feet apart in each direction. Repeat tooling with each floating or troweling operation.
   b. Run decorative feature grooves with a 1/4-inch-deep rounded tool before the final troweling in paving where shown.

F. CEMENT FINISHERS FINISH:
1. Use for curb faces, stair risers and other vertical formed surfaces customarily stripped and finished the same day they are placed and before the concrete fully sets.
2. Use form work specially designed for removal before the concrete sets.
3. Remove forms when concrete has achieved initial set and is stiff enough to retain its own shape but before it fully sets.
4. Work over surface with a moist wood or rubber float and cement paste to fill minor voids and consolidate the surface. Fill holes and larger voids with mortar but do not build up a coating of mortar over the entire formed surface. Finish with a fine hair brush.

G. CURING, SEALING, HARDENING AND DUSTPROOFING COMPOUND:
1. Apply a membrane curing, sealing, hardening and dustproofing compound to freshly placed concrete flatwork to retain moisture in the concrete for at least 30 days. Curing of formed concrete is described in Section 03300.

3.02 CONCRETE FINISHES FOR FORMED SURFACES

A. General:
1. See the Schedule of Concrete Finishes at the end of this Section and notes and schedules on Architectural and Structural Drawings for the location, and extent and type of finish required. Where a specific finish is not called for, finish surfaces to match similar adjacent items.
2. Complete all patching and finishing within 10 days after stripping forms.

B. FILLED FINISH:
1. Remove fins, drips, runs and other projections by scraping. Correct offsets larger than 1/8-inch by power grinding a taper of at least 1:16.
2. Fill solidly form tie holes and "bug" holes over 1/2-half inch in maximum dimension with cement mortar described in Part 2.
3. Finish filled holes flush with adjacent surface of the wall.
4. Keep surface damp for 48 hours.

C. FILLED AND RUBBED FINISH:
1. Complete work required for a Filled finish.
2. Remove fins, drips, runs, offsets and other projections by scraping, chipping or grinding as required to produce a smooth, flat surface free of offsets. The maximum permitted deviation from a true plane surface when tested with an 8-foot-long straight edge is 1/8-inch. The minimum taper required to correct offsets is 1:32.

D. SACKED FINISH:
1. Complete all work required for a Filled and Rubbed finish.
2. Grout fill surface:
   a. Prepare grout in accordance with Part 2.
   b. Wet concrete surfaces and allow surface water to evaporate leaving the concrete damp but surface dry.
   c. Apply grout with rubber floats to the entire surface area to be finished. Work grout into and compress all air bubbles, holes, voids and surface irregularities. Compress grout in voids with cork floats. When grout has become stiff but is still plastic, remove all excess from surface with rubber squeegees or cork floats.
   d. After the surface whitens from drying (about 30 minutes at normal temperature) clean the surface by rubbing vigorously with clean burlap wrapped around wood blocks.
   e. Keep the surface damp for 48 hours.
### A. SLABS

<table>
<thead>
<tr>
<th></th>
<th>LOCATION OF FINISH</th>
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<tbody>
<tr>
<td>1</td>
<td>Wood or Magnesium Float 3.01B Applies to slab surfaces indicated to receive a &quot;Float Finish&quot;. This finish is also the initial steps for all other finishes. Applies to all interior and exterior slabs scheduled to receive a bonded ceramic tile or bonded mortar finish and tank slabs to receive swept-in-grout. Applies to floor slab of Secondary Clarifiers except in channels.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Broom Finish 3.01C Applies to slabs indicated to receive a &quot;Broom Finish&quot; and to all exterior paving, stair treads, and interior slabs in wet process areas not indicated to receive another finish. Applies to floor slab of Headworks Structure.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Trowel Finish 3.01D Applies to slabs indicated to receive a &quot;Trowel Finish.&quot; Applies to all interior building slabs that are not indicated to receive a Float or Broom Finish. Applies to all slabs intended to receive resilient flooring or carpet. DOES NOT apply to slabs intended to receive a bonded ceramic tile or a bonded cement mortar finish or swept-in-grout. Applies to floor slabs of Operations Building, Solids Processing Building, and Oxidation Ditch.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Cement Finishers Finish 3.01F Applies to curb faces, stair raisers and other vertical formed surfaces customarily finished the same day they are placed and before the concrete fully sets.</td>
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</tbody>
</table>

### B. CURING, SEALING, HARDENING AND DUSTPROOFING SLABS

<table>
<thead>
<tr>
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<th>LOCATION OF FINISH</th>
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<tbody>
<tr>
<td>1</td>
<td>Curing, Sealing, Hardening, and Dustproofing 3.01G Apply two coats of Curing, Sealing, Hardening and Dustproofing Compound to interior building concrete that will receive no other finish. Apply the first coat when the concrete is wet; apply the second coat 30 days later. Applies to floor slabs of Operations Building and Solids Processing Building.</td>
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### C. FORMED SURFACES

<table>
<thead>
<tr>
<th></th>
<th>LOCATION OF FINISH</th>
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<tbody>
<tr>
<td>1</td>
<td>Filled Finish 3.02B Applies to walls and other vertical and horizontal formed surfaces, including beams and columns indicated to receive a Filled Finish and to all concrete surfaces where no specific finish is indicated.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Filled and Rubbed Finish 3.02C Applies where indicated and to interior walls and ceilings of normally of occupied buildings and to interior walls of tanks from 1 foot below the lowest operating liquid level to the bottom of the tank.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sacked Finish 3.02D Applies where indicated and to interior walls of tanks from 1 foot below the lowest operating liquid level to the top of the wall and to the bottoms and walls of water channels.</td>
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</tr>
</tbody>
</table>

### D. SEE SECTION 03300 FOR CURING FORMED CONCRETE

END OF SECTION
DIVISION 4
MASONRY

04220 Concrete Masonry Units
SECTION 04220
CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. All concrete unit masonry.
   2. Related reinforcing.
   3. All scaffolding, bracing, forming and shoring required for this work.

B. Related Sections:
   1. Section 03200: Reinforcing Steel
   2. Section 03300: Cast in Place Concrete
   3. Section 07190: Water Repellent Sealer

1.02 REFERENCES

A. American Society for Testing Materials (ASTM):
   1. A615 Standard Specification for Deformed and Plain Billet-Steel Bars for
      Concrete Reinforcement
   2. C90 Standard Specification for Load-Bearing Concrete Masonry Units
   3. C140 Standard Test Methods for Sampling and Testing Concrete Masonry
      Units and Related Units
   7. C270 Standard Specification for Mortar for Unit Masonry
   8. C331 Standard Specification for Lightweight Aggregates for Concrete
      Masonry Units
      Specimens of Hydraulic-Cement Mortar and Concrete
   11. C426 Standard Test Method for Drying Shrinkage of Concrete Masonry
        Units
        Evaluation of Mortars for Plain and Reinforced Unit Masonry

B. Uniform Building Code Standards
   1. 21-16 Field Tests Specimens for Mortar
   2. 21-17 Test Method for Compressive Strength of Masonry Prisms
   3. 21-18 Method of Sampling and Testing Grout

C. "Masonry Design Manual" published by the Masonry Industry Advancement
   Committee.
D. "1997 Design of Reinforced Masonry Structures" published by the Concrete Masonry Association of California and Nevada.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300:
   1. Product Data: Fully describe every item proposed for use.
   2. Samples: Masonry units proposed for use on the project.
   3. Certifications: Manufacturer's certification that masonry units were manufactured and wet cured for 28 days prior to delivery.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the Uniform Building Code (UBC), 1997 edition, especially Chapters 19 and 21 including referenced UBC Standards. Where full allowable stresses were used in the design of the buildings, structures or structural elements the Contractor shall provide testing for masonry, mortar, and grout satisfying the requirements of UBC Chapter 21, Section 2105 for full allowable stresses used in design. Verification of fm of concrete masonry shall be achieved by either masonry prism testing, masonry prism test records, or the unit strength method. Comply with UBC Standards 21-16, 21-17 and 21-18.

B. When ½ allowable masonry stresses are used for design, special inspection is not required. See Drawings for buildings, structures or structural elements requiring special inspection. Special inspection shall be in accordance with UBC Section 1701.7.

C. All construction or work shall be subject to inspection by the local building official and the Owner's representative. The Contractor shall make all work or construction accessible and exposed for inspection of the cells and for the size and placement of reinforcement, anchors, or other imbedded items.

1.05 DELIVERY, HANDLING AND STORAGE

A. Store all material protected from moisture and from contamination by dirt, mud or other foreign material.

1.06 COORDINATION

A. Coordinate with other trades whose items that require embedment into masonry. Build in items furnished under other sections as work progresses.

PART 2 - PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Manufacture all concrete masonry units from aggregate conforming with ASTM C331, "Lightweight Aggregates for Concrete Masonry Units." Manufacture units using concrete that weights between 85 and 105 pounds per cubic foot (1362 and 1682 kg per cubic meter) when measured in accordance with ASTM C140.
B. Provide hollow load-bearing concrete masonry units Grade N conforming to ASTM C90, Type I as modified by the UBC Standard 21-4 "Hollow and Solid Load-Bearing Concrete Masonry Units" and meeting the following requirements:
1. Minimum compressive strength of 1,900 psi (13,100 kPa) when wet cured (or equivalent) for a period of 28 days.
2. Maximum linear shrinkage of 0.065% from saturated to oven dry conditions, when tested in accordance with ASTM C341, or 0.045% when tested in accordance with ASTM C426.
3. Wet cure (or equivalent steam cure) all blocks a minimum of 28 days before delivery to the site.

C. Manufacturer: Best Blocks, Inc., of Sacramento and Newark, CA; Basalite, Division of Pacific Coast Building Products, Inc., of Napa, CA; or equal.
1. Typical Exterior Units: 8x8x16 nominal split-face, center scored split-face and blocks shall be tan in color except that 3-score split-face shall be a dark brown color.
2. Interior Units: Smooth in tan color.
3. Provide all bond beam, lintel, half, pilaster, wall, cap blocks, and other special shapes and sizes required. Provide open-end standard, open-end bond beam and double open-end bond beam units unless noted otherwise on the Drawings. Use lintel block units where underside of lintel will be exposed.

2.02 MORTAR

A. Mortar: Type "S" and complying with ASTM C270 and proportioned as necessary to comply with the requirements of UBC Table 21A and 21D for the strength of block used.

B. Tint mortar with mineral oxide colors to match selected block color.

2.03 GROUT

A. Grout: Minimum strength of 2,500 psi. Cement content of the grout shall be increased, as necessary to achieve the specified masonry assembly strength (f'm) and adequate workability. Grout compressive strength, when tested per UBC Standard 21-18 shall equal or exceed the concrete masonry unit strength. Portland cement, hydrated lime, fine aggregate and pea gravel conforming to ASTM C404 and ASTM C476. Proportion grout in accordance with UBC Table 21B. Use only favorably reviewed admixtures.

2.04 CEMENT

A. Cement for Grout and Mortar: Portland cement, Type II and conforming to ASTM C150, and meeting the requirements of low alkali cement in conformance with Table 2 of ASTM C150. Masonry cement is not permitted.

2.05 WATER

A. Mixing Water: Potable and free from excess alkalies.
2.06 LIME

A. Hydrated Lime: Conform to ASTM C207, Type S.

2.07 SAND

A. Mortar Sand: Conform to ASTM C144, except that at least 4% passing No. 100 (150 mm) sieve. Uniformly grade from fine to coarse. Allow not more than 2% by weight of deleterious substances.

B. Grout Sand: Sand and pea gravel for grout shall conform to ASTM C404, Table 1, coarse aggregate.

2.08 REINFORCING

A. Reinforcing Steel: Conform to ASTM A615, Grade 60.

B. Detail and fabricate reinforcing steel in accordance with the requirements for reinforcing steel in Section 03200 and as shown.

2.09 BONDING AGENT

A. Non-reemulsifiable polyvinyl acetate, Roplex, Acryl-60, or equal.

PART 3 - EXECUTION

3.01 BATCHING AND MIXING MORTAR

A. Proportion mortar by volume using containers of known volume.

B. Mix ingredients in a paddle type (plastic) mixer for at least 3 minutes.

C. Add only enough water to produce a plastic mix. Do not retemper mortar, which has begun to hydrate. Any mortar that is unused within 2 ½ hours or grout that is unused within 1-½ hours after initial mixing shall be removed from the work.

3.02 GROUT

A. Plant batch grout by weight and mix in transit. Design grout mix to have a certified 28-day strength of 2,500 psi (17.2 MPa) and a slump of 9 to 10 inches (230 to 250 mm).

3.03 CONSTRUCTION METHODS AND DETAILS

A. General:
   1. Install work plumb, level, and of correct dimensions and location.
   2. Lay block in running bond.
   3. Install reinforcing as specified and/or shown. All vertical wall reinforcement placed in a direction perpendicular to the wall plane shall be placed within a
tolerance of ±1/2 inch. All longitudinal reinforcement shall be placed within a
tolerance of ±2 inches.
4. Lay masonry units so the vertical cells line up and are not obstructed by excess
mortar. Unless noted otherwise on the Drawings provide additional vertical
reinforcing of one #6 bar at every corner and a #6 bar each side of every wall
opening.
5. Sandblast concrete foundation or slab to expose aggregate. Use bonding
agent to bond the first layer of mortar setting bed to the concrete slab or
foundation.
6. Unless noted otherwise on the Drawings construct horizontal bond beams
reinforced with one #5 bar at the top and bottom of walls and at intermediate
locations where shown, but not farther apart than 2'-0".
7. Construct bond beams over all openings reinforced as shown but with not less
than two No. 5 bars.
8. Grout all cells.
9. Locate control joints as shown on the Drawings or at 20'-0" maximum spacing
where not shown but not less than 2'-0" from a jamb or opening. Place bond
beam reinforcing continuous through expansion and control joints, wrapping
bars with 1/8-inch thick bond breaking tape 2'-0" both sides of joint. Do not
splice bond beam reinforcing within 6'-0" of an expansion or control joint.

B. Provide cleanout openings in the bottom course of all cells containing vertical
reinforcing. Spacing of cleanout openings shall not exceed 2'-8". Locate cleanouts
on the inside face of the exterior walls; seal cleanouts after inspection and before
grouting. Use a high-pressure jet stream of water to remove mortar fins and any
foreign matter from the grout space. Cleanouts may be eliminated if grout pour
height is reduced to a maximum of 2'-0".

C. Joints:
1. Set units with 3/8-inch-thick mortar joints. Compress partially set mortar with a
convex tool to produce a dense surface.
2. Butter head joints solid for the thickness of the face shell so that there are no
voids between abutting faces. Set units in bed joints that are filled solid with
mortar for the thickness of the face shell. Remove mortar fins that project more
than 3/8-inch into the grout cell.
3. If a unit is repositioned after placing, it shall be completely removed, cleaned
and reset in fresh mortar.
4. Cure mortar joints by keeping masonry units and joints damp for ten days after
laying units by applying a very fine water mist spray and covering work with
polyethylene sheeting.
5. Repair any shrinkage cracks in block or mortar joints as described in
paragraph 3.06 of this Section.
6. Use no mortar which has been standing for more than 60 minutes after being
mixed.

D. Cut masonry units accurately and cleanly to size with diamond blades on power
masonry saws.
E. Special Units: Provide all required special units. Where special units are not available from the supplier, cut available units and fabricate required special shapes by epoxy bonding.

F. Reinforcing: Conform to the requirements for reinforcing steel in Section 03200. Anchor reinforcing bars in straight alignment and secure against displacement with metal positioners spaced not further apart than 200 bar diameters. Lap reinforcing steel 48 bar diameters minimum at splices. Stagger splices. When a foundation dowel does not line up with the vertical core to be reinforced, add a full height reinforcing bar matching those used in other vertical cores and grout the core full height. Set an additional dowel in the vertical core originally intended to be reinforced by drilling a hole 8 inches deep in the concrete foundation or slab and setting a bar in epoxy grout.

G. Grouting:
1. Limit maximum height of grout pour to 8'-0" unless otherwise favorably reviewed by the Engineer.
2. Place grout in the reinforced hollow concrete block wall after the units have been set for at least 24 hours.
3. Place grout using a method to avoid segregation.
4. Fill all cells solid with grout. Consolidate grout by mechanical vibration. See paragraph 3.03B of this Section.
5. Allow sufficient time between pours of two consecutive lifts of grout for the grout to consolidate and settle, and for absorption of excess moisture. The time between grout lifts shall be at least 1 hour.
6. Consolidation of the succeeding grout lift and the reconsolidation of the previous grout lift may be done in the same operation. Reconsolidate the last lift of a grout pour in a separate and distinct operation.
7. If grouting is done in multiple lifts, stop the top surface of the grout of each lift 1-1/2 inches below a mortar joint, except at the top of a wall. When grouting bond beams, stop the grout pour 1/2-inch below the top of the masonry unit.
8. Remove unused grout within 90 minutes after addition of mixing water.

H. All embedded items (bolts, etc.) shall be secured in place prior to grouting. Provide a minimum of 1-inch grout around all bolts in masonry. Embed all anchors, ties, and sleeves required to accommodate the work of others. Build in or embed other work required to be built into masonry.

3.04 FIELD QUALITY CONTROL

A. Test mortar and grout in accordance with the Uniform Building Code Standards 21-16 and 21-18 and ASTM C780.
1. Make at least 3 test specimens of mortar and grout per week.
2. Make at least 3 test specimens of mortar and grout for each floor level of masonry placed.
3. Make a set of 3 prisms for each 5,000 square feet of wall area, but not less than one set of three prisms.
3.05 CLEANING

A. Clean down all masonry by scrubbing with water masonry cleaner and bristle brushes. Do not clean with muriatic acid. Do not use high pressure cleaning equipment.

3.06 REPAIRS

A. Repair or replace all defective work including:
   1. Units that are smeared with mortar or grout.
   2. Unevenly laid units.
   3. Repair all cracks wider than 4 mils.
      a. Dig out cracks 4 mils and wider in masonry units and install a polyurethane sealant "B" in accordance with the requirements of Section 07900. Use a sealant that has a 20-year life expectancy and is compatible with the masonry sealer. Apply sealant in accordance with the manufacturer's instructions.
      b. Route out and repoint cracks in mortar joints with a stiff mortar modified by replacing one-third of the mixing water with acrylic bonding agent. Re-tool the patched joint.

END OF SECTION
DIVISION 5
METALS

05100  Structural Metal Framing
05210  Steel Joists
05310  Steel Decking
05500  Metal Fabrications (Miscellaneous Metal)
05722  Aluminum Ladders
05724  Aluminum Component Railing System
SECTION 05100

STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Structural steel, stainless steel or aluminum, such as beams, channels, angles, tees, bars, pipe, tubing and plates.
2. Fabricated metal items, such as pipe supports, brackets, hangers, equipment supports, and lift hooks.
3. Clip angles, connection plates and base plates.
4. All anchors, eye bolts, turnbuckles, cable clamps, bolts, nuts, washers, inserts, and other metal items not specified elsewhere.
5. Fabricated tanks, hoppers, and similar structures, if not specified elsewhere.
6. All structural metal framing.

B. Related Sections:
1. Section 05500: Metal Fabrications
2. Section 05722: Aluminum Ladders
3. Section 05724: Aluminum Component Railing System
4. Section 09960: Protective Coatings
5. Section 09900: Painting

1.02 REFERENCES

A. Aluminum Association:

B. American Institute of Steel Construction Specifications:
1. AISC Specification Structural Steel Buildings, Allowable Stress Design and Plastic Design
2. AISC A325 Joints Structural Joints Using ASTM A325 or A490 Bolts

C. American Iron and Steel Institute (AISI)

D. American National Standards Institute:
1. ANSI B18-2-1 Square and Hex Bolts and Screws
2. ANSI B18-2-2 Square and Hex Nuts
3. ANSI B18-21-1 Lock Washers
4. ANSI B18-22-1 Plain Washers
5. ANSI H35-1 Alloy and Temper Designation Systems for Aluminum

E. American Society for Testing and Materials Standard Specifications:
1. ASTM A36 Structural Steel
2. ASTM A53 Pipe, Steel, Black and Hot-dipped, Zinc-coated Welded and Seamless
3. ASTM A123 Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products
4. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. ASTM A307 Carbon Steel Bolts and Studs 60,000 psi Tensile Strength
6. ASTM A325 Structural Bolts, Steel, Heat-Treated
7. ASTM A370 Test Methods and Definitions for Mechanical Testing of Steel Products
8. ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
9. ASTM A525 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
10. ASTM A563 Carbon and Alloy Steel Nuts
11. ASTM B633 Electrodeposited Coatings of Zinc on Iron and Steel
12. ASTM C827 Test Method for Early Volume Change of Cementitious Mixtures
13. ASTM C1107 Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
14. ASTM E8 Test Methods for Tension Testing of Metallic Materials
15. ASTM E165 Practice for Liquid Penetrant Inspection
16. ASTM E709 Practice for Magnetic Particle Examination
17. ASTM F436 Hardened Steel Washers
18. ASTM F844 Washers, Steel, Plain (Flat), Unhardened for General Use
19. ASTM F959 Compressible-Washer-Type Direct Tension Indicator for Use with Structural Fasteners

F. American Welding Society:
1. AWS D1.1 Structural Welding Code - Steel
2. AWS D1.2 Structural Welding Code - Aluminum
3. AWS D10.4 Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing
4. AWS A5.1 Mild Steel Covered Arc Welding Electrodes
5. AWS A5.3 Aluminum and Aluminum Alloy Electrodes for Shielded Metal Arc Welding
6. AWS A5.4 Covered Corrosion-Resisting Chromium-Nickel Steel Welding Electrodes
7. AWS A5.5 Low Alloy Steel Covered Arc Welding Electrodes
8. AWS A5.9 Corrosion-Resisting Chromium-Nickel Steel Base and Composite Metal Cored and Stranded Welding Electrodes and Welding Rods
9. AWS A5.10 Aluminum and Aluminum Alloy Bare Welding Rods and Electrodes

G. International Conference of Building Officials (ICBO)

H. Uniform Building Code (UBC)

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.
B. Product Data:
1. Hangers, pipe and equipment supports (shelf items).
2. High-strength bolts.
3. Adhesive capsule anchors, cartridge dowels and expansion anchors.
4. Stainless steel and aluminum items (not fabricated).
5. Non-shrink grout.
6. Certified mill test results on structural metals.
7. Electrode manufacturer’s data.
8. Insulation between dissimilar metals.

C. Samples: Manufacturer's latest standard product: Specify special or unique products.

D. Shop and Erection Drawings:
1. Structural framing.
2. Field assembly or erection sequence.

E. Quality Assurance:
1. Welder performance qualification test records “welders certification”.
2. Written Welding Procedure Specifications (WPSs) in accordance with AWS D1.1 requirements for each different welded joint proposed for use whether prequalified or qualified by testing.
3. Procedure Qualification Record (PQR) in accordance with AWS 1.1 for all procedures qualified by testing.

1.04 QUALITY ASSURANCE

A. General:
1. Furnish materials and fabricated items from an established and reputable manufacturer or supplier.
2. Supply all new materials and fabricated items made from first class ingredients and construction and guaranteed to perform the service required.
3. The Contractor is responsible for preparing and submitting written Welding Procedure Specifications (WPSs). WPSs for each joint type shall indicate proper AWS qualification and be available where welding is performed. WPSs shall be included with any shop drawings referencing welds. WPSs shall include the manufacturer and specific electrode.

B. Codes and Standards:
1. Metalwork:
2. Welding:
   a. Steel: AWS D1.1.
   b. Aluminum: AWS D1.2.
3. Welders:
   a. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.
b. All welding operators are subject to examination for requalification at any time during the progress of the work.

4. Bolting:
b. High Strength: AISC A325 Joints.

C. Tests:
1. General: Contractor will provide an Independent Testing Laboratory favorably reviewed by the Engineer for Special Inspection, defined by UBC Section 1701, to the following:
a. Welding.
b. High strength bolting.
c. Anchorages to concrete or masonry.
2. Weld Tests: By an Independent Testing Laboratory, favorably reviewed by Engineer and paid by Contractor.
a. Visual inspection:
   1) Check fit-up of joint materials. Verify satisfactory alignment of material. Verify gaps and bevels of penetration welds.
   2) Check during welding. Verify satisfactory technique is used.
   3) Check after welding completed and cleaned by wire brush or chipping hammer.
   4) Inspect with magnification when necessary and under strong, adequate light.
   5) Inspect for the following defects:
      a) Surface cracking.
      b) Porosity.
      c) Excessive roughness.
      d) Unfilled craters.
      e) Gas pockets.
      f) Undercuts.
      g) Overlaps.
      h) Size.
      i) Insufficient throat and concavity.

b. Nondestructive testing: Ultrasonic testing, except where not feasible due to the type or location of the weld. Magnetic particle, liquid penetrant or radiograph tests when ultrasonic testing is not feasible.
   1) Ultrasonic inspection technique and standards: AWS D1.1 Part C.
   2) Particle inspection method: ASTM E709.
   3) Penetrant inspection method: ASTM E165.
   4) Radiography tests: AWS D1.1, Part B.

3. Anchorages to concrete or masonry:
a. Procedure: Visual inspection of layout including horizontal location, minimum embedment, minimum cover, minimum spacing, and minimum edge distance. Inspect for development with reinforcing steel for concrete masonry unit construction.

D. Additional Tests: Provide and pay for all necessary additional tests made on welds or bolts required to repair or replace faulty work performed during the original fabrication.
1.05 DELIVERY, STORAGE AND HANDLING

A. Handle, ship and store material in a manner that will prevent distortion, rust, damage to the shop coat or any other damage.

B. Store material in a clean, properly drained location out of contact with the ground.

C. Ensure that dissimilar metals are not in contact with each other.

D. Replace or repair all damaged material in an approved manner.

PART 2 - PRODUCTS

2.01 STRUCTURAL STEEL MEMBERS

A. Beams, Channels, Angles, Structural Tees, Plates and Similar Items: ASTM A36.

B. Structural Tubes: ASTM A500, Grade B.

C. Structural Pipe: ASTM A53 Type E or S, Grade B.

2.02 STAINLESS STEEL ARTICLES

A. Material: AISI Type 304, unless Type 316 is specifically specified.

2.03 FABRICATED ALUMINUM ITEMS


B. Surfaces in Contact With Concrete or Masonry: Shop prime with a zinc chromate coating.

C. Bolted Connections: Provide stainless steel fasteners.

2.04 METAL FASTENERS

A. General

1. For buried, submerged, or conditions where anchors or fasteners will be continuously or intermittently wet, except where otherwise shown or specified, all bolts, anchor bolts, mechanical anchors, or adhesive anchors, washers, and nuts shall be 316 stainless steel.

2. For exterior or exposed conditions provide hot dipped galvanized materials except where otherwise shown or specified.

3. For all other exposure conditions provide hot dipped galvanized materials except where otherwise shown or specified.

B. Bolting

1. Regular Hexagon Bolts: ASTM A307, Grade A

2. Stainless Steel Bolts: AISI 316. 18-8 material is not acceptable.

3. Regular Hexagon Nuts: Material: ASTM A563, Grade A.
6. Dimensional Requirements:
   b. Nuts: ANSI B18.2.2.

C. Cast-in-Place Anchor Bolts

1. Headed Bolts: ASTM A307, Grade C, $f_{ul} = 58-80$ ksi, $f_y = 36$ ksi, or ASTM A36. For high strength applications utilize ASTM A354, Grade BD, $f_{ul} = 150$ ksi, $f_y = 130$ ksi.
3. Welded Headed Studs or Welded Hooked Studs: AWS D1.1, Grade B, $f_{ul} = 60$ ksi, $f_y = 50$ ksi.
4. Provide a standard hex headed bolt with the dimensions of the hex head conforming to ANSI/ASME B18.2.1 or plain rod conforming to ASTM A36 with threaded ends and double hex nuts at the anchored end.
5. Bent bar anchor bolts shall not be used in concrete masonry unit construction. If bent bar anchor bolts are substituted for headed anchor bolts in concrete calculations shall be submitted to demonstrate concrete pullout strength of fastener in tension.
6. Provide minimum embedment shown on the Drawings, or a minimum of eight bolt diameters.

D. Mechanical Anchoring Systems (friction anchors are not acceptable)

1. Mechanical Undercut Anchoring Systems
   a. Anchor: Undercut anchor shall be of an undercut style with brazed tungsten carbides on the embedded end that perform the self-undercutting process. Undercut portion of anchor shall have a minimum projected bearing area equal to or greater than 2.5 times the nominal bolt area.
   b. Carbon Steel Bolt and Sleeve:
      1) Bolt: ISO 898 , class 8.8, or SAE Grade 5.
      2) Sleeve: European Standard No. 25CrMoS4 or AISI 1010.
      3) Nuts: ASTM A563 Grade A and meeting the dimensional requirements of ANSI B18.2.2.
      4) Washers: SAE 1005-1033 or AISI 1040 and meeting the dimensional requirements of ANSI B18.2.2 Type A Plain.
      5) Plating: Zinc plated in accordance with ASTM B633, SC1, Type III Fe/Zn 5.
   c. Stainless Steel Bolt and Sleeve:
      1) Bolt: AISI 316 or 316Ti.
      2) Sleeve: AISI 316 or 316Ti or Type 304 stainless steel.
      4) Washers: DIN 6796 or Type 18-8 stainless steel.
   d. Submit a product evaluation report by ICBO.
   e. Provide embedment depth, edge distance, and anchor spacing as shown on the Drawings and in accordance with manufacturer's recommendations for published allowable loads.
   f. Manufacturer: Hilti, Inc. HDA Undercut Anchor, or equal.
2. Mechanical Expansion Anchoring Systems
   a. Anchor: Expansion anchor shall be preassembled expanding sleeve or wedge type with a single piece three section wedge. Anchors shall meet the description of Federal Specification A-A 1923A or A-A 1922A, Type 4. Anchor will bear a length identification code that is visible after installation. Provide hex head stud style unless flat or rod coupler styles are noted on Drawings.
   b. Carbon Steel Anchors:
      1) Anchor Body: ASTM A510 or AISI 1018 or AISI 12L14.
      2) Nuts: ASTM A563 Grade A and meeting the dimensional requirements of ANSI B18.2.2.
      3) Washers: SAE 1005-1033 and meeting the dimensional requirements of ANSI B18.2.2 Type A Plain.
      4) Plating: Zinc plated in accordance with ASTM B633, SC1, Type III Fe/Zn 5.
   c. Stainless Steel Anchors:
      1) Anchor Body and Wedges: ASTM A276 or ASTM A493 with chemical composition of either AISI 304 or 316 or 316L.
      2) Nuts: ASTM F594 with chemical composition of either AISI 304 or 316 or 316L.
      3) Washers: ASTM A240 with chemical composition of either AISI 304 or 316 or 316L.
   d. Submit a product evaluation report by ICBO.
   e. Provide embedment depth, edge distance, and anchor spacing as shown on the Drawings and in accordance with manufacturer's recommendations for published allowable loads.

3. Mechanical Drop-In Anchoring Systems
   a. Anchor: Internally threaded flush mounted or shell type expansion anchor. Anchors shall meet the description of Federal Specification FF-S-325, Group VIII, Type 1 or A-A-55614, Type 1.
   b. Carbon Steel Anchors:
      2) Anchor Plug: AISI 1018.
      3) Plating: Zinc plated in accordance with ASTM B633, SC1, Type III, Fe/Zn 5.
   c. Stainless Steel Anchors:
      1) Anchor Body: AISI 316 stainless steel.
      2) Anchor Plug: AISI 316 stainless steel.
   d. Submit a product evaluation report by ICBO.
   e. Provide embedment depth, edge distance, and anchor spacing as shown on the Drawings and in accordance with manufacturer's recommendations for published allowable loads.
   f. Manufacturer: Hilti, Inc. HDI/HDL Drop-In, Simpson Strong-Tie Drop-In, Power Fastening, Inc. Steel Drop-In, or equal.
E. Adhesive Anchoring Systems

1. Adhesive (Ester) Capsule Anchoring Systems
   a. Adhesive: Two-component vinyl urethane methacrylate or vinylester based adhesive and hardener. The two-components shall be stored in a dual chamber foil capsule or glass capsule.
   b. Anchor Rod or Insert: Rod or insert with chamfered threaded end for ease of starting nut on one end and 45 degree chisel or cut point on opposite end. Furnish nuts and washers to meet the requirements of the rod or insert. Unless noted otherwise on the Drawings, provide hot dip galvanized rods or inserts or stainless steel. Stainless steel rods or inserts shall be provided in buried or submerged locations.
      1) ASTM A36 or A307 (standard carbon steel anchor).
      2) ASTM A193 Grade B7 (high strength carbon steel anchor).
      3) Reinforcing bars as specified in Section 03200 with chisel or cut point.
      4) AISI 304/ASTM A276 or AISI 316L/ASTM A276 stainless steel meeting the mechanical requirements of ASTM F-593 (Condition CW).
   c. Submit a product evaluation report by ICBO.
   d. Provide embedment depth, edge distance, and anchor spacing as shown on the Drawings and in accordance with manufacturer's recommendations for published allowable loads.
   e. For submerged application in potable water provide NSF/ANSI STD 61 certification.

2. Adhesive (Ester) Injection Anchoring Systems
   a. Adhesive: Adhesive consisting of methacrylate resin or acrylic based adhesive, hardener, cement and water. The injectionable adhesive shall consist of two components and a static mixing nozzle as recommended by the manufacturer.
   b. Anchor Rod or Insert: Rod or insert with chamfered threaded end for ease of starting nut on one end and 45 degree chisel or cut point on opposite end. Furnish nuts and washers to meet the requirements of the rod or insert. Unless noted otherwise on the Drawings, provide hot dip galvanized rods or inserts or stainless steel. Stainless steel rods or inserts shall be provided in buried or submerged locations.
      1) ASTM A36 or A307 (standard carbon steel anchor).
      2) ASTM A193 Grade B7 (high strength carbon steel anchor).
      3) Reinforcing bars as specified in Section 03200 with chisel or cut point.
      4) AISI 304/ASTM A276 or AISI 316L/ASTM A276 stainless steel meeting the mechanical requirements of ASTM F-593 (Condition CW).
   c. Submit a product evaluation report by ICBO.
   d. Provide embedment depth, edge distance, and anchor spacing as shown on the Drawings and in accordance with manufacturer's recommendations for published allowable loads.
e. For submerged application in potable water provide NSF/ANSI STD 61 certification.

f. Manufacturer: Hilti HIT HY 150/HIT-ICE Injection Adhesive Anchor, Simpson Strong-Tie Acrylic-Tie, Power Fastening AC100, or equal. For materials with voids and holes like hollow block provide Hilti HIT 20 Injection Adhesive Anchor for Masonry Construction, Simpson Strong-Tie ATS for Acrylic-Tie, or equal.

3. Adhesive (Epoxy) Injection Anchoring Systems

a. Adhesive: Adhesive consisting of two-component epoxy base resin and hardener material meeting the requirements of ASTM C-881 Types I, II, IV, and V, Grade 3, Classes B and C. The adhesive shall be supplied in manufacturer’s standard side-by-side cartridge and dispensed through a static-mixing nozzle supplied by the manufacturer.

b. Anchor Rod or Insert: Rod or insert with chamfered threaded end for ease of starting nut on one end and 45 degree chisel or cut point on opposite end. Furnish nuts and washers to meet the requirements of the rod or insert. Unless noted otherwise on the Drawings, provide hot dip galvanize rods or inserts or stainless steel. Stainless steel rods or inserts shall be provided in buried or submerged locations.

1) ASTM A36 or A307 (standard carbon steel anchor).
2) ASTM A193 Grade B7 (high strength carbon steel anchor).
3) Reinforcing bars as specified in Section 03200 with chisel or cut point.
4) AISI 304/ASTM A276 or AISI 316L/ASTM A276 stainless steel meeting the mechanical requirements of ASTM F-593 (Condition CW).

c. Submit a product evaluation report by ICBO.

d. Provide embedment depth, edge distance, and anchor spacing as shown on the Drawings and in accordance with manufacturer’s recommendations for published allowable loads.

e. For submerged application in potable water provide NSF/ANSI STD 61 certification.

f. Manufacturer: Hilti HIT RE 500 Epoxy Anchoring System, Simpson Strong-Tie Epoxy-Tie ET or ETF (fast cure), Power Fastening Power-Fast Plus, or equal. For materials with voids and holes like hollow block provide Simpson Strong-Tie ETS for Epoxy-Tie, or equal.

2.05 WELDING ELECTRODES, FILLER METALS

A. Steel: AWS A5.1 or A5.5, E70XX category.

B. Stainless Steel: AWS A5.4 or A5.9.

C. Aluminum: AWS A5.3 or A5.10.

D. For welding dissimilar metals, submit the appropriate electrodes for Product Review.
2.06 GALVANIZING

A. Hot-dip galvanize all exterior and exposed steel items, except when specified otherwise.
   1. Sheet steel, plain or shaped: ASTM A525, coating designation G 90, commercial grade.
   2. Products fabricated from rolled, pressed and forged steel shapes, plates, bars and strip 1/8-inch-thick or heavier: ASTM A123.
   5. Where specified, electroplate nuts, bolts and washers with zinc coating of 0.001-inch minimum thickness in accordance with ASTM B633 Class SC4.
      Where specified, provide a 4-mil DFT coating of zinc silicate.
   6. Size nuts so that they screw on threaded bolts readily after galvanizing or coating.
   7. Grind smooth fabricated items at welded joints, edges, and corners, and galvanize after fabrication.

B. Repair Materials: Gal-Viz by Thermacote Welco, Pasadena, CA; ReGalv by Rotometals, Inc., San Francisco, CA; or equal.

2.07 NON-SHRINK GROUT

A. ASTM C1107, Grade C (precision) with no shrinkage as measured by ASTM C827. Furnish a pre-mixed product consisting of properly proportioned amounts of non-metallic dimensionally stable material to which water is added.

2.08 MISCELLANEOUS ITEMS

A. Furnish all items required to complete the project, but not specified herein, not specified in Section 05500.

2.09 FABRICATION

A. Structural Steel Work: Comply with the applicable provisions of the AISC Specification, the AISC Standard Practice and AWS D1.1. Weld only in accordance with favorably reviewed WPSs, which are to be available to welders and inspectors during the production process. Provide workmanship equal to standard commercial practice in modern structural shops.
   1. Fabricate and assemble in the shop to the greatest extent possible, and deliver to the project as a unit ready for installation. Coordinate the work, making all provisions necessary for the passage of all applicable work into, and attachment to, the structures. Make joints carefully and neatly, with corners mitered and spliced, bolted, screwed, or welded together.
   2. Make proper allowance for the expansion and contraction of the metals, and of the materials to which they are fastened.
   3. Make completely watertight joints on exterior work.
   4. Shape all members correctly, with no kinks, twists, dents, or other blemishes prior to erection. Evenly spring all curved work.

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5. Make exposed edges free of burrs, sharp edges or corners. Make corners rounded or chamfered. Grind exposed welds smooth when specified.

6. Include supplementary parts necessary to complete each item, even though such work may not be definitely specified. Provide all such miscellaneous metalwork required by the project in accordance with good accepted standard practice.

7. Review monorail supports and splices with the hoist manufacturer.

8. Shop prime all items that are not galvanized or epoxy coated, including connection angles, using material which is compatible with the finish coat. Provide finish paint coats as specified in Section 09900, or Section 09960.

B. Stainless Steel Work:
1. Use the proper type of stainless steel electrodes or welding rods complying with AWS D10.4. Grind all welded joints smooth and polished, using wheels never used on carbon steel. Provide welds that eliminate injury to stainless steel parts in appearance, strength and resistance to corrosion.

2. Remove by grinding and polishing, all scratches, marks, pits and other blemishes on exposed surfaces incurred during fabrication of the material, until the entire surface possesses the same finish as the adjacent work.

C. Aluminum Work:
1. Comply with the applicable provisions of the AA Manual and AWS D1.2.

2. Back painting: When aluminum is in contact, such as with concrete, mortar, masonry, or adsorptive materials subject to wetting, including condensation, give the contact surfaces a brush coat of cut-back asphaltic, or coal tar paint. Submit paint for favorable review.

D. Base and Bearing Plates: Furnish under all columns, pipe supports, including rack type, supports for tanks, equipment frames and cabinets, and similar items. Provide rounded or chamfered corners.

E. Dissimilar Metals: Insulate the faying surfaces with a brush coat of cut-back asphaltic or coal tar paint or by gasketing. Submit for favorable review.

F. Metals in contact with cementitious or other material: Provide finish coating prior to erection.

2.10 SOURCE QUALITY CONTROL

A. Material Tests: Not required for materials identified with valid mill test records.
1. Unidentified materials: Test samples from each 20 tons of each material, or fraction thereof. Perform tension and bend tests, conforming to ASTM A370 for steel. Perform tension tests conforming to ASTM E8 for aluminum.

2. Do not provide unidentified stainless steel.

3. Testing laboratory: Selected by Engineer, to take samples and perform tests. Costs paid by Contractor.

B. Welding:
1. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.
2. Weld only in accordance with favorably reviewed WPSs, which are to be available to welders and inspectors during the production process.


PART 3 - EXECUTION

3.01 ERECTION

A. Structural Steel Work:
1. Erect members in accordance with the AISC Specification, and the AISC Standard Practice except as modified.

2. Incorrect fabrication or damaged members:
   a. When a condition exists whereby parts cannot be assembled or fitted properly as a result of errors in fabrication, or of deformation due to handling or transportation, report the condition immediately. The method of correction must be approved before any corrective work is done. Make the corrective work in the presence of the Engineer.
   b. Straighten plates and angles or other shapes using approved methods.
   c. Do not heat already heat-treated parts for straightening.

3. Connections:
   a. Provide anchor bolts and other connections between structural steel and foundations.
   b. Set all anchor bolts by template, with provisions to hold bolts rigid and in correct position with respect to plan and elevation.
   c. Install adhesive and expansion anchorages by personnel with satisfactory previous experience using the same Products, following the manufacturer’s recommendations and in compliance with the latest ICBO report.
   d. Detail any undesigned connections in accordance with the AISC Specification
   e. Do not increase any hole diameter or slot length without the Engineer’s approval.

4. Install work anchored in sleeves set in concrete with non-metallic non-shrink grout. Allow a 1/4-inch minimum clearance between items anchored and the sleeve.

5. Where metal is fastened to concrete, make the connections by anchor bolts, or by fastenings embedded in concrete, such as adhesive, or expansion anchors.

6. Provide a 4-inch band of coal-tar epoxy applied, half in concrete and half in air, to galvanized or painted steel, partially embedded in concrete and subject to weathering.

7. Provide grout pads below base and bearing plates of non-shrink non-metallic grout having a minimum thickness of 3/4-inch unless otherwise noted. Do not bear directly on concrete slabs or equipment bases.

8. Provide leveling nuts on anchor bolts, below base plates, and adjust prior to grouting.

9. Complete the work square, plumb, straight and true, accurately fitted, and with tight joints and intersections.
B. Mechanical Anchoring Systems: Mechanical anchoring systems shall be installed in accordance with the manufacturer's installation instructions.

1. Mechanical Undercut Anchoring Systems
   a. Drill a hole in the base material using drill bit diameter and embedment depth in accordance with the manufacturer's instructions. CAUTION: Oversized holes in the base material will make it difficult to set the anchor and will reduce the anchor's load capacity.
   b. Remove dust from holes with compressed air.
   c. Assemble the anchor with the nut and washer so the top of the nut is flush with the top of the anchor.
   d. Place the anchor in the fixture and drive into the hole until washer and nut are tight against the fixture.
   e. Install nut and washer and tighten to the required installation torque.

2. Mechanical Expansion Anchoring Systems
   a. Drill a hole in the base material using drill bit diameter and embedment depth in accordance with the manufacturer's instructions. CAUTION: Oversized holes in the base material will make it difficult to set the anchor and will reduce the anchor's load capacity.
   b. Remove dust from holes with compressed air.
   c. Assemble the anchor with the nut and washer so the top of the nut is flush with the top of the anchor.
   d. Place the anchor in the fixture and drive into the hole until washer and nut are tight against the fixture.
   e. Install nut and washer and tighten to the required installation torque.

3. Mechanical Drop-In Anchoring Systems
   a. Drill a hole in the base material using drill bit diameter and embedment depth in accordance with the manufacturer's instructions. CAUTION: Oversized holes in the base material will make it difficult to set the anchor and will reduce the anchor's load capacity.
   b. Remove dust from holes with compressed air.
   c. Insert anchor into the hole. Tap with hammer until flush against the surface.
   d. Using the drop-in setting tool, drive the expander plug towards the bottom of the anchor until shoulder of setting tool makes contact with the top of the anchor.

C. Adhesive Anchoring Systems: Adhesive anchoring systems shall be installed in accordance with the manufacturer's installation instructions.

1. Adhesive (Ester) Capsule Anchoring Systems
   a. Drill to specified depth and diameter.
   b. Remove dust from holes with compressed air.
   c. Install in clean holes free of standing water.
   d. Insert capsule(s) to the bottom of hole.
   e. Drive stud or rod to the bottom of hole. Some anchoring systems require drill rotation with hammering action. Do not disturb anchor during the specified cure time.

2. Adhesive (Ester or Epoxy) Injection Anchoring Systems
   a. Drill to specified depth and diameter.
   b. Clean hole with a wire brush. Remove dust from holes with compressed air.
c. Install in clean holes free of standing water.
d. Dispense bead of adhesive off to the side to check for proper mixture before using.
e. Fill hole halfway to 2/3rds, starting from bottom of hole to prevent air pockets. Withdraw nozzle as hole fills up.
f. Insert anchor, turning slowly until the anchor contacts the bottom of the hole. Do not disturb anchor during the specified cure time.

D. Welding:
1. Weld only in accordance with favorably reviewed WPSs, which are to be available to welders and inspectors during the production process. Perform all welding by the shielded electric arc method in accordance with AWS D1.1.
2. Repair and make additional inspections, at the Contractor's expense, of the weld areas which have been rejected as a result of inspection. Follow this procedure until the welds are acceptable to the Engineer.
3. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.

E. High Strength Bolting:

F. Repair of Connections: The Contractor shall pay for all necessary additional tests made on weld or bolts required to repair or replace faulty work performed during the original fabrication or during erection.

G. Repair of Galvanized Coating:
1. Repair surfaces damaged by cutting or welding by the heated repair method. Repair handrails or other surfaces that will not be painted and that are field welded or damaged by the heated galvanize repair method.
2. Heat substrate to 600°F, or apply hot process touch-up material right after welding before metal has cooled below 600°F.
3. Rub bar of specified galvanize repair material over surface of hot substrate to apply a uniform coating of zinc. Wire brush hot coating with a clean wire brush to smooth out and bond zinc coating to substrate to apply a uniform coating of zinc.

3.02 FIELD QUALITY CONTROL

A. Welding:
1. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.
2. The Owner's testing agency will inspect shop or field welding for conformance with AWS D1.1 requirements and will verify that welds are made in accordance with favorably reviewed WPSs.

B. High Strength Bolting: Verify procedures are followed.

C. Concrete and Masonry Anchorages: Verify manufacturer's installation recommendations are followed and comply with the ICBO report.
D. Erection Sequence: Verify each stage is completed before proceeding to the next.


END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Metal joists fabricated from structural steel including open web steel joists, steel joist girders, longspan steel joists, and deep longspan steel joists. Contractor is responsible for the design, manufacture, and installation of steel joists as shown on the Drawings.

B. Related Sections:
   1. Section 05100: Structural Metal Framing
   2. Section 05310: Steel Decking

1.02 REFERENCES

A. American Society for Testing and Materials Standard Specifications:
   1. ASTM A36 Carbon Structural Steel
   2. ASTM A242 High-Strength Low-Alloy Structural Steel
   3. ASTM A529 High-Strength Carbon-Manganese Steel of Structural Quality
   4. ASTM A572 High-Strength Low-Alloy Columbium-Vanadium Structural Steel
   5. ASTM A588 High-Strength Low-Alloy Structural Steel with 50 ksi Minimum Yield Point to 4 in. Thick
   6. ASTM A606 Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
   7. ASTM A1008 Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
   8. ASTM A1011 Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

B. Steel Joist Institute (SJI) Standard
   1. 41st Edition Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders

C. American Institute of Steel Construction Specification for Design, Fabrication, and Erection of Structural Steel for Buildings (Allowable Stress Design)

D. American Iron and Steel Institute Specification for the Design of Cold-Formed Steel Structural Members
1.03 DEFINITIONS

A. Open Web Steel Joists: Open web, parallel chord, load-carrying members suitable for the direct support of floors and roof decks in buildings, utilizing hot-rolled or cold-formed steel, including cold-formed steel whose yield strength has been attained by cold working. Open web steel joists also include longspan, deep longspan, and super longspan type open web steel joists.

B. Steel Joist Girders: Open web, primary framing members, designed as simple span members supporting equally spaced concentrated loads from open web steel joists.

1.04 SYSTEM DESCRIPTION

A. Design Requirements:
   1. The design of chord sections for open web steel joists shall be based on a yield strength of 50 ksi. The design of web sections for open web steel joists shall be based on a yield strength of either 36 ksi or 50 ksi. The design of chord and web sections for longspan, deep longspan, super longspan type open web steel joists and joist girders shall be based on a yield strength of at least 36 ksi, but not greater than 50 ksi.
   2. Joists and joist girders shall be designed in accordance with AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings and the AISI Specification for the Design of Cold-Formed Steel Structural Members.
   3. Joists and joist girders shall have their components so proportioned that the unit stresses in tension, compression, bending and weld stresses shall not exceed the allowable stresses as contained in the standard specifications of the Steel Joist Institute.

1.05 SUBMITTALS

A. Quality Assurance/Control Submittals
   1. Design Data: Submit design data, calculations, and drawings of all open web steel joists and joist girders. Submit shop drawings with detailed dimensions showing the number, type, location, spacing, anchorage and mark of all joists and joist girders.
   2. Certificates: Affidavits or certified test reports for steel yield strength.

1.06 QUALITY ASSURANCE

A. Qualifications: All welders used in the manufacture of steel joists shall be certified to American Welding Society standards. All welds shall be in accordance with the Steel Joists Institute's welding criteria. Open web steel joists shall be designed in accordance with the latest edition of the standard specifications of the Steel Joist Institute.

B. Regulatory Requirements: THE CONTRACTOR AND THE STEEL JOIST ERECTORS SHALL COMPLY WITH THE OSHA INTERPRETATION OF 29CFR-1926.751(C)2 TO MEAN ALL JOIST FORTY (40) FEET (12192MM) AND
LONGER TO REQUIRE A ROW OF BOLTED BRIDGING TO BE IN PLACE BEFORE SLACKENING OF HOISTING LINES.

C. Pre-Installation Meetings: The Contractor, the erector, the inspectors and other interested parties shall meet prior to installing open web steel joists and joist girders to review handling, field welding, and stability requirements for joists and joist girders.

1.07 DELIVERY, STORAGE AND HANDLING

A. Handle, ship and store material in a manner that will prevent distortion, rust, damage to the shop coat or any other damage. Care shall be exercised at all times to avoid damage to the joists and joist girders and accessories through careless handling during unloading, storing, and erecting. Dropping of joists or joist girders shall not be permitted.

B. The Contractor shall inspect all joists and joist girders upon delivery at the site and notify the fabricator of any discrepancies or damage before erecting joists and joist girders.

C. The Contractor shall store and protect joists and joist girders at the site to prevent any damage to the joist or joist girders and accessories including protective coatings and paint finish. Store material in a clean, properly drained location out of contact with the ground.

D. Ensure that dissimilar metals are not in contact with each other.

E. Replace or repair all damaged material in an approved manner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Open web steel joist and joist girders shall be as manufactured by Vulcraft, a Division of Nucor Corporation, Valley Joist, or equal.

2.02 MATERIALS

A. The yield strength of all steel used shall be at least 36 ksi but shall not be greater than 50 ksi. Submit affidavit or certified test reports that the steel meets or exceeds the specified yield strength.

B. The welding electrodes used for arc welding shall conform to the standard specifications of the Steel Joist Institute.

C. The Contractor shall provide all accessories for the open web steel joists and joist girders including miscellaneous framing between joists for openings in ducts, skylights, access hatches, etc. Loose individual or continuous bearing plates and
bolts or anchors for such plates. Horizontal bracing in the plane of the top and bottom chords from joist to joist or joist to structural framing or walls.

2.03 MANUFACTURED UNITS

A. Concentrated and Non-Uniform Loads:
   1. Concentrated design loads and other non-uniform design loads on steel joists are shown on the Drawings. The location and magnitude of the loads are shown on the Drawings. The joist manufacturer shall provide special joists, labeled “SP”, for these locations.
   2. The joist manufacturer shall either shop install an additional web member or field install an additional member at all concentrated loads not occurring at panel points.

B. Members:
   1. Chords: Bottom and top chords shall be designed to resist axial and bending stresses in accordance with the SJI standard specifications. Top chords shall be attached to roof or floor slabs or decks with an attachment capable of resisting a lateral force of not less than 300 pounds and a spacing not exceeding 36 inches.
   2. Web: Web members shall be designed to resist vertical shears in accordance with the SJI standard specifications.
   3. Fillers and Ties: Fillers, ties or welds shall have l/r ratios in accordance with the SJI standard specifications.
   4. Eccentricity: Due consideration shall be given to the eccentricity of members connected at a joint in accordance with the SJI standard specifications.
   5. Extended Ends: Refer to the Drawings for details for extended top chords or full depth cantilever ends. Refer to the Drawings or request detailed information from the Engineer for the magnitude and location of the design loads to be supported, the deflection requirements, and the bracing to be provided for extended top chords or full depth cantilever ends.

C. Connections:
   1. The methods, strength, splices, and eccentricity of joist and joist girder connections shall be in accordance with the standard specifications of the Steel Joists Institute. Refer to the SJI standard specifications for inspection requirements for welded connections.

D. Bridging:
   1. Bridging is required and shall consist of either horizontal or diagonal bridging in accordance with the SJI standard specifications. The number of rows of bridging shall be in accordance with the bridging table in the SJI standard specifications.
   2. The joist manufacturer shall check the bridging requirements and provide bridging as required to adequately brace the top chord against lateral movement under full loading conditions.
   3. Uplift forces due to wind are shown on the Drawings. The joist manufacturer shall check the design of the joists and bridging for uplift loads. As a minimum
the joist manufacturer shall provide a single line of bottom chord bridging near the first bottom chord panel point at each end of the joist.

4. The joist manufacture shall detail and provide termination for all bridging lines terminating at walls or beams including the end anchorage. The Contractor shall provide anchor bolts for bridging end anchorage.

5. Bridging shall not be welded to joist web members. Do not hang any mechanical, electrical or other systems piping, conduit, or equipment from bridging.

6. Where bottom chord bearing joists are utilized a row of diagonal bridging shall be provided near the support to provide lateral stability. Install the bridging as the joists are set in place.

7. Joist girders shall be erected without bridging. The ends of the bottom chords of joist girders shall be restrained from lateral movement in order to brace the girder from overturning. No loads shall be placed on Joist Girders until the open web steel joists bearing on the girder are in place and welded to the girder.

2.04 FINISHES

A. Shop Priming: Steel joists shall receive a shop-coat of rust inhibitive primer whose performance characteristics conform to those of the standard specification of the Steel Joist Institute. The standard shop paint is a primer coat intended to protect the steel for only a short period of exposure in ordinary atmospheric conditions and shall be considered an impermanent and provisional coating. The standard shop paint shall conform to SSPC Specification 15-68T, Type 1 (red oxide), Federal Specification TT-P-636 (red oxide), or equal.

B. Provide finish paint coats as specified in Section 09900, or Section 09960.

C. Joists, outriggers, joist extensions, bracing, bridging, and any other metal items associated with the roof framing system on the Solids Processing Building shall be galvanized in accordance with ASTM A653, G-90 Commercial Grade.

2.05 SOURCE QUALITY CONTROL

A. Inspection: The manufacturer shall notify the Owner of the schedule for plant fabrication of open web steel joists and joist girders so that the Owner or the Owner’s representative may witness in-plant tests and inspections.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that steel bearing plates have been provided for masonry and concrete end supports in accordance with the requirements of the SJI standard specifications. Verify that the steel bearing plates for open web steel joists bear at least 4 inches over the concrete or masonry. Verify that the steel bearing plates for joist girders bear at least 6 inches over the concrete or masonry. Steel bearing plates shall not be located more than ½ inch from the face of the wall or column.
3.02 PREPARATION

A. The Contractor is responsible for all protection and safety requirements during erection and handling of steel joists and joist girders. If it is necessary for the erector to climb on the joists, extreme caution must be exercised since unbridged joists may exhibit some degree of instability under the erector's weight.

B. The Contractor is responsible for measuring the supporting concrete, masonry, and steel structures for support of steel joists and joist girders and any adjustments in the structures for proper fit of joists and joist girders.

3.03 ERECTION

A. All bridging and bridging anchors shall be completely installed before construction loads are placed on the joists.

B. THE CONTRACTOR AND THE STEEL JOIST ERECTORS SHALL COMPLY WITH THE OSHA INTERPRETATION OF 29CFR-1926.751(c)2 TO MEAN ALL JOIST FORTY (40) FEET (12192MM) AND LONGER TO REQUIRE A ROW OF BOLTED BRIDGING TO BE IN PLACE BEFORE SLACKENING OF HOISTING LINES.

3.04 INSTALLATION

A. Verify that the steel bearing plates for open web steel joists bear at least 4 inches over the concrete or masonry. Verify that the steel bearing plates for joist girders bear at least 6-inches over the concrete or masonry. Verify that the ends of joists extend at least 2½ inches over steel supports and the ends of joist girders extend at least 4 inches over steel supports. Notify the Engineer if the above bearing requirements for open web steel joists or joist girders cannot be satisfied.

B. Anchorage of the ends of open web steel joists and joist girders shall be as shown on the Drawings. As a minimum provide end anchorage for either masonry or concrete or steel supports in accordance with the SJI standard specifications.

C. The Contractor shall provide means for adequate distribution of concentrated loads so that the carrying capacity of any joist is not exceeded.

D. The Contractor and the erector shall comply with all erection stability and handling requirements of the SJI standard specifications.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Labor, materials, equipment and services to furnish and install all decking, including connectors, accessories, closures and all pieces required to make the decking complete.

B. Related Sections:
   1. Section 03300: Cast-In-Place Concrete
   2. Section 05100: Structural Metal Framing
   3. Section 05500: Metal Fabrications
   4. Section 09900: Painting

1.02 REFERENCES

A. American Iron and Steel Institute:
   1. AISI Manual Cold-Formed Steel Design Manual

B. American Society for Testing and Materials Standard Specifications:
   1. ASTM A525 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   2. ASTM A653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   3. ASTM A780 Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

C. American Welding Society:
   1. AWS D1.3 Structural Welding Code - Sheet Steel
   2. AWS A5.1 Mild Steel Covered Arc-Welding Electrodes

D. Factory Mutual Engineering Corporation, Loss Prevention Data:
   1. FM 1-28 Insulated Steel Deck

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data:
   1. Metal deck unit cross-section, with dimensions and section properties.
   2. Accessories and methods of installation, including reinforcement at openings.
   3. Deck unit manufacturer's installation directions.
   4. Welding equipment data, including type, voltage and amperage.
C. Shop Drawings:
   1. Metal deck units, details and layouts.
   2. Erection sequence and procedure.
   3. Welded connection location, type and sequence.
   4. Size and number of openings to be cut.
   5. Indicate both fire-resistance-rated construction and non-rated construction.

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. AISI Manual.
   2. AWS D1.3.
   3. FM 1.28.

B. Welding Procedures: AWS D1.3.

C. Welders:
   1. Satisfy AWS D1.3 qualification procedure.
   2. All welding operators are subject to examination for requalification at any time during the progress of the work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Before erection, stack the decking stored at the site on platforms or pallets and cover to provide a weathertight enclosure.

B. Store packaged materials in their original, unbroken packages in a dry area until ready for installation.

C. Do not use metal decking for storage or as a working platform. Do not damage or overload roof decking during construction.

PART 2 - PRODUCTS

2.01 STRUCTURAL-QUALITY STEEL SHEETS

A. ASTM A446, Grade A and hot-dip galvanize to ASTM A525, Type G90.

2.02 ELECTRODES FOR MANUAL SHIELDED METAL ARC WELDING

A. AWS D1.3. Provide covered mild steel electrodes conforming to AWS A5.1, E60 series.

2.03 GALVANIZING REPAIR PAINT

A. ASTM A780. High-zinc-dust content paint for regalvanizing welds in galvanized steel.
2.04 DECKING

A. Metal Deck Units:
   1. Fabricate with the specified structural-quality steel sheets.
   2. Refer to Drawings for sheet thickness and section properties.
   3. Provide fluted or corrugated section with interlocking type side laps.

B. Length of Deck Units: Span three or more spacings where possible.

C. Metal Closures Between Decking and Other Construction: Fabricate from the specified structural-quality steel sheets not less than nominal 0.0478-inch (18-gauge) thick before galvanizing.

D. Provide the configuration required to provide tight-fitting closures at open ends of flutes and sides of the roof decking.

PART 3 - EXECUTION

3.01 GENERAL

A. Install metal deck units and accessories in accordance with the approved Shop Drawings, descriptive data and as specified.

B. Do not exceed carrying capacity of decking with construction loads.

C. Do not use decking for storage or working platforms until permanently secured in position.

3.02 WELDING

A. Comply with AWS D1.3.

3.03 PLACING DECK UNITS

A. Verify that supporting members are completely in place and interconnected before the placing is started.

B. Place units on the supporting steel framework or concrete, or masonry wall and adjust to final position with ends bearing on the supporting members accurately aligned, end to end, before being permanently fastened. Provide not less than 3 inches of end bearing.

C. Place deck units in straight alignment for the entire length of run and with close alignment between flutes at ends of abutting deck units. Place and align the units to maintain the required number of units indicated on the approved Shop Drawings and to prevent stretching or contracting of the sidelap interlocks.
3.04 FASTENING DECK UNITS

A. Fasten to the steel supporting members at ends and at intermediate supports by fusion welds. Refer to Drawings for weld size and spacing. Coordinate the welding sequence and procedure with the placing of deck units.

B. For all spans, lock sidelaps between adjacent deck units together as noted on Drawings or at intervals not exceeding 24 inches on centers by welding.

C. Reject any units with unwelded blowholes.

3.05 JOINT COVERS

A. Provide pressure sensitive tape for abutting ends of the deck units.

3.06 HANGER SUPPORTS

A. Reinforce local decking area to receive hangers for support of the ceiling construction, air ducts, diffusers and lighting fixtures as indicated on Drawings.

3.07 CUTTING AND FITTING

A. Perform where indicated and as required for the passage of other work projecting through, or adjacent to, the decking.

B. Provide additional metal reinforcement and closure pieces, as required for strength, continuity of the decking, or the support of other work.

3.08 REINFORCEMENT AT OPENINGS

A. Reinforce decking around openings 6 to 12 inches in size by means of a flat, galvanized, structural-quality steel sheet placed over the opening on the top of the decking and fusion welded to the surface of the roof decking. Provide sheets not less than nominal thickness of 0.0478-inch (18 gauge) before galvanizing and at least 12 inches wider and longer in size than the opening. Do not exceed 12 inches on centers weld spacing, with not less than one weld at each corner.

3.09 METAL CLOSURES

A. Provide metal closures for open ends of flutes at openings, walls and other building construction and to close openings between decking and other building construction. Tack weld metal closures in position.

3.10 TOUCHUP PAINTING AND GALVANIZING

A. Prior to installation, provide the specified final coating on any surfaces that cannot be painted after erection. Refer to Section 09900 for painting procedure.

B. After completion of decking installation, wire brush, clean and touchup scarred areas on the top and bottom surfaces of the metal decking and on the surface of
supporting steel members. Scarred areas include welds, weld scars, bruises and rust spots. Touchup galvanized surfaces with galvanizing repair material. Refer to Section 05500 for galvanizing repair procedure.

END OF SECTION
SECTION 05500

METAL FABRICATIONS (MISCELLANEOUS METAL)

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. All metal fabrications and other miscellaneous metal items together with related accessory items and fasteners, including:
      a. Aluminum stairs.
      b. Stair treads and nosings.
      c. Chain closures.
      d. Gratings.
      e. Grating support angles.
      f. Floor plates.
      g. Steel angle edgers.
      h. Steel channel and angle door frames.
      i. Steel fascias, angles and trim exposed as part of the finished structure.
      j. All other metal fabrications and miscellaneous metal not covered under other sections.

B. Related Sections:
   1. Section 05100: Structural Metal Framing
   2. Section 05722: Aluminum Ladders
   3. Section 05724: Aluminum Component Railing System

1.02 REFERENCES

A. American National Standards Institute:
   1. B18.23.1 Beveled Washers

B. American Society for Testing Materials:
   1. A36 Specification for Carbon Structural Steel
   2. A53 Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless
   3. A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   4. A153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   5. A283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
   6. A307 Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
   7. A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
   8. A501 Specifications for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
9. A653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Gavannealed) by the Hot-Dip Process
10. C595 Specification for Blended Hydraulic Cement
11. F844 Specification for Washers, Steel, Plain (Flat), Unhardened for General Use

C. Publications of the National Association of Architectural Metal Manufacturers (NAAMM):
   1. "Metal Product Outline; Division 5 Metal"
   2. "Metal Stair Manual"
   3. "Metal Finishes Manual"
   4. "Pipe Railing Manual"
   5. "Metal Bar Grating Manual"

D. Steel Structures Painting Council (SSPC), Volume 2. Standards for Surface Preparation are specified by SSPC followed by SP and a number indicating the specified type of surface preparation.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe every product proposed for use.

C. Shop Drawings:
   1. Show dimensions, finishes, joining, attachments, inserts, and relationship of work to adjoining construction.
   2. Indicate all shop and erection details including cuts, copes, connections, holes, threaded fasteners and welds. Indicate welds using AWS "Welding Symbols."
   3. Show field measured dimensions of this and adjacent work and location of inserts on fabrication drawings.
   4. Submit a full floor plan layout and details for all grating and plate angle frames and gratings and plates.

1.04 QUALITY ASSURANCE

A. Contractor's Qualifications: Welding procedures, welders, and welding operations shall be qualified for the type of work required in accordance with AWS Standard Qualification Procedures.

B. Regulatory Requirements: Comply with the following codes and reference standards unless higher standards are specified, shown or required by applicable codes:
4. Stair, guardrail and accessibility design requirements in UBC, OSHA and the Federal Americans with Disabilities Act (ADA).

C. Testing:
   1. Test materials in accordance with Section 05100.
   2. Test welding in accordance with Section 05100.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver anchorage devices that will be embedded in the work of other trades in sufficient time to permit their timely installation. Provide proper setting drawings, templates and directions for installation.

B. Store materials above ground on platforms, skids or other supports. Store all fasteners and welding electrodes in a weathertight and dry location until ready for use. Store packaged materials in their original labeled containers.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Standard Structural Steel Shapes, Bars and Plates: ASTM A36.

B. Architectural and Miscellaneous Steel Items: ASTM A283, Grade A.

C. Steel Tubing: ASTM A500, (cold formed) Grade A, or ASTM A501 (hot formed), welded or seamless.

D. Steel Pipe: Seamless, conforming to ASTM A53, Type E or S, Grade B.

E. Aluminum: ASTM B483, Alloy 6061-T6 or 6063-T5 or T6.

F. Bolts and Nuts: ASTM A307, Grade A.

G. Plain Washers: ASTM F844.


I. Anchorages to Concrete and Masonry:
   1. Refer to Section 05100 for anchors carrying shear or tension loads 400 lbs. or more.
   2. Provide cast-in-place, expansion or bonded anchorages with minimum size 3/8-inch-diameter, 3-inch embedment.
   3. Provide a satisfactory evaluation report by ICBO.
   4. Do not load the anchorage in excess of half the ICBO values without inspection by Engineer.
   5. Material: Stainless steel unless noted otherwise on the Drawings.
   6. Do not use for loads in tension or withdrawal or for loads subject to vibration.
J. Drive-Anchors: One-piece deformed spring steel anchor: RAWL-Drives, Buildex, or equal. 1/4-inch minimum diameter. Drive anchors shall be long enough so that all of the deformed portion plus 1/2-inch will be embedded in the concrete or masonry. Use for loads less than 200 pounds.

K. Non-Shrink Grout: ASTM C1107, Grade C (precision) with no shrinkage as measured by ASTM C827. Furnish a pre-mixed product consisting of properly proportioned amounts of non-metallic dimensionally stable material to which water is added.

L. Safety Stair Nosings: Nosing base to be extruded aluminum type 6063-T5 filled with resilient epoxy binder (13%) combined with a filler that contains at least 60% aluminum oxide abrasive. Provide a minimum coefficient of friction of 0.50. Furnish in two contrasting colors having a difference in light reflectivity of at least 70% to meet ADA requirements for the visually impaired. Top surface 3 inches wide; 1/4-inch thick. American Safety Tred #3511 for poured concrete stairs; equivalent products by Wooster; or equal.

2.02 GALVANIZING

A. Hot-dip galvanize all exterior ferrous metal work and all interior ferrous metal work so noted.

B. Hot-dip galvanize all sheet steel, plain or shaped in accordance with ASTM A653, G-90 Commercial Grade.

C. Hot-dip galvanize all products fabricated from rolled, pressed and forged steel shapes, plates, bars and strip 1/8-inch thick or heavier, in accordance with ASTM A123.

D. Hot-dip galvanize all steel hardware, nuts, bolts, washers, anchors, and threaded rods in accordance with ASTM A153. Size thread clearance to allow for galvanized coating; rerun threads after galvanizing, if required, to assure a smooth fit.

2.03 GALVANIZING REPAIR

1. Heat substrate to 600°F, or apply hot process touchup material right after welding before metal has cooled below 600°F.
2. Rub bar of specified galvanize repair material over surface of hot substrate to apply a uniform coating of zinc. Wire brush hot coating with a clean wire brush to smooth out and bond zinc coating to substrate.

2.04 SHOP PRIMING

A. Refer to Section 09900 for surface preparation, pretreatment, primers, and application techniques.
B. Apply one shop coat of rust inhibiting primer in accordance with Section 09900 or urethane zinc-rich primer in accordance with Section 09960 to all steel fabrications not scheduled to be galvanized.
  1. Apply two coats of primer to surfaces not in contact but inaccessible after assembly.

2.05 ISOLATION COATINGS

A. Aluminum pigmented asphalt paint for aluminum in contact with other metals.

B. Asphalt or bituminous mastic for aluminum in contact with concrete or plaster.

2.06 FABRICATIONS

A. Aluminum Stairs with Grating Treads:
  1. Stringers and connectors: Fabricate from structural aluminum shapes.
  2. Treads:
     a. Aluminum bar grating, welded rectangular design, 1 ½-inch x 3/16-inch bearing bars spaced 1-3/16-inch on centers with 1/2-inch x 3/16-inch cross bars spaced 4 inches on centers.
     b. Safety nosings: Provide a 2-inch-minimum width aluminum angle or channel nosing with a colored abrasive surface meeting the slip-resistance and visually impaired requirements specified under paragraph 2.01 of this Section.
  3. Intermediate Landings:
     a. Aluminum bar, welded rectangular design gratings with bars spaced 1-3/16 x 4 inches on center and complying with the paragraph headed "Gratings" in this Section.
     b. Safety nosings: Provide a safety nosing meeting the requirements for nosings on grating treads for grating landings; meet the requirements of paragraph 2.01 of this Section for concrete landings.
  4. For interior stairs the top and bottom nosings shall have a 70% contrast with adjacent surfaces; for exterior stairs all nosings shall have a 70% contrast with adjacent surfaces.
  5. Guardrails for metal stairs: Fabricate from aluminum pipe using same materials and fabrication method described for guardrails in Section 05724. Attach rail posts to stringers by field welding or with bent anchor plate and four bolts.

B. Channel and Angle Door Frames:
  1. Construct channel and angle door frames using hot-rolled steel channels and bars or steel angles and bars. Provide single piece head members and jamb members without splices or joints.
  2. Fabricate anchors from steel bars or plate, welded to frames. DO NOT USE welding studs (Nelson studs) to anchor members to concrete.
  3. Mortise, reinforce, drill and tap frames to receive finish hardware. Coordinate detailing of frames with finish hardware requirements (Section 08700) prior to fabrication of frames.
  4. Hot-dip galvanize all channel and angle door frames after fabrication. Retap screw holes after galvanizing. Miter weld and grind smooth door frame
corners. Fabricate door frames too large to permit galvanizing as a single unit as separate head and jamb members with concealed bolted connections at top corners.

5. Deliver door frames as shop-fabricated single-piece units when possible.

C. Steel Angle Edgers: Provide steel angle edgers detailed and sized as shown, with anchors welded to the angle. Galvanize after fabrication in place. Secure angle edgers that will be cast in concrete in the forms so that when the forms are stripped, the concrete and edgers will be flush.

D. Chain Closure: Provide chain closures and related fittings made from 5/16-inch-316 stainless steel, with oblong links. Provide three chains 4 inches longer than the anchorage spacing for each guarded area. Provide each chain with boat type snap hooks at each end. Provide eye bolts with 3/8-inch-shank diameter and with 7/8-inch eye for attachment of chains at each anchorage. Provide fittings of the same material and finish as the chain.

E. Grating Support Frames:
2. Provide grating support angles for all gratings. Fabricate grating support angles in complete, closed frames that will lie completely flat in a true plane. Install grating frames so they will support the grating with even, uniform, non-rattling bearing.
3. Design and fabricate grating frames as required to prevent twisting due to any large ratio of length to width. Restrict the length of each closed section of long narrow grating frames to 10 feet maximum.
5. Coat upper surfaces of grating support frames with bituminous mastic.

F. Grating:
1. Provide gratings that comply with requirements in the NAAMM Metal Bar Grating Manual.
3. Aluminum grating:
   a. Manufacturer: Ohio Gratings Inc.; Seidelhuber; or equal.
   b. Aluminum alloy 6063-T6 rectangular bar gratings with a serrated top surface, pressure locked, 1-3/16 x 4-inch bar spacing unless noted otherwise.
   c. Provide banding strips same depth as main bars at grating ends and at all cut openings. Anchor gratings in place with stainless steel bolts. Fabricate with top surface of all bars flush. Install grating flush with adjacent concrete or other walking surfaces.
   d. Furnish gratings with bar sizes and intermediate supports sized to support superimposed loads of 150 lbs. per square foot with deflection limited to 1/4-inch, unless noted otherwise on the Drawings.
   e. Field measure installed grating frames before fabricating gratings.
   f. Provide grating panels that are absolutely flat, correctly sized, and fabricated to lie in their frames with uniform, non-rattling bearing on all supporting surfaces.
   g. Band: Ends of all fixed and removable grating sections. Weld banding bars of the same thickness as the main bearing bars to the ends of all
bearing and cross bars. Weld the banding bars flush with the bearing bars at each panel corner and grind the weld smooth and flush. Round all edges and corners to 1/8-inch radius.

h. Band all shop and field cutouts and openings. Weld the banding bars to all cut bearing and cross bars.

i. Leave "split" openings in the gratings when required for the passage of pipes, valve stems or other devices.

j. Provide "fixed" grating for all operating grating platforms. Bolt "fixed" grating to support members.

k. Where required for access or where noted, provide removable grating sections sized to limit the weight of any one section to 70 pounds.

l. Bolt removable sections in place by the same method used for fixed grating. Mark removable sections.

G. Floor Plates and Support Frames:

1. Aluminum 3/4-inch-thick checkerplate with full edge banding and stiffeners sized and spaced as required to support 150 pounds per square foot superimposed loads.

2. Support on a stainless steel welded angle frame and set below the floor so that the surface of the floor plate will be flush with the floor.

2.07 ATTACHMENTS

A. Metal Anchors: Provide metal anchors required to secure all frames and other items rigidly in place and detailed for installation into concrete forms prior to placing concrete.

B. Anchor Bolts: Full diameter hot-dip galvanize steel unless otherwise shown. DO NOT USE welding studs (Nelson studs) to anchor members to concrete.

PART 3 - EXECUTION

3.01 ERECTION TOLERANCES

A. Conform to straight plumb and horizontal lines which also form a true flat plane to within 1/8-inch in 2 feet and 1/4-inch in 10 feet and 1/2 maximum overall.

B. Curved surfaces shall conform to a true arc of a circle to within 1/8-inch in 12 inches and 1/4-inch maximum overall.

3.02 INSTALLATION GENERAL

A. Fabricate and pre-fit metal work in the shop, in transportable components ready for field erection.

B. Make proper allowance for expansion and contraction of the metals and of the materials to which they are fastened.
C. Where metal is fastened to concrete, make the connection by means of sleeves and fastenings embedded in concrete or by expansion shield anchor bolts or wedge anchor bolts. Wood plugs, plastic plugs or powder driven studs are not acceptable.

D. Construct metal work in accordance with AISC Standard practices to withstand the forces normally applied and in compliance with UBC and OSHA requirements.

E. Grind welds smooth on all metal work exposed to view. Provide work that has:
   1. Surfaces that are flat, straight, square, plumb and level.
   2. Smooth curves, free of flat spots, and of uniform radius or, if intended to be of changing radius, follow a flowing fair curve.
   3. Make transitions between curved and straight portions of work at tangent points to achieve smooth and free flowing lines and surfaces without flat spots or abrupt changes in direction.

F. Provide 1/8-inch radius corners and edges on all exposed work.

G. Perform all welding in accordance with AWS Code D1.1. Employ methods and techniques to achieve strength and good appearance.

H. Field Assembly: Set members to lines and elevations indicated. Align and adjust members before making permanent connections.

I. Galvanized Metal Repair: Repair damaged galvanized metal by the heated substrate method as specified in paragraph 2.03.

J. Touchup Painting (Ferrous Metals): After field assembly, clean all bare metal and all abrasions to shop coat, and spot paint with same primer used in the shop.

3.03 STAIRS AND PLATFORMS

A. Furnish anchor bolts and other connectors required for connection to concrete or other materials.

B. Set structural members to lines and elevations shown. Align and adjust members before making permanent connections.

C. Where stairs land on sloping floors, the height of the first riser at the center of the stair shall be equal to the height of all other risers.

3.04 METAL STAIR NOSINGS

A. Provide safety stair nosings in accordance with paragraph 2.01 of this Section at all concrete stairs and landings. Make nosings the full length of each tread less 2 inches at each end. Protect exposed surfaces of safety nosings during construction and leave the surfaces clean and free of concrete and staining.

B. For interior stairs, provide a top and bottom nosing that contrast with adjoining surfaces and nosings on intermediate treads. For exterior stairs, provide nosings
on all treads that contrast with surrounding surfaces. Adequate contrast is defined as a 70% difference in light reflectivity.

3.05 GRATINGS AND FLOOR PLATES

A. Install support frames so that gratings and floor plates have continuous support and so gratings and floor plates will sit in their frames without rattling or rocking in any direction including across diagonal corners.

3.06 MISCELLANEOUS

A. Furnish the following for field installation:
   1. Miscellaneous metal work not specified in other sections.

3.07 REPAIRS

A. Repair or replace all defective work including:
   1. Unsightly welds.
   2. Discontinuous welds.
   3. Uneven connections.
   4. Variations exceeding specified tolerances.
   5. Kinks, bends.
   6. Other defects affecting the quality, strength, utility and appearance of the work.

3.08 CLEANING

A. Wash thoroughly using clean water and detergent.

B. Do not use acid solutions, steel wool or other abrasives.

C. Remove stubborn grease stains with mineral spirits.

END OF SECTION
SECTION 05722
ALUMINUM LADDERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Aluminum ladders.

B. Related Sections:
   1. Section 05100: Structural Metal Framing
   2. Section 05500: Metal Fabrications (Miscellaneous Metal)
   3. Section 05724: Aluminum Component Railing System

1.02 REFERENCES

A. Aluminum Association:
   1. ASD-1 Aluminum Standards and Data (Aluminum Alloys and Tempers).

B. American Society for Testing Materials:
   1. B244 Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and Other Nonconductive Coatings on Non-Magnetic Basis Metals with Eddy-Current Instruments

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe all products proposed for use.

C. Shop Drawings:
   1. Show all dimensions, materials, alloys, finishes, joining, attachments, inserts, and relationships of work to adjoining construction.
   2. Indicate all shop and erection details including cuts, copes, connections, holes, threaded fasteners and welds. Indicate welds using AWS “Welding Symbols.”
   3. Show field measured dimensions of this and adjacent work.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. The fabricator and installer must be a State Licensed Specialty Contractor regularly engaged in custom fabrication and installation of fully welded and anodized architectural aluminum.
   2. Welding procedures, welders, and welding operations shall be qualified for the type of work required in accordance with AWS Standard Qualification Procedures.
B. Comply with the following Regulatory Requirements:

C. Comply with the following trade association and reference standards:

D. Samples of the following items illustrating the required level of workmanship are available for inspection at the Engineer's office:
   1. Grinding and finishing welds.
   2. A three-way rounded (hart) miter.

1.05 DELIVERY, STORAGE AND HANDLING

A. Provide anchorage devices in time to be incorporated in other work. Provide setting drawings, templates and directions for installation.

B. Store materials aboveground on platforms, skids or other supports. Store all fasteners and welding electrodes in a weathertight and dry place. Store packaged materials in their original containers.

PART 2 - PRODUCTS

2.01 FABRICATION OF ALUMINUM LADDERS

A. General: Aluminum alloy 6063-T5 or T6. Tightly fit and fully weld all joints using a gas shielded arc process. Size welds to develop the full strength of members joined. Grind flush welds smooth; grind fillet welds to a uniform radius. Round all exposed edges, corners and ends to a 3/16-inch radius. Sand welds and blend in to match finish of adjacent metal.

B. Rails: 1/2-inch x 3-inch flat bar drilled for insertion of rungs. Ease all edges, ends and corners of rails to a 3/16-inch radius.

C. Rungs: 1-inch-diameter solid bar inserted through holes drilled in the rails and welded on the outside or use 1-inch-square serrated extruded rungs with three 1/8-inch radius semicircular grooves per face manufactured by Tri Tech, Inc; Alcoa; or equal. If square rungs are used, turn 1-inch-diameter shouldered tenons on the ends and insert them in holes drilled in the rails.

D. Brackets: 1/2-inch x 3-inch bent brackets spaced 5-foot maximum on center and within 1 foot of each end. Shop weld bracket to rails. Connect each bracket to the wall with two 3/4-inch stainless steel bolts and drilled expansion shield.

E. Anodize after fabrication and welding is complete in accordance with paragraph 2.02 of this Section.

F. Detail and install ladders so that all steps including the first and last are of equal height and are 12 inches or less.
2.02 ALUMINUM FINISHING AND ANODIZING

A. After fabrication and finishing give all aluminum a medium chemical etch and an Architectural Class I clear, AA-M32-C22-A41 anodic coating, at least 0.7 mils thick. Comply with the “Standards for Anodized Architectural Aluminum,” published by the Aluminum Association and referred to in NAMM “Metal Finishes Manual.” Measure thickness in accordance with ASTM B244.

B. Where aluminum is in contact with concrete, grout, plaster or other metals, apply a coating of aluminum pigmented bituminous paint after anodizing.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Fabricate, pre-assemble and fit metal work in the shop, and then disassemble into transportable components ready for shipping and field erection.

B. Fabricate and install finish work conforming to a straight line or flat plane to within 1/8-inch in 8 feet and to within 1/4-inch total.

C. Install curved surfaces conforming to a true arc of a circle within 1/8-inch.

D. Make proper allowance for expansion and contraction of the metals and of the materials to which they are fastened.

E. Where metal is fastened to concrete, make the connection by means of embedding at least 6 inches deep in sleeves set in concrete or by expansion shield anchor bolts. Do not use wood plugs, plastic plugs or powder driven studs.

F. Construct work to withstand the forces required by UBC and OSHA.

G. Round or chamfer and grind smooth all exposed edges and corners.

H. Perform all welding in accordance with AWS manual “Welding Aluminum”. Employ methods and techniques to achieve the full strength of the members joined and finished architectural appearance.

I. Field Assembly: Set members to lines and elevations indicated to required tolerance. Align and adjust members before making permanent connections.

3.02 LADDERS

A. Install ladders with fasteners adequate to take a 1,000 pound working load applied in any direction at any point.

B. Install ladders so that top and bottom step are the same height as every intermediate step and do not exceed 12 inches.
3.03 REPAIRS

A. Replace all defective work including:
   1. Unsightly welds.
   2. Discontinuous welds.
   3. Uneven connections, surfaces, finishes or coatings.
   4. Variations exceeding specified tolerances.
   5. Kinks, bends, tool marks, grinding marks.
   6. Other defects affecting the quality, strength, utility and appearance of the work.

3.04 CLEANING

A. Wash thoroughly using clean water and detergent.

B. Do not use acid solutions, steel wool or other abrasives.

C. Remove stubborn grease stains with mineral spirits.

END OF SECTION
SECTION 05724
ALUMINUM COMPONENT RAILING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY
A. Section Includes:
   1. Guardrails, stair rails, handrails, toeboards and related work employing a stock manufactured aluminum Component Railing System.
   2. Related custom manufactured items.
   3. Work in this Section requires the highest level of workmanship, skill and care and may require specialized manufacturing equipment and techniques.

B. Related Sections:
   1. Section 05100: Structural Metal Framing
   2. Section 05500: Metal Fabrications (Miscellaneous Metal)
   3. Section 05722: Aluminum Ladders

1.02 REFERENCES
A. Aluminum Association:
   1. ASD-1 Aluminum Standards and Data (Aluminum Alloys and Tempers)

B. American Society for Testing Materials:
   1. B241 Specification for Aluminum Alloy Seamless Pipe and Seamless Extruded Tubing
   2. B244 Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and Other Non-Conductive Coatings on Non-Magnetic Basis Metals with Eddy-Current Instruments
   3. B429 Specification for Aluminum Alloy Extruded Structural Pipe and Tube (For 6063-T52 Extruded Pipe or Tube)
   4. B483 Specification for Aluminum Alloy Drawn Tubes for General Purpose Applications (for 6063-T832 Drawn Pipe or Tube)
   5. C595 Specification for Blended Hydraulic Cement

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.

B. Product Data: Fully describe all products proposed for use.

C. Shop Drawings:
   1. Show dimensions, materials, alloys, finishes, joining, attachments, field splices, control joints, inserts, and relationships of work to adjoining construction.
2. Indicate all shop and erection details including cuts, copes, connections, slip joints, holes, threaded fasteners and welds. Indicate welds using AWS "Welding Symbols."

3. Show field measured dimensions of this and adjacent work and field measured locations of cans and inserts.

4. Provide setting drawings, templates and directions for installation.

D. Samples: A full size sample section of railing showing the intersection of an intermediate end post with a top rail and mid rails.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. The fabricator and installer must be a State Licensed Specialty Contractor regularly engaged in fabrication and installation of architectural aluminum railing systems. Fabricator and installer must be approved by Component Railing System manufacturer. The installer must be a State Licensed Specialty Contractor, must be approved by the component railing system manufacturer, and must be regularly engaged in installation of architectural aluminum railing systems.
   2. Welding procedures, welders, and welding operations shall be qualified for the type of material and work required in accordance with American Welding Society (AWS) Standard Qualification Procedures.

B. Comply with the following regulatory requirements:
   2. Stair and guardrail design requirements of applicable OSHA regulations.

C. Comply with the following trade association and reference standards:

1.05 DELIVERY, STORAGE AND HANDLING

A. Provide inserts, sleeves and anchorage devices in time to be incorporated in other work.

B. Store materials above ground on platforms, skids or other supports. Store all fasteners and welding electrodes in a weathertight and dry place. Store packaged materials in their original containers.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL
A. Provide an aluminum Component Railing System manufactured and installed under the responsibility of a single specialist firm.

B. Furnish a system that employs fittings that are internally welded to vertical members. See paragraph 2.01.E.4 of this Section. Mechanical attachment of fittings to vertical members is not acceptable.

C. Manufacturer/Installer and Product Line: C-V Pipe Rail C4300 by Crane Veyor Corporation (CVC); “Alumarail” modified to meet these specifications and manufactured by Enerco Metal Products, Inc.; or equal.

D. Part numbers listed in this Specification Section are Crane Veyor Part Numbers and are used to describe the quality and function of the item required.

E. Posts, Rails, Connectors, Toeboards and Related Items for Component Railing System:
1. 1-1/2-inch Aluminum Pipe: Schedule 40, 1.90-inch outside diameter, alloy 6063 in T6 temper handrail grade, or 6063-T1 or T52 handrail grade where required for bending. Use 6063-T832 where a clear anodized finish is required.
2. Aluminum Reinforcing Sleeve: Aluminum drawn tube, 6063-T832, 1.6-inch diameter x 0.125-inch thickness. Outside diameter to be a tight fit inside the aluminum pipe.
3. Aluminum Reinforcing Bar: Solid aluminum bar, 6061-T6, outside diameter to be a tight fit inside the aluminum pipe.
4. Component Railing System Connectors:
   a. Drawn, forged or fabricated aluminum alloy 6063-T5, T6, or T832.
   b. Coped to fit tightly at joint to post, rails or other members and shall have a stub or sleeve of reduced diameter to fit snugly inside the connecting member.
   c. Provide an internal bulkhead just inside the point where the connectors are coped to fit the post or connecting member.
   d. Provide 1/2-inch-diameter hole in the center of the bulkhead and weld the connector to the member to which it is being attached through the hole. Weld all the way around the perimeter of the hole in the bulkhead to develop the full strength 1/2-inch-diameter weld with a fully concealed weld.
   e. Mechanical attachment of connector to post is NOT ACCEPTABLE.
   f. At intermediate railing posts use a “T” top rail connector and saddle intermediate rail connectors CVC #C4350, or equal.
   g. At end railing post, join the top rail to the post with a pipe bend or radius elbow. Miters or “T” connectors with end cap are unacceptable. CVC #C4355, or equal.
   h. At inside and outside corners:
      1) Use two posts located close to the corner in each direction such that clear space between posts does not exceed maximum spacing allowed between horizontal rails. Bend top rail at corners or use a welded radius elbow.
      2) Where shown or required use a custom fabricated single corner post with a side outlet elbow (3-way elbow) as a top of post fitting. Attach...
top rails to posts with "T" top rail connector; attach intermediate rails to
posts with saddle connectors.

I. Provide 4 inches high extruded aluminum with "F" shaped flanges along
the top and bottom edge: CVC #C43880; or equal. At interior and exterior
corners, use special corner connectors #C43900 and at splices use
#C43890.

F. Set guardrail posts in pockets cast in concrete. Form a void in concrete with 16-
gauge stainless steel sleeves, 1-inch larger than post diameter by 10 inches deep
with closed bottom and removable slip-on plastic covers, or use a removable
styrofoam void forming device of the same size. CVC; R&B Wagner, Inc.; or equal.

G. Use a stainless steel base plate for bolt attachment to steel channel stair stringers.
Weld a stainless steel tube to a 3/8-inch-thick stainless steel base plate sized to fit
inside the aluminum pipe rail post #C43230(s).

H. Socket for Removable Posts: Stainless steel post socket with closed bottom.
#C43300.

I. Aluminum Bars and Plates: 6063-T6 alloy, 35,000 psi yield, 21,000 psi allowable.

J. Refer to Section 05100 for adhesive anchors and mechanical anchors for attaching
items to concrete or masonry.

K. Grout: Hydraulic quick-setting cement, nonshrinking, unaffected by water after
setting and conforming to ASTM C595. Super Por-Rock; or equal.

L. Bolts, nuts, washers and screws in contact with aluminum: Stainless Steel, AISI
Type 304, with hex head bolts and nuts.

M. Handrail Wall Brackets for Aluminum Railing: Cast aluminum alloy 214, or
Almag 35, extruded aluminum 6063 alloy or formed aluminum 5052 alloy, drilled for
screw attachment to pipe handrail and for 3/8-inch-diameter bolt anchor to wall, 2-
1/2-inch or 3-inch offset, CVC #C4305 Wagner No. 1772 (cast), No. ER8002
(extruded) or No. 1939R (formed); Julius Blum; or equal.

N. Structural Epoxy Adhesive: #C4907, Scotch-Weld 3M Company; Devon; or equal.

O. Wall Flanges: Two-part consisting of: 1) an extra-heavy wall attachment flange
(#C43275-M) 1/4-inch-diameter drilled for four 1/4-inch-diameter countersunk head
expansion anchor bolts and 2) a cover flange (#C43480).

2.02 ALUMINUM ANODIZING

A. After fabrication and finishing give all aluminum railings a medium chemical etch
and a clear Architectural Class I anodic coating, at least 0.7 mils thick, clear AA-
C11-A41. Comply with the "Standards for Anodized Architectural Aluminum,"
published by the Aluminum Association and referred to in NAAMM "Metal Finishes Manual." Measure thickness in accordance with ASTM B244.

B. Where aluminum is in contact with concrete, grout, plaster or other metals, apply a coating of aluminum pigmented bituminous paint or epoxy paint to the aluminum after anodizing to act as an isolation barrier.

2.03 FABRICATION OF ALUMINUM HANDRAILS, GUARDRAILS, AND STAIR RAILS

A. Make joints with special connectors designed for concealing shop welding to posts and flush slip on epoxy bonding of horizontal railing members in the field. Accurately cope connectors for a smooth hairline fit. Joints shall be weld joints on the inside of the connector so that welds are not visible from the outside. Bolts, screws, pop-rivets or other exposed fasteners are not acceptable. Remove all sharp edges with fine abrasive.

B. Fabricate custom components that cannot be assembled with fittings using aluminum pipe and welding type fittings. Fully weld all joints all around using alloy 5356 filler wire, grind smooth and finish with progressively finer grits of abrasive ending with 180 grit.
1. Avoid posts at inside or outside corners. Locate a post close enough to the corner in each direction such that clear space between posts does not exceed maximum spacing allowed between horizontal rails. From the corner with tight radius pipe bends or manufactured welding type elbows. Miter not permitted.
2. At wall returns, at intersections of top rails with posts at the end of a run, and at other changes in direction, either custom bend the pipe rail or use manufactured formed or bent pipe ells having a minimum 2-inch-inside radius. Make custom bends on a roll type hydraulic tubing bender. Provide bends that are free of buckles, pucks or deformed surfaces.
3. At all cross and tee intersections, accurately cope members for a tight fit and internally plug weld as described above.
4. Cap ends of pipes except wall returns with manufactured bulb end caps. Return wall rails to within 1/8-inch of the wall.
5. Posts: Schedule 40 pipe internally reinforced at the bottom with a 20-inch-long tight fitting solid aluminum bar bonded to the inside of the post with structural epoxy. Space posts no further apart than 5 feet regardless of spacing shown on the Drawings.
6. Where posts are bolted to the top edge of stair stringers or at similar situations where a flanged connection is required, fabricate the flange from a 1/4-inch-thick stainless steel plate. Round corners to a 1/4-inch radius and ease all exposed edges to a 1/16-inch radius. Weld a stainless steel sleeve to the plate. Size the sleeve to be a snug fit inside of the aluminum pipe post. Slide the post over the stainless steel sleeve and bond with epoxy.
7. Where chains and snap rings are required, provide a continuous aluminum reinforcing sleeve inside of the aluminum post. Provide 1-inch-diameter 304 stainless steel eye bolts, a 304 stainless steel chain with 13 welded 3/16-inch-diameter wire links per foot, and chrome plated brass snap fasteners. Locate the eyes of the eye bolts on the outside of the post away from the walking side of the rail and not facing the opening that the chain closes.
8. Provide expansion joints consisting of a 6-inch-long solid aluminum sleeve sized to slip inside the members and bonded on one side of the joint only to allow for the thermal movement. Allow a minimum of 1/4-inch space for expansion in each 24-foot section. Allow more space if required to accommodate anticipated temperature changes. Locate expansion joints within 6 inches of a post. Ease exposed edges of pipe rail to a 1/16-inch radius.

9. Mix and apply structural epoxy in accordance with the manufacturer's instructions and in accordance with "Adhesive Bonding" by Alcoa Aluminum.

10. Provide 3/16-inch-diameter holes in inconspicuous locations to vent interior of members.

C. Anodizing:
   1. Anodize all parts after the exposed welding is complete in accordance with paragraph 2.02 of this Section. Internally welded connectors may be attached to posts after anodizing.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Shop weld all connectors and fittings to vertical post assemblies. Field cut horizontal railing members and epoxy bond to connectors on post assemblies.

B. Install work to a straight line or flat plane to within 1/8-inch in 6 feet and to within 1/4-inch total deviation. Install curved surfaces conforming to a true arc of a circle to within 1/16-inch.

C. Equally space posts in any run and not more than 5 feet on center. Space posts in parallel rows so they are in alignment.

D. Make proper allowance for expansion and contraction of the metals and of the materials to which they are fastened.

E. Set posts 10 inches deep in sleeves cast in concrete using waterproof, nonshrinking grout. Attach wall or floor flanges to concrete with stainless steel adhesive anchor bolts or to other construction with stainless steel machine bolts.

F. Construct work to withstand the forces required by UBC and OSHA.

G. Round and grind smooth all exposed corners and edges.

H. Perform all welding in accordance with AWS manual "Welding Aluminum." Employ methods and techniques to achieve the full strength of the members joined and architectural appearance.

I. Field Assembly: Set members to lines and elevations indicated. Align and adjust members before making any permanent connections.
3.02 GUARDRAILS AND HANDRAILS

A. Provide work of the highest quality performed by mechanics skilled in executing high quality architectural metal work.

B. Set shop fabricated guardrail sections into position and align the top rail so that it is true to specified tolerances. Do field joining with structural epoxy adhesive. Mix and apply adhesive in accordance with manufacturer's instructions.

C. Support guardrails with temporary braces and shoring to maintain true alignment until all final connections and grouting are completed. Build surface of grout up at post, 1/4-inch higher than surrounding surfaces to direct water away from post.

D. Attach toeboards to posts using two self-tapping, stainless steel machine screws minimum at each connection. Use special toeboard connectors at corners and special splice plates at end joints.

E. Coat surfaces of aluminum in contact with concrete, grout, plaster or dissimilar metals with specified coating material.

3.03 REPAIRS

A. Replace all defective work including:
   1. Unsightly welds.
   2. Discontinuous welds.
   3. Uneven connections, surfaces, finishes or coatings.
   4. Variations exceeding specified tolerances.
   5. Kinks, bends, tool marks, grinding marks.
   6. Other defects affecting the quality, strength, utility and appearance of the work.

3.04 CLEANING

A. Wash thoroughly using clean water and detergent.

B. Do not use acid solutions, steel wool or other abrasives.

C. Remove stubborn grease stains with mineral spirits.

END OF SECTION
DIVISION 6
WOODS AND PLASTICS

06200  Finish Carpentry
06800  Fiberglass Tank Baffles
SECTION 06200
FINISH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY
A. Provide all nonstructural interior woodwork, exposed to view, and all other finish carpentry.
B. Install all standing and running trim, utility shelving, door and window jambs, stops and casings.
C. Install all miscellaneous items and Specialties furnished but not installed under other sections.
D. Jobbing, Adjustments and Final Fitting: Provide work required to make minor repairs, patching, and adjustments in all finish work so that all work comes together neatly, operates smoothly, and project is complete and ready for use by Owner.
E. Related Work Specified Elsewhere:
   1. Section 09900: Painting - back priming, sealing, painting and transparent finishes
   2. Section 12346: Wood Laboratory Casework
   3. Division 10: Specialties and miscellaneous items

1.02 SUBMITTALS
A. Submit the following for Product Review in accordance with Section 01300.
B. Product Data for all items proposed to be furnished.
C. Shop Drawings of stock and custom milled items.

1.03 QUALITY ASSURANCE
A. Comply With the Following Standards and Grading Rules:
1.04 DELIVERY AND STORAGE
A. Deliver interior materials only after building is closed in and dried out, and the heating, ventilating, and air conditioning system has been in operation for five days.
B. Store all materials on raised skids. Store interior materials inside; protect exterior materials from the sun.

1.05 PROJECT CONDITIONS
A. Verify that backing required for attachment of work in this and other sections has been installed prior to application of gypsum wallboard, acoustical tile and similar finishes.
B. Coordinate exact placement of all items attached to, penetrating or recessed in wall or ceiling finishes including light fixtures, electrical outlets, switches, and air registers to insure a neat overall finished result.

PART 2 - PRODUCTS

2.01 WOOD MATERIALS
A. All materials kiln dried to 8% moisture content for interior material; 12% for exterior material. Comply with Woodwork Institute of California (WIC) grading rules, Custom grade unless a higher grade is indicated.

<table>
<thead>
<tr>
<th>Item</th>
<th>Material and Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window casings, and other standing and running trim.</td>
<td>Douglas Fir, Grade for opaque finish.</td>
</tr>
<tr>
<td>Closet shelves, storage room shelves, hook strips, cleats, clothes poles, and related trim not furnished under Section 06400.</td>
<td>Grade for opaque finish. Plywood shelves shall be edge banded with Douglas Fir having vertical grain showing on the shelf edge.</td>
</tr>
</tbody>
</table>

2.02 NON-WOOD MATERIALS
A. Bolts and Screws: Hex head machine bolts, carriage bolts with hex nuts, hex head lag screws and wood screws, provide cut washers unless malleable washers indicated. Use hot dipped galvanized fasteners for all exterior locations; electro-galvanized for interior use.
B. Nails: Common, box, casing or finish, sizes as shown or as required. Exterior fasteners hot dipped galvanized.
C. Expansion Anchor Bolts and Drive Anchors for Attaching Items to Concrete or Masonry:
   1. Adhesive Capsule Anchors: Shall be steel, Molly Parabond capsule anchors, by the Molly Division of the Emhart Fastener Group; HVA adhesive anchors by Hilti Fastening Systems; or equal. Use adhesive capsule anchors in exterior locations only.
2. Expansion Anchor Bolts: Shall be steel machine bolts with steel expansion shields and may require a larger embedment hole than the nominal bolt size. Minimum bolt size 1/2-inch diameter. Minimum embedment in concrete or masonry 3 inches. Do not load in excess of 1/4 of certified test value for static loads or 1/10 of test values for vibratory (machinery) loads and seismic loads. HILTI HSL Heavy Duty Anchor; RAWL-Bolt; or equal. Use where noted and for:
   a. Loads of 1,000 pounds or over.
   b. To attach all machines and devices with moving parts.
   c. For all loads in tension or withdrawal.
3. Wedge Anchor Bolts: Special steel machine bolts with built-in expanding wedge and requiring a hole in the concrete the same size as the nominal bolt size. Minimum size: 3/8-inch-diameter by 3-inch embedment in concrete or masonry. Do not load in excess of 1/4 of certified test value. Phillips Red Head Wedge Anchors WS series; Wej-it expansion bolts; or equal. Use where noted and for:
   a. Loads less than 1,000 pounds.
   b. Loads in shear only.
   c. DO NOT USE to attach machinery or resist vibratory loads.
4. Drive-Anchors: One-piece deformed spring steel anchor: Rawl-Drives; equivalent Buildex; or equal.

D. Adhesives:
   1. Construction Adhesive: Polyurethane type by 3M; U.S. Plywood; or equal.
   2. Panel Adhesive: Latex type by U.S. Plywood; DAP; or equal.
   3. Woodworkers Glue: Aliphatic type yellow glue; Bordens; Franklin; or equal.

E. Water Repellent Preservative: Clear water repellent preservative containing pentachlorophenol; Woodlife; Pentaseal; or equal.

F. Sealant: One part polyurethane, same as sealant "B" in Section 07900, Joint Sealants: Vulkem #116; Sikaflex la; or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. All work shall be back primed and sealed under Section 09900, Painting, immediately upon delivery and before installation.

B. Install door jambs plumb and straight. Provide double cedar shingle wedges behind each pair of nails.

C. Install all casings and standing and running and trim straight and with even reveal. Miter members at outside corners; cope members at inside corners. Glue all mitered joints.

D. Space finish nails uniformly; set below surface.

E. All work shall be plumb, level and in a flat plane. All joints shall fit tight and have flush surfaces.
F. Machine and hand sand all members and joints with progressively finer abrasives, finishing with 220-grit abrasive paper ready for application of finishes specified under Section 09900.

G. Fasten all items to backing securely using appropriate fasteners. Provide attachments capable of withstanding a force equal to two times the dead weight of the item attached, but not less than 200 lbs., acting in any direction.

3.02 INSTALLATION OF MISCELLANEOUS ITEMS AND BUILDING SPECIALTIES

A. Install all Specialties and other miscellaneous items furnished but not installed under other sections. Install all items plumb and level.

B. Provide concealed backing. Provide appropriate fasteners matching the finish of items to be installed.

C. Attachment shall meet strength requirements for intended use and shall comply with seismic requirements in Division 1 but shall not be less than required to support the weight of the item and its contents plus an applied load of at least 200 lbs. acting in any direction.

3.03 JOBNING

A. Perform final fitting and make final adjustments including all required repairs and patching so that finished work provided under all sections comes together neatly, operates smoothly and is ready for final inspection, acceptance and use by the Owner.
SECTION 06800

FACTOR TANK BATTERIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Fiberglass material for baffles.
   2. Attachment and support hardware.

1.02 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data:
   1. Fiberglass Panels and Supports
   2. Mounting Hardware

C. Shop Drawings:
   1. Fiberglass Panels and Supports
   2. Mounting Hardware

1.03 QUALITY ASSURANCE

A. Provide certification that all materials comply with the requirements of this specification.

1.04 DELIVERY, STORAGE AND HANDLING

A. Store materials after delivery at site in bundles in a dry, dark place away from sunlight.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pre-Engineered fiberglass baffle wall system composed of fiberglass panels and support columns and stiffeners and 316 stainless steel mounting hardware. Panels and fasteners shall be of suitable construction for submerged wastewater service and resistant to sunlight and chlorine compounds up to a concentration of 0.05% solution. Provide a baffle wall system by Enduro Composites, Inc.,

B. Mounting System: Baffle walls shall use FRP columns for vertical support and stiffened cap rails to provide lateral stiffness and a finished top. The vertical columns shall be anchored to the floor of the basin using 316 SS anchor plates with epoxy wedge anchors.

C. Color:
   1. Panels shall be grey.
D. Warranty: Panels and fasteners shall be warranted for integrity for a minimum of 10-years.

E. Manufacturer: Provide a baffle wall system by Enduro Composites, Inc. or equal.

2.2 DIMENSIONS

A. Provide baffle walls to the dimensions shown on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install baffle walls in accordance with the Drawings and the Manufacturers Instructions.

B. Size anchor bolts in accordance with manufacturers instructions.

3.02 FIELD QUALITY CONTROL

A. Verify the baffle support system is correctly installed.

END OF SECTION
DIVISION 7

THERMAL AND MOISTURE PROTECTION

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>07190</td>
<td>Water Repellent Sealer</td>
</tr>
<tr>
<td>07200</td>
<td>Insulation</td>
</tr>
<tr>
<td>07400</td>
<td>Preformed Metal Roofing</td>
</tr>
<tr>
<td>07600</td>
<td>Flashing and Sheet Metal</td>
</tr>
<tr>
<td>07900</td>
<td>Joint Sealants</td>
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</tbody>
</table>

FINAL
January 2004
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Thermal and Moisture Protection
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: A clear water repellent sealer application to all exterior exposed concrete unit masonry surfaces.

B. Related Sections:
   1. Section 04220: Concrete Unit Masonry
   2. Section 09900: Painting

1.02 SUBMITTALS

A. Submit in accordance with Section 01300:
   1. Product Data: Fully describe all products proposed for use. Include Material Information Sheet for all products.
   2. Manufacturer's five-year warranty for Water Repellent Sealer.

1.03 QUALITY ASSURANCE

A. Qualifications: Apply water repellent sealer by a licensed Waterproofing Specialty Contractor (California License No. C61 Waterproofing and Sealant Work) exclusively engaged in applying waterproofing materials, sealers and sealants.


1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver material in labeled unopened containers.

B. Store all material on raised platforms protected from moisture and from contamination by dirt, mud or other foreign material.

1.05 COORDINATION

A. Coordinate with other trades whose work may be damaged by sealer application.

B. Protect glass and other finished surfaces with polyethylene sheeting taped in place.
1.06 SPECIAL GUARANTEE

A. Apply sealer under the supervision of the sealer manufacturer's representative.

B. Provide a signed five (5) year Special Guarantee in accordance with Section 01700, signed by the sealer manufacturer, applicator and Contractor against sealer's failure to prevent water intrusion through the treated masonry.

PART 2 - PRODUCTS

2.01 SEALER

A. Material:
   1. Waterbased penetrating clear water repellent sealer for lightweight concrete block and architectural concrete.
   2. Not less than 20% solids content.
   3. Meet requirements of Air Quality Management District having jurisdiction.
   4. Meet ASTM C67-78 and ASTM C14-75 submersion tests with a repellency rating of 96%.
   5. Apply at the rate recommended by the manufacturer for the density, porosity and texture of block used,
   6. Manufacturer: Hydrozo Clear 40 VDC; or equal.

PART 3 - EXECUTION

3.01 APPLICATION OF CLEAR SEALER

A. Apply sealer after concrete and masonry has cured at least 30 days, and after the concrete and the masonry has been cleaned.

B. Prior to applying sealer clean down all masonry and architectural concrete by scrubbing with water and masonry or concrete cleaner and bristle brushes.

C. Inspect surface for cracks. Rout out all cracks 5 mils and wider and fill with a high performance joint sealant having a 20-year life expectancy and recommended by the water repellent sealer manufacturer for use on substrates to be sealed with his sealer.

D. Spray-Apply Sealer: Use applicator recommended by the sealer manufacturer. Operate at lowest possible pressures, 20 psi maximum. Do not allow fogging or bounce-off except on tension break coat.

E. Protect surfaces, which are not to be coated. Cover all glass, anodized aluminum, metal, and doors, etc. with polyethylene sheeting; continuously seal all edges with tape.

F. Apply sealer material in accordance with manufacturer's instructions. Apply enough sealer so the masonry surface appears uniformly wet, for each coat, for from two to five hours after application.
1. Rate of Application: Coverage as recommended by the manufacturer for porous concrete block but coverage shall not exceed 40 square feet per gallon for the first coat and 70 square feet per gallon for the second coat.

2. First Coat: Apply the first coat in two passes: the first pass, a light spray to break surface tension; the second pass, a full flood coat applied in an overlapping pattern producing a 12-inch rundown.

3. Second Coat: After 48 hours, apply a flood coat in an overlapping pattern producing a 12-inch rundown.

END OF SECTION
SECTION 07200

INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Building thermal insulation.

B. Related Sections:
   1. Section 09250: Gypsum Wallboard
   2. Section 09500: Acoustical Treatment

1.02 REFERENCES

A. American Society for Testing Materials (ASTM):
   2. C665 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
   3. E84 Surface Burning Characteristics
   5. E136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe every item proposed for use. Submit UL Data Sheets for insulation required to have a flame spread rating or used as part of a fire-rated assembly.

1.04 PRODUCT, DELIVERY, STORAGE AND HANDLING

A. Deliver insulation materials to the job in original packages with manufacturer's "R" Values and UL flame spread ratings clearly shown. Provide certification of compliance with applicable Federal Specifications.

PART 2 - PRODUCTS

2.01 LOW DENSITY BLANKET/BATT INSULATION

A. Thermal, Batt Insulation. Glass fiber thermal insulation complying with ASTM E136 in 3-1/2-inch-thick R-11 and 10-inch R30. Foil-faced ASTM C665, Type III, Class B.

B. Exposed Building Insulation: Low density fiberglass insulation complying with ASTM C665, Type II, Class A, with a white Polypropylene-scrim foil facing (PSF) having a light reflectance of 78-1/11, a perm rating of 102, a flame spread rating of 1.
5 and smoke developed rating of 5 when tested in accordance with ASTM E 84, 6-inch R-19. Owens Corning Certified R Metal Building Insulation Fiberglas Flame Spread 25 Insulation with PSF face, Certainteed; or equal.

2.02 INSULATION ANCHORS (STICK CLIPS)

A. Insulation Anchors: Slotted metal clip welded to perforated cold rolled carbon steel backing plate: Erico Jones Insul-Anchor with slotted 3/4-inch-wide sheet steel prong #1A-PG and WCN P150 FY Slotted Washer, Miracle Stuck-ups with WS washer, Stic-klip fasteners type B with holding washers; or equal. Provide adhesive recommended by manufacturer for particular substrate.

PART 3 - EXECUTION

3.01 INSTALLATION OF CONCEALED LOW DENSITY FIBERGLASS BLANKET/BATT THERMAL INSULATION

A. Between Roof Joists:
   1. Fit insulation blanket between joists, fasten to joists through nailing flaps provided or run 16-gauge galvanized steel support wire at right angles to joist or diagonally at 16-inch centers to support insulation. Wire tie support wire to joist at every crossing.
   2. Place foil face on the interior side.

B. In Metal Stud Walls:
   1. Friction fit 3-1/2-inch insulation blanket between studs.
   2. Place foil face on the interior side.

C. Do not install insulation on top of or within 3 inches of recessed light fixtures unless the fixtures are UL approved for such use.

3.02 INSTALLATION OF LOW DENSITY FLAME SPREAD 25 INSULATION ON STICK CLIPS

A. Install insulation anchors in mastic in accordance with manufacturer's recommendations. Space clips 18 inches on center both ways and within 3 to 6 inches of all edges.

B. Apply insulation with white face on the interior side. Impale insulation on fastener prongs, slip slotted washer over prongs and bend two halves of prongs in opposite directions.

C. Cover insulation anchors with self-adhesive circular ASJ patches. Cover insulation joints with 3-inch-wide self-adhesive ASJ tape. Cover exposed edges of insulation with one or two widths of 5-inch-wide self-adhesive ASJ tape lapping face and rear surface at least 2 inches.

END OF SECTION
SECTION 07400
PREFORMED METAL ROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provide preformed standing seam sheet metal roofing. Provide prefinished metal fascias, metal soffit liner panels, gutters and downspouts.

B. Related Work Specified Elsewhere: Section 07600: Flashing and Sheet Metal

1.02 SUBMITTALS

A. Submit literature fully describing manufacturer's product.

B. Submit manufacturer's color chart showing full range of standard colors.

C. Submit samples of factory colored sheet metal for selection of color.

D. Submit shop drawings based on the Contract Documents clearly showing the design, dimensions, materials, methods of construction and installation of each piece to be installed.

1.03 QUALITY ASSURANCE

A. Comply with Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) specifications for material and workmanship not otherwise specified herein.

B. Install under the supervision of roofing manufacturer's trained sheet metal craftsmen.

1.04 GUARANTEE

A. Furnish the Owner with a written guarantee effective for a period of 2 years from the date of filing the Notice of Completion, that all roofing and related flashings are in accordance with the roof manufacturer's specifications, are watertight, without defects in labor and materials, and that the Contractor will maintain roofing and related flashings by repairing any leakage due to ordinary usage during that period including repair of damage caused by leaks or by repair of them.

1.05 DELIVERY AND STORAGE

A. All materials used in this work shall be from one manufacturer only. Deliver materials to the job site in the factory packaging with identifying labels intact. Store materials as recommended by the manufacturer.
PART 2 - PRODUCTS

2.01 ROOFING SYSTEM

A. Standing seam roofing: Craftsman Series by MBC1; ASC Pacific; or equal. Include rain gutters, downspouts, fascias, and flashing contiguous with roofing system.

B. Roofing panels and battens shall be fabricated in continuous lengths from eave to ridge without intermediate joints or laps.

2.02 MATERIALS

A. Fabricate all roofing components from factory prefinished, 24 gauge galvanized steel sheet meeting ASTM A525, G-90 Commercial Class 1.25, minimum zinc coating: 1.25 ounces per square foot of surface. See paragraph 2.02F for factory finish.
   1. Metal pans: 22-1/2 inches wide with 1/2-inch turn-up standing seam.
   2. Rain gutters and downspouts: Formed sheet metal to configuration shown.
   3. Starters, trim, fascias: Manufacturer's factory formed sheet metal shapes.
   5. Soffit panels: 24-gauge galvanized and prefinished.

B. Flashing: 24 gauge galvanized sheet metal custom-formed to suit conditions.

C. Reglets: Recessed or surface type, formed from 24-gauge galvanized sheet metal.

D. Fasteners:
   1. To metal framing: Self-drilling, self-tapping, TEKS by Buildex; Redhead self-tapping screws by Phillips; or equal.

E. Underlayment: Asphalt saturated fiberglass felt, weighing 30 pounds per 100 square feet.

F. Finish: Fluoropolymer resin base, thermo-cured two coat system, 1 mil thickness minimum; Kynar 500; Duranar 200; or equal. Furnish manufacturer's 20 year written guarantee against failure of the finish.
   1. Roofing panels and trim will be all one color, selected from manufacturer's standard range.
   2. Rain gutters, fascias, downspouts and soffits will be one different color selected from manufacturer's standard range.
   3. All sheet metal components, including flashings and trim, shall be factory finished.

G. Sealant: One part polyurethane, Vulkem 116; Sikaflex la; or equal.
PART 3 - EXECUTION

3.01 PREPARATION

A. Inspect all surfaces to receive roofing and report defects, if any.

B. Coordinate all work with other trades whose work adjoins, combines or aligns with this work.

C. Take field measurements before proceeding with the work.

3.02 INSTALLATION

A. General:
   1. Align panels straight and perpendicular to roof eaves and ridges.
   2. Lay out battens equidistant from corners or ends.
   3. Lay out battens so they meet each other at hips and ridges.
   4. Provide panels and battens in one-piece lengths from eaves to ridges.

B. Underlayment: Lay one layer of 30 pound felt, dry, lapping sides 6 inches minimum, and ends 12 inches minimum.

C. Hold-down clips: Anchor panel hold-down clips to deck with screws. Space clips 36 inches on centers maximum.

D. Fasteners: Conceal all fasteners wherever possible. Provide fiber washers under heads of exposed screws.

E. Flashing: Provide flashing at all pipes and penetrations through roof. Provide flashing at vertical surfaces adjoining the roof. Install flashing as shown detailed. If not detailed, do work equal to that shown in the SMACNA Architectural Sheet Metal manual to obtain a weathertight and watertight installation.

F. Accessories: Provide ribs, cleats, stiffeners, sleeves, hangers, and other reinforcements required to make sections rigid and substantial in the same metal as roofing system

G. Sealant: Apply sealant to concealed lap joints and at other locations as required for a watertight installation.

H. Finish Repair:
   1. Touch up scratches and small blemishes with compatible finish material.
   2. Replace items that are dented, creased, bent or rusted with new sound items.

END OF SECTION
SECTION 07600
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Galvanized steel, stainless steel, and aluminum sheet metal flashing, counterflashing, and all other sheet metal work not covered in other sections.

B. Related Sections:
   1. Section 07400: Manufactured Roof Panels
   2. Section 08520: Aluminum Windows
   3. Section 09900: Painting - backpriming sheet metal work
   4. Section 10200: Louvers
   5. Section 15800: Heating, Ventilating and Air Conditioning - sheet metal ductwork

1.02 REFERENCES


1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe all manufactured items to be furnished.

C. Shop Drawings: Show all custom-fabricated items clearly illustrating the design, dimensions, materials, methods of construction and installation of each piece of work.

D. Manufacturers' Instructions: For manufactured items.

1.04 QUALITY ASSURANCE


B. Where specific details are not provided comply with applicable details in the SMACNA Architectural Sheet Metal Standards.
1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver all items to the job site unpainted and in sufficient time for field priming and incorporation into work of other trades.

B. Store materials under dry conditions and protect from moisture and physical damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sheet Steel: Copper bearing, 26-gauge or heavier where noted; hot dip galvanized complying with ASTM A525, G90 Commercial Class 1.25 ounce.

B. Aluminum: 6061-T6 alloy, 0.064-inch thick or heavier where noted.

C. Stainless Steel: Type 304, 2D finish unless a higher polish is called for, ASTM-A-240, 26-gauge or heavier where called for.

D. Sheet Lead: Weighing 2.5 pounds per square foot (0.039-inch thick).

E. Solder: ASTM B32, low lead solder. Use special solder for stainless steel.

F. Flux: Noncorrosive.

G. Fasteners:
   1. To Concrete Masonry Units: Deformed steel wedge pins driven into lead expansion shields; RAWL, Phillips, or equal.
   2. Component Fasteners: Self-drilling/self-tapping, stainless steel screws, type S-12, Buildex TEKS; Gosche Fasteners; or equal.

H. Flashing Reglets and Counterflashing:
   1. Surface Type Reglet: 26-gauge, minimum, galvanized steel with stainless steel drive pins and neoprene washer, Fry Sprinklok Expan-O-Seal; Superior Cushion-Lock; or equal.
   2. Recessed Type Reglet: 26-gauge, minimum, galvanized steel, Fry, type CO; Superior Cushion-Lock; or equal.
   3. Counterflashing: 26-gauge, minimum, galvanized steel formed to insure a tight seal against both reglet and roofing felts, Fry Springlok Flashing; Superior Cushion-Lock; or equal.

I. Sealant: Polyurethane sealant type "B" as specified in Section 07900. Where specified sealant is incompatible with other adjacent sealants, Contractor shall submit a sealant suitable for intended use and of equivalent life expectancy.
2.02 FABRICATION

A. Before fabrication, take field measurements, ascertain existing field conditions and have discrepancies corrected before proceeding with sheet metal work.

B. Fabricate sheet metal items in the shop to the greatest extent possible. Fabricate using techniques and methods described in the SMACNA Architectural Sheet Metal Standards.

C. Make sections uniform with true, straight breaks, accurately fitted and rigidly secured. Provide overlapping tabs for soldered joints. Fabricate items in maximum lengths.

D. Provide accessories necessary to complete installation. Provide ribs, cleats, stiffeners, sleeves, hangers and other reinforcements required to make sections rigid and substantial, in same metal as basic unit.

E. Miter corner joints and reinforce with extended tabs or backing plates.

F. Soldering: All soldered joints shall lap at least 1-inch. Pre-tin and sweat-solder joints full width. Reinforce all soldered joints with metal rivets. Do not solder aluminum.

G. Lap expansion joints at least 4 inches and seal with polyurethane sealant type "B".

2.03 FLASHING FOR VENT PIPES THROUGH ROOF

A. Fabricate a 24-gauge galvanized steel conical Flashing collar with roll-formed flared bottom edge, lapped and sweat-soldered watertight to 24-gauge galvanized steel bottom flange.

B. Fabricate a separate sheet lead Counterflashing collar to fit around vent pipe and overlap conical Flashing collar. The top of Counterflashing to be bent down inside the pipe.

2.04 FLASHING FOR CONTINUOUS PIPES AND CONDUITS THROUGH ROOF

A. Fabricate a conical Flashing collar same as for vent pipes.

B. Fabricate a separate sheet lead Counterflashing collar to fit around pipe and overlap conical Flashing collar. Furnish a stainless steel draw band with stainless steel tightening bolt. Seal the joint in the lead Counterflashing and the joint between the Counterflashing and the pipe with polyurethane sealant.
PART 3 - EXECUTION

3.01 INSPECTION

A. Examine surfaces to receive sheet metal work for defects that will adversely affect the execution and quality of the work.

B. Do not start work until all unsatisfactory conditions are corrected.

C. Insure that all wood nailers have been properly installed.

D. Insure that all galvanized sheet metal items are prime coat painted on all concealed and exposed surfaces, under Section 09900, before installation.

3.02 WORKMANSHIP

A. All work shall be watertight and shall drain properly.

B. Make proper allowance for expansion and contraction of the metals and of the materials to which they are fastened.

C. Form work accurately to sizes, shapes, and dimensions indicated or necessary, with angles and lines in true alignment, straight and sharp.

D. Erect work plumb, level and in proper plane, without bulges, or waves. Fit metal closely and neatly to cores or framework. Cope or flange intersections to fit accurately. Reinforce heavily loaded joints with screws or rivets.

E. Soldering: Pre-tin and apply flux to surfaces of sheet metal. Slowly and thoroughly apply heat to completely sweat the solder through the full width of seam.

F. Set items in sealant or plastic cement as shown or noted; or when such application is necessary to provide a watertight job.

G. Provide isolation between dissimilar metals or other materials with sealant, butyl tape, bituminous paint or asphalt saturated felt.

H. Perform sealant work in conformance with the requirements of Section 07900.

3.03 FLASHING

A. Install all Flashings as required to provide watertight protection.

B. Lap all seams in direction of water flow.

C. Carry Flashings around corners at least 4 inches.

D. Lap joints 4 inches minimum. Apply sealant to the overlapping surfaces of the joints.
3.04 INSTALLATION

A. At Vent Pipes Through Roof:
   1. Provide a 24-gauge galvanized steel conical Flashing collar with roll-formed bottom flange soldered to 24-gauge base Flashing. The base Flashing shall extend 8 inches minimum from the base of the conical collar all around.
   2. Provide a separate Counterflashing collar for the top of the vent pipe.

B. Flashing at Round Ducts, Conduits, and Other Pipe Through Roof:
   1. Provide a conical Flashing collar same as for vent pipes.
   2. Provide a separate Counterflashing collar over the conical collar. Use a stainless steel draw band to fasten top of Counterflashing around the pipe or conduit. Embed Counterflashing in a 2-inch-wide bed of sealant and apply a large bead of sealant to the top exposed edge.

C. Copings:
   1. Fabricate from 24-gauge galvanized steel.
   2. Make end splices with an interlocking joint designed to allow for longitudinal movement. Use Alternates 1, 4 or 5 on Plate 68 of the SMACNA manual. Apply sealant to the overlapping surfaces of the joints.
   3. Miter, lap, seam and seal corners.

D. Flashing at Curb Mounted Equipment, and Similar Rectangular Projections Through Roof:
   1. Provide 24-gauge galvanized steel Counterflashings. Fold Flashings at least 4 inches around corners and lap in the direction of water or wind.
   2. Provide a shop fabricated saddle Flashing (cricket) at the uphill side of skylights and equipment curbs installed on roofs sloping more than 1/4-inch per foot.
   3. Lap end joints 4 inches and seal with sealant.

3.05 CLEANUP

A. Clean all finished surfaces, removing all solder, flux, etc. Neutralize soldering flux with a 5 to 10 percent washing soda solution, wash down all work with soap and hot water, flush with clean water, and wipe dry.

B. Repair or replace all damaged or defective areas to insure watertightness and neat appearance.

END OF SECTION
SECTION 07900

JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Sealant work required:
      a. For a watertight project.
      b. To provide sanitary conditions.
      c. Required by code and not specifically covered in another section.
   2. Seal between all plumbing fixtures and adjacent surfaces.
   3. Minimum standards for all sealant work whether covered in this Section or in other sections.

B. Related Sections:
   1. Section 08520: Aluminum Windows
   2. Section 08800: Glazing
   3. Section 09300: Ceramic Tile

1.02 REFERENCES

A. Federal Specifications:
   1. TT-S-00-230C Sealing Compound: Elastomeric Type, Single Component (For Caulking, Sealing and Glazing in Buildings and Other Structures)
   2. TT-S-00-227E Sealing Compound: Elastomeric Type, Multi-Component (For Caulking, Sealing and Glazing in Buildings and Other Structures)
   3. TT-S-00-1543A Sealing Compound: Silicone Rubber Base (For Caulking, Sealing and Glazing in Buildings and Other Structures)

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe all products proposed for use.

C. Samples: Physical samples of cured sealants for selection of colors.

D. Manufacturer’s Instructions: Application instructions for all products used.

1.04 QUALITY ASSURANCE

A. Qualifications: Provide sealant work performed by a licensed Specialty Sealant and Waterproofing Contractor who is exclusively engaged in sealant application work.
All work to be performed by qualified journeymen proficient in the craft of sealant application.


1.05 PROJECT CONDITIONS

A. Environmental Requirements: Apply sealant only when temperature and humidity conditions are at the levels recommended by the sealant manufacturer.

1.06 SPECIAL GUARANTEE

A. Provide a written Special Guarantee in accordance with Section 01700 covering replacement of sealant work that fails within 2 years of the date of project acceptance. Failure includes:
1. Becoming brittle or cracking due to exposure, contraction or expansion.
2. Failure to resist abrasion of normal use and traffic.
3. Tear failure due to movement within 50% of joint width for Class A sealants.
4. Cohesive or adhesive failure due to movement within 50% of joint width for Fed. Spec. Class A sealants.
5. Water infiltration for joints intended to exclude water; air infiltration for joints intended to exclude air.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sealant Type "A": Exterior and interior horizontal traffic deck sealant two-part self-leveling polyurethane with a Shore "A" hardness greater than 34, conforming to Fed. Spec. TT-S-00227E Type I, Class A, in color selected. Acceptable products are:
   1. Mameco "Vulkem" No. 245 used with #401 primer.
   2. PRC #230 used with recommended primer.
   3. Or equal.

B. Sealant Type "B": Exterior and interior vertical surface sealant for use in joints in concrete, metal and similar materials, conforming to Fed. Spec. TT-S-00230C Type II, Class A, in color selected. Acceptable products are:
   2. One part polyurethane: Sika Sealant Division Sikaflex la.
   3. Or equal.

C. Sealant Type "C": Paintable silicone sealant suitable for sealing cracks, voids, joints, etc. in exterior or interior surfaces that are to be painted or left unpainted. Acceptable products are:
   1. G.E. Paintable Silicone Sealant.
   2. Dow Corning Paintable Silicone Sealant.
   3. Or equal.
D. Sealant Type "D": Not used.

E. Sealant Type "E": Mildew Resistant Silicone Sealant: One part silicone sealant for sealing non-porous interior surfaces where conditions of high humidity and temperature extremes exist. Dow Corning #786 Mildew Resistant Silicone Sealant; General Electric #1700 Sanitary Sealant; or equal.

F. Sealant Type "F": Silicone glazing sealant, Shore "S" 30 durometers: Dow Corning Silastic 732-RTV; General Electric STC-1200; or equal.

G. Sealant Backup: Polyethylene rod stock. Acceptable products are:
   1. Dow Corning "Ethafoam."
   2. Hercules, Inc., HBR Backer Rod.
   3. Or equal.

H. Sealant Tape: Resilient, nonstaining, 100% vulcanized butyl rubber, scrim reinforced, self-adhering, extruded sealant tape containing no asphalts. Acceptable products are:
   1. Protective Treatments, Inc., #303
   2. Tremco #440,
   3. Or equal.

PART 3 - EXECUTION

3.01 CONDITION OF SUBSTRATE

A. Allow concrete and masonry to cure for at least 28 days before applying sealants.

B. Inspect substrates to receive sealant work for:
   1. Deviation beyond allowable tolerance for joint width and required clear joint depth. Joint width shall not be less than 1/4-inch or the width shown.
   2. Presence of contaminants, which cannot be removed by normal joint cleaning.

C. Do not start work until unsatisfactory conditions are corrected.

3.02 PREPARATION OF SURFACES

A. Clean surfaces to which sealant is to be adhered:
   1. For Concrete and Masonry: Sandblast joint surfaces taking care to protect exposed finish surfaces.
   2. For Metal: Sand or scrape and solvent clean with a non-film forming solvent.
   3. For Ceramic Tile: Scrape, sand or grind.

B. Insure that cleaned surfaces are not contaminated before applying sealant.

3.03 APPLICATION

A. Follow sealant manufacturer's published instructions.
B. Install sealant backup the proper distance from face of joint for joint proportioned in accordance with sealant manufacturer's recommendations. Use polyethylene rod stock larger than joint so that backup can be firmly held in place.

C. Apply primer and/or cleaner conditioner recommended by sealant manufacturer for substrate. Avoid getting primer on the face of material or on areas that will not be covered by sealant.

D. Mask edges of joint with masking tape where required to avoid contamination of exposed surfaces adjacent to joint.

E. Apply self-leveling sealant by pouring, pumping or with a caulking gun. When using pump or caulking gun fill joint from the bottom up to avoid air entrapment. Fill joint flush with surface of adjacent material without overfilling or spilling sealant on exposed surfaces.

F. Apply vertical grade sealants by hand or power operated caulking gun. Use a caulking tip the proper width for the joint required. Fill the joint from the bottom up to insure a fully filled joint without entrapped air bubbles or voids. Use lubricant recommended by sealant manufacturer to tool joints. Force sealant against sides and bottom of joint and into all crevices; press out air bubbles and voids. Tool sealant surface smooth and flush with adjacent surfaces for butt joints or to an even, straight-sided fillet of uniform width and slope for fillet joints.

G. Where the substrate or adjacent sealants are incompatible with the specified sealant, submit a sealant suitable for the required use and of equivalent life expectancy to the specified sealant.

3.04 EXPANSION JOINTS

A. Apply sealant in expansion joints when the joint opening width is approximately halfway between dimensional extremes of thermal movement.

B. Place sealant backer rod the proper distance from face of joint to insure that sealant bead depth is never more than half the bead width at any time between dimensional extremes of joint.

3.05 SEAL BETWEEN PLUMBING FIXTURES AND ADJACENT SURFACES

A. Install a bead of mildew resistant silicone sealant (Sealant E) between plumbing fixtures, countertops, shower enclosures and similar items and the surfaces they are mounted on.

3.06 CLEANUP

A. Upon completion, remove protective masking and clean any sealant from adjacent finished surfaces beyond edge of joint.

END OF SECTION
### DIVISION 8

**DOORS AND WINDOWS**

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SECTION 08110
HOLLOW METAL WORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. All hollow metal work including:
      a. Doors and frames.
      b. Window frames.
      c. Door louvers.

B. Related Sections:
   1. Section 08700: Finish Hardware
   2. Section 08800: Glazing
   3. Section 10200: Louvers

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A366 Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality
   2. ASTM A525 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   3. ASTM A526 Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process Commercial Quality
   4. ASTM A569 Specification for Steel, Carbon (0.15 Maximum Percent) Hot-Rolled Sheet and Strip, Commercial Quality


D. Steel Door Institute (SDI) publication ANSI/SD1-100-1991, Recommended Specifications for Standard Steel Doors and Frames.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe all products proposed for use. Include data and details on door construction including internal reinforcement and door edge construction.

C. Shop Drawings: Submit custom prepared project-specific shop drawings showing dimensions and details. Include a schedule showing locations of doors and frames.
complete with listing of types and styles. Field measure before ordering. Provide frames with throat opening size required by field conditions regardless of size shown on drawings. Review of door frame submittal DOES NOT include review of throat opening dimension for compatibility with field requirements or Contract Documents.

D. Manufacturers' Certificates of Compliance: Before delivery of doors, frames, and accessories, submit certificates from the manufacturer attesting that doors, frames and accessories meet the requirements of the referenced standards.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with:

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery: Inspect doors, frames, and accessories delivered to the site for damage. Unload and store with a minimum of handling. During delivery, strap door frames of welded unit construction together in pairs with the head of one frame inverted for bracing. Replace doors and frames damaged during delivery.

B. Provide a bottom spreader bar tack welded to frames to maintain jamb alignment until frames are installed.

C. Storage: Store doors and frames carefully on platforms under cover in dry and accessible locations, which are adequately ventilated and free from dust or water and which permit easy access for inspection and handling. Avoid the use of non-vented plastic or canvas shelters that create a humidity chamber.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers include Forderer Hollow Metal Products; Fire Protection Products; Republic; Steelcraft; or equal.

2.02 MANUFACTURED UNITS

A. Frames, Steel:
   1. Cold rolled steel conforming to ASTM A366 or commercial grade hot-rolled and pickled steel conforming to ASTM A569.
   2. Metal thickness: 16 gauge or heavier where noted.

B. Doors, Steel:
   1. Commercial quality, stretcher level, cold rolled steel, conforming to ASTM A366.
   2. Thickness of face sheets: 16 gauge or heavier where noted.
C. Jamb Anchors:
   1. Provide the number of anchors required by the fire rating but not less than the following number for each jamb.
      a. Frames up to 7'-6" high, three anchors.
      b. Frames 7'-6" to 8'-0" high, four anchors.
      c. Frames over 8'-0" high, four anchors plus one additional anchor for each 2 feet or fraction thereof above 8 feet.
      d. Provide head anchors at 2-foot centers for openings wider than 3 feet.
   3. Frames in Stud Walls: Furnish strap jamb anchors, not less than 16-gauge thickness and fully welded inside frames.
   4. Frames in Previously Placed Concrete Walls: Provide countersunk holes for 1/2-inch flat head galvanized steel expansion bolt anchors. Weld pipe spacers or equivalent spacer inside jambs to prevent anchor from collapsing frame.
   5. Provide special anchors when specified or detailed.

D. Floor Anchors: 14-gauge minimum thickness, welded to frame at each jamb or mullion, punch for two 3/8-inch-diameter anchor bolts. Additional jamb anchors do not waive the requirement for floor anchors.

E. Door Louvers:
   1. Provide 18-gauge louvers manufactured for installation in doors. Louvers shall be stationary, weatherproof, 45° zee configuration blades.
   2. Manufacturer: Air Louvers Model 900 with trim Style A-1 or equal.
   3. Provide 1/4-inch mesh galvanized hardware cloth screens in removable galvanized channel frames on the inside surface of louvers in exterior doors.

F. Hollow Metal Frames for Windows:
   1. 16-gauge steel.
   2. Exterior Locations: 16-gauge galvanized steel.
   3. Number of Anchors: Provide anchors in head and jambs spaced as required for door frames.

2.03 FABRICATION

A. General: Fabricate in the shop. Accurately fit all work and fabricate in a manner to produce smooth, even surfaces free from warp, wave, buckle and other defects. Make square corners and angles unless shown otherwise on the Drawings. Set members in proper alignment, with edges straight and clean. Make provisions for hardware at locations according to prevailing accepted standards and as shown on the Drawings.

B. Preparation for Hardware: Make to hardware templates and physical hardware. Locate center of panic hardware pushbar door knob and lever handle 38 inches above the floor. Locations shall be coordinated between frames and doors, as shown on the Drawings and according to applicable accessibility and other code requirements. Make cutouts as required for intrusion alarm switches where
scheduled. Punch stops of all frames for silencers, three in latching stop for single doors, two in head of double door frames.

C. Frames: Fully welded, seamless construction with no visible seams or joints, strong, rigid and constructed so as not to bind, sag, twist or otherwise fail in use. Provide frames with throat opening dimension required to meet field requirements regardless of throat size shown.

1. Frame members: Form each frame member from one piece of sheet steel.
2. Joints: Miter corner joints, including integral stops, reinforce and weld continuously full length of joint. Fit other joints neatly and weld continuously full length of joint.
4. Floor anchors: Weld to bottom of door frame jambs.
5. Spreaders: Connect removable steel channel spreader ties across bottoms of welded door frames to hold rigid during shipping and until they are secured in place in the work.
6. Hardware reinforcing: Weld in place, comply with NAAMM CH-1 standards. Shop drill and tap for template hardware. Field-drill and tap for surface mounted hardware.
   a. Templates: Obtain from finish hardware manufacturer.
   b. Hinges: 7-gauge steel, 1-1/4 inches wide by not less than 10 inches long. Prepare for full mortise hinges.
   c. Strikes: 12-gauge steel, 1-1/2 inches wide with minimum lap of 2 inches beyond cutout.
   d. Closers: 12-gauge steel, length to accommodate closer. Provide reinforcing at two locations on each frame for installation of either regular or parallel arm closers whether or not closers are scheduled.
   e. Plaster guards: 24-gauge steel, provide at strike and hinge reinforcing.
   f. Flush bolts: 12-gauge steel.
7. At exterior locations and where noted, provide shop welded 16-gauge galvanized steel rain hood at head of door frame.

D. Doors:
1. Type: SDI Type III, extra heavy duty, fully welded style 2 full flush hollow steel construction for interior doors and exterior doors. Doors shall have no visible joints or seams on exposed faces and vertical edges.
2. Top and bottom rails: 16-gauge channel; fully flush design, continuous welded to face sheets.
3. Face sheet (or face panel) reinforcing shall meet the requirements of ANSI A151.1 for twist strength. The following methods are acceptable:
   a. Continuous vertical stiffeners of not lighter than 22-gauge steel, spaced not to exceed 6 inches on centers and spot welded to both face sheets at intervals not greater than 6 inches. Fill all voids with insulation.
   b. An inner grid system consisting of vertical and horizontal members of not lighter than 18-gauge steel, welded or interlocked for maximum strength and spaced not to exceed an average of 12 inches in either direction, and spot welded to both face sheets at intervals not greater than 6 inches. Fill all voids with insulation.
c. A continuous formed sheet steel truss core, full height and width, spot welded to face sheet at intervals not greater than 6 inches in both directions. Fill all voids with insulation.

d. Doors required to have a maximum temperature rise on the protected side shall have insulating cores as required to achieve the specified performance.

4. Edge profile: Bevel vertical edges of stiles 1/8-inch in 2 inches.
5. Door thickness: 1-3/4 inches or thicker as noted.
6. Clearances: 3/32-inch clearance at jambs and head and 3/8-inch clearance at bottom; 1/4-inch clear between door and threshold where threshold occurs. Provide required clearance between door and stop to accommodate smoke gasket.
7. Exterior doors: Provide a watertight flush closing channel at the top edge. Provide weep holes in the bottom closure to permit escape of entrapped moisture.
   a. Exterior doors: Weld moldings watertight, provide removable molding on inside face of door.
9. Door cutouts: Cut outs for door openings shall be spaced at least the distance away from door edges or recesses for hardware that is required to maintain door fire rating and guarantee. All cut outs shall be made in the shop fabricating the doors.
10. Hardware reinforcing: Comply with NAAMM CHM-1 Standards. Shop drill and tap for template hardware. For surface mounted hardware, drill and tap in the field.
   a. Hinge: 7 gauge
   b. Lockset: 12 gauge
   c. Flush bolt: 12 gauge
   d. Closer: 9 gauge
11. Provide reinforcement for closers both sides of all interior doors whether closers are scheduled or not.

E. Door Louvers: Provide louvers meeting the requirements of paragraph 2.02 of this Section and of the same material and finish as the door. Install at the factory in tamperproof molding with screws on the interior side of the door.

F. Doors With Special Cutouts:
   1. Provide cutouts in paired doors where monorail beam passes through door opening.
   2. Provide 1/4-inch-thick reinforced non-conductive rubber or plastic closure plates screwed to outside face of doors and scribe to profile of monorail beam leaving 1/4-inch maximum clearance all around beam.

G. Astragals: Provide 1/8-inch-thick flat plate astragal welded to active leaf of paired doors unless other type of astragal is called for.

2.04 HOLLOW METAL WINDOW FRAMES

A. Shapes: As shown in the Drawings. 16-gauge minimum. Fabricate from galvanized steel for exterior locations.
B. Anchors: Same as for door frames.

C. Anchor Spacing: One anchor within 6 inches of each corner on all sides of window frame and spaced 36 inches on centers maximum.

D. Glazing Stops: Loose stops as detailed, 16-gauge minimum, to be on interior side of door, secured with oval head sheet metal screws spaced 16 inches on centers maximum.

2.05 FINISHES

A. Refer to Section 09900 for surface preparation, pretreatment, primers, and application techniques.

B. Apply one shop coat of rust inhibiting primer to all ferrous metal not scheduled to be galvanized.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Frames: Set accurately in position, plumbed, aligned and braced securely until permanent anchors are set. Anchor bottom of frames securely to floors. Secure wall anchors to adjoining construction as indicated or required.

B. Grouting: Fill space between door frames and wall solid with grout in masonry walls and elsewhere when noted.
   1. Masonry walls: Fill space between door frames and block with cement mortar at the same time as masonry units are being laid up. Apply a bead of one part polyurethane sealant between the block and door frame on the exterior side of the opening per Section 07900.

C. Hanging Doors: Set accurately, snug against all stops and free from hinge bind. If shimming is required use sheet brass shims. Install hardware, weather stripping, and smoketight gaskets. Adjust closing and latching speed of door closers for smooth operation, self-closing and automatic positive latching. Fasten with matching machine screws or bolts at all points where fasteners are indicated or required. Leave hardware in perfect working order. Clean and polish.

D. Remove locksets, latchsets, and kickplates for field painting of doors. Replace hardware after painting work is completed.

E. Labeled Doors and Frames: Install in accordance with Underwriters' Laboratories, Inc. requirements for class of opening and fire rating in hours as scheduled. Install smoketight gaskets at door jambs, heads and meeting astragals as required to meet ASTM E283, SDI-116, and CBC Chapter 10. Field modifications of listed or labeled doors and frames are not permitted.

END OF SECTION
SECTION 08305
ACCESS DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Access doors not furnished under Divisions 15 or 16.
   2. Requirements for access doors furnished under other sections.

B. Related Sections: Section 09250: Gypsum Wallboard

1.02 REFERENCES

A. Underwriters Laboratories Inc. Standards: 10B, Fire Tests of Door Assemblies

1.03 SUBMITTALS

A. Submit in accordance with Section 01300:
   1. Product Data: Fully describe all items proposed for use.
   2. Shop Drawings: Show dimensions and details.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

B. Manufacturer's Recommendations: Comply with manufacturer's published recommendations for installation of material used.

PART 2 - PRODUCTS

2.01 ACCESS DOORS

A. Access Doors:
   1. Manufacturer: Inryco/Milcore; J. L. Industries; or equal.
   2. 2 feet square unless other sizes are indicated.
   3. Suitable for wall or ceiling finish and type of construction.
   4. Self-latching with flush key operated cylinder locks.
   5. Phosphated treat and paint metal parts with a baked on primer. Doors shall be manufactured by Inryco/Milcore; J. L. Industries; or equal.
   6. Access door types: For access doors in unrated gypsum wallboard, or ceramic tile, provide flush panel type doors with appropriate trim, 16-gauge frame and 14-gauge door panel. Doors shall be 16x16 inches unless noted otherwise.
PART 3 - EXECUTION

3.01 INSTALLATION OF ACCESS DOORS

A. Furnish access door to trades framing walls or installing wall finishes for installation by them. Provide installing trades with instructions for installing doors.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Vault and wet well access hatches.

1.02 REFERENCES

A. Trade and Technical Association Standards:

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe all items proposed for use.

C. Shop Drawings: Show dimensions, attachments, inserts, and relationship of work to adjoining construction.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Applicable Occupational Safety and Health Regulations.

1.05 GUARANTEE

A. Furnish a written guarantee effective for a period of 2 years, after final acceptance of the project that floor hatches will not leak and will be free of defects in materials and workmanship.

PART 2 - PRODUCTS

2.01 ACCESS HATCHES

A. Spring-assisted access hatches are required for all hatches installed as a part of this project.
B. Spring-Assisted Access Hatches:

1. Single Leaf: Bilco Model "J"; Babcock-Davis, Model AM; or equal. All shall be of same manufacturer.

2. Double Leaf: Bilco Model "JD"; Babcock-Davis Model GT; USF Fabrication or equal. All hatches on the project shall be of same manufacturer.

3. 300 PSF loading unless designated otherwise.

4. Equip with heavy forged brass hinges, stainless steel pins, spring operators and an automatic hold-open arm with a positive automatic latch that will secure the door in the open position until the release handle is activated. Submit details of latch for review. Provide snaplock with removable handle. Provide aluminum recessed hasp to door and frame for a padlock.

5. Provide stainless steel hold-open pin through holes in hold-open arms to insure against accidental hatch closure. Attach pin to hatch with a short stainless steel chain to prevent loss.

Frame: 1/4-inch (6.35 mm) thick aluminum channel with anchor flange around perimeter. Dimensions shall be as shown on the Drawings. Provide channel to collect drain water and provide 1-1/2-inch (38 mm) drainage coupling for connection to drainlines.

C. Doors: Doors shall open to 90 degrees and lock automatically to secure the door in the open position until the release handle is activated. A snap lock with removable handle shall be provided.

D. Safety Net: A safety net spanning the entire opening to provide fall protection for the hatches on the existing influent and effluent wetwells. The safety net shall be of the type designed for access hatches and meet all OSHA regulations for fall protection. The safety net system shall be manufactured of aluminum or stainless steel side rails and nylon webbing with PTEF thread for UV and chemical resistance. The net shall be easily retractable for unencumbered access.

E. Hinged Hatch Safety Gate: The Hinged Hatch Safety Grate is an extruded aluminum fall protection grate that smoothly rotates 90 degrees to its open position and locks in place by a hold-open rod. The grate has an OSHA safety yellow or orange finish

1. Hardware components are made of 316 stainless steel to withstand corrosive wastewater environments.

2. The fall through prevention system shall consist of a grate made of 6061-T6 aluminum and be designed to withstand a minimum pedestrian load of 300 lbs. per square foot. The grate shall operate independent of the cover.

3. The grate openings shall be 4" x 6".

4. The grate will pivot on an aluminum hinge device with 316 SS hardware that permits it to rotate upward 90 degrees and automatically lock in place. An aluminum pull rod will be attached to the grate so the operator is positioned with the grate between him and the hatch's opening whenever he pulls on it to raise the grate. A 316 SS rod will automatically engage to secure the grate in its open position, and can be lifted upward to permit the grate to close.
5. The grate shall have an OSHA safety yellow finish to increase visual awareness of the safety hazard.

F. All hardware: Stainless steel throughout.

G. Finish: Mill finish aluminum with bituminous coating applied to the exterior portion of the frame that will be concealed after installation.

H. Provide stainless steel hold-open pin through holes in hold-open arms to ensure against accidental hatch closure. Attach pin to hatch with a short stainless steel chain to prevent loss.

I. Warning Sign: Provide a 10x12-inch minimum size sign permanently attached to the underside of hatch doors reading: “WARNING: Confined Space. Make Sure Hold-Open Latch is Positively Engaged Before Using. Insert Pin in Holes in Hold-Open Arms to Hold Door Open.”

2.02 HATCH COVER/SAFETY NET SCHEDULE

(1) One (1) hatch cover complete for the In-Plant Pump Station*
(2) One (1) hatch cover complete for the Scum Pump Station*
(3) One (1) hatch cover complete for the Influent Flow Meter Vault*
(4) One (1) hatch cover complete for the Effluent Flow Meter Vault*
(5) One (1) hatch cover safety net system for the existing Influent Pump Station**
(6) One (1) hatch cover safety net system for the existing Effluent Pump Station**

*See Drawings for hatch dimensions. Provide Hinged Hatch Safety Grate with these hatches.

** Approximate dimensions for the existing hatch openings are 42"x42" and 30"x48". Contractor to field verify dimensions of the existing Influent and Effluent Pump Station hatches.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Deliver hatches to pre-caster in time for installation in the concrete pour.

B. Make sure all aluminum surfaces which will be in contact with concrete are coated with bituminous paint.

C. Coordinate connection of drainage coupling to plumbing drain line prior to the concrete pour. Install frame so that door channel drains to the exterior of the wetwell.

D. Set frame level and true to plane at all four corners, and flush with adjacent finished surfaces. Doors, when closed, shall be flush with frames and flush with each other.

END OF SECTION
SECTION 08330
ROLL-UP DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Hand-operated roll-up doors.

B. Related Sections:
1. Section 08700: Finish Hardware
2. Section 09900: Painting

1.02 REFERENCES

A. American Society for Testing Materials (ASTM):
1. A123 Specifications for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products
2. A653 Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron-Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.03 SUBMITTALS

A. Submit in accordance with Section 01300:
1. Product Data: Describe every product or item proposed for use.
2. Shop Drawings: Prepare especially for the project, showing elevations at 1/4-inch = 1'-0" and details at 3-inch = 1'-0", or larger if necessary for clarity. Field measure openings and verify clearance prior to preparing shop drawings. Show connections to adjacent construction. Show electrical details.

1.04 QUALITY ASSURANCE

A. Qualifications:
1. Provide roll-up doors manufactured by a firm specializing in roll-up (overhead coiling) industrial doors.
2. Install door using a Licensed Specialty Contractor engaged exclusively in providing and installing roll-up and other industrial doors and who is approved by the door manufacturer.

1.05 WARRANTY

A. All Roll-Up Doors shall be warranted for a period of twelve (12) months from the time of building acceptance by the Owner against defects in workmanship and materials.
PART 2 - PRODUCTS

2.01 HAND-CHAIN OPERATED ROLL-UP DOORS

A. Manufacturer: Type FCM with primer suitable for field painting by the Cookson Company; equivalent by Overhead Door Corporation; or equal.

B. Construction and Features:
1. Galvanized coating: Hot-dip galvanize all steel components unless noted otherwise. Hot-dip galvanize sheet steel thinner than 1/8-inch with a zinc coating of at least 1.25 ounce per square foot in accordance with ASTM A653. Hot-dip galvanize steel 1/8-inch thick and heavier in accordance with ASTM A123.

2. Curtain-insulated: Fabricate interlocking slats from not less than 18-gauge galvanized copper bearing strip steel in a flat face pattern, No. 4 slat by Cookson Company; equivalent by Overhead Door Corporation; or equal. The outer slat shall be 18 gauge thick. Fabricate the inner slat from 22-gauge minimum galvanized steel. Fill the space between the inner and outer slat solid with expanded polyurethane insulation. Reinforce bottom slat with two structural steel angles, minimum 1/8-inch thickness, back-to-back. Design door to withstand wind load of 20 pounds per square foot. Support load of barrel and curtain by two grease-sealed ball bearings.

3. Guides: Fabricate from hot-rolled structural steel angles bolted with 3/8-inch-diameter bolts to form a slot of sufficient depth to retain curtain in guides during periods of heavy wind pressure. Make wall angles continuous. Flare the top of each guide to facilitate entry of curtain. Provide galvanized steel bolts, anchor bolts, nuts and washers. Galvanize guides and remove any bumps on curtain contact surfaces.

4. Brackets: Fabricate from steel plate of not less than 5/16-inch thickness. Bolt brackets to wall angle with a minimum of two 1/2-inch-diameter bolts.

5. Hood: Fabricate from one piece of 24-gauge galvanized steel sheet. Form to fit curvature of brackets with sufficient beads or flanges to prevent deflection. a. Provide a neoprene wind baffle in constant contact with the full width of the curtain coil.

6. Windlocks: Provide wind locks at both ends of alternating slats to prevent pull out of slats from side guides.

7. Gears: Cast iron with teeth cast from machine cut patterns. Provide not less than 3-inch pitch diameter for pinion gears. Design gear ratio for a maximum manual effort of not more than 30 pounds.

8. Provide galvanized chain operator with provisions for padlocking chain operator 4 feet above the floor.

9. Barrel: Fabricate from steel tubing not less than 4 inches in diameter, designed to limit maximum deflection to 0.03-inch per foot of span. Provide oil-tempered tension springs capable of correctly counterbalancing the weight of the curtain. Provide adjustable springs by means of an exterior wheel.

10. Weatherstrip at side guides to properly seal door perimeter without affecting ease of operation. Provide flexible neoprene strip at door bottom.

11. Factory finish: Bonderize all exposed galvanized metal surfaces of curtain and hood. Apply primer suitable for field painting.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Install doors using manufacturer's trained and authorized specialist.

B. Install, adjust and test doors in accordance with manufacturer's printed instructions.

C. Attach guides to masonry walls with machine bolts in concrete anchors. Attach guides to steel construction using drilled and tapped machine bolts.

END OF SECTION
SECTIoN 08520
ALUMINUM WINDOWS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Aluminum windows.
   2. Glass and glazing for aluminum windows, window wall and sliding doors specified in this Section.

B. Related Sections:
   1. Section 08110: Hollow Metal Work
   2. Section 08800: Glass - glazing

1.02 REFERENCES

A. Architectural Aluminum Manufacturer's Association (AAMA).

1.03 SUBMITTALS

A. Submit the following for Product Review in accordance with Section 01300.

B. Product Data:
   1. Manufacturer's current product literature fully describing all products and systems proposed for use. Literature shall be clearly marked to identify products and options being furnished and shall reference the contract specification section and paragraph number that describes the product.
   2. Reports of tests performed by an independent laboratory to verify specified performance of windowall, windows and sliding glass doors.

C. Shop Drawings: Detail fabrication, assembly and installation drawings especially prepared for this project

1.04 QUALITY ASSURANCE

A. Comply with the applicable sections of the adopted editions of the San Francisco Building Code and Uniform Building Code Standards.

1.05 DELIVERY STORAGE AND HANDLING

A. Do not deliver materials until openings are ready for installation.

B. Stack units on edge on raised wood sleepers and under cover.
1.06 SPECIAL GUARANTEE

A. Provide a written two-year guarantee signed by the window manufacturer, window installer and General Contractor providing for the repair or replacement of windows that leak or fail to operate smoothly, close tightly and lock securely.

PART 2 - PRODUCTS

2.01 SLIDING ALUMINUM WINDOWS

A. High performance weatherstripped double-glazed sliding aluminum windows with an Architectural Class I dark bronze anodized finish. Arcadia Series 800; Fentron; or equal.


C. Adjustable steel ball bearing rollers. Removable sill cap to allow fixed panel to bypass for cleaning. Spring-loaded locking mechanism meeting AAMA forced-entry resistance Specification 1302.1. Built-in anti-lift out device.

D. Glaze with double-insulated bronze glass having a 5/8-inch total thickness in exterior openings. Glazing sealant shall be Silicone Type D applied in accordance with the requirements of Section 07900.

E. Finish shall be a dark bronze anodic coating with a minimum of 0.7 mils thick. Aluminum Association (AA) Architectural Class I dark bronze, AA-M10C22A44.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all units plumb and level. Seal all joints between window frames and opening in building construction watertight in accordance with Section 07900. Joint shall be 1/4-inch wide. Install a backer rod 1/4-inch below the surface. Install a 1/4-inch x 1/4-inch bead of polyurethane sealant. Tool and compress the sealant. All fasteners to be stainless steel. Plastic inserts of any type are not acceptable.

B. Glaze windows in accordance with Section 08800.

C. Clean frames with a solvent moistened rag. Clean glass without scratching. Test and adjust operable and fixed units for proper smooth operation and positive locking.

END OF SECTION
SECTION 08700
FINISH HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnish and install all finish hardware.
   2. Supervision of the coordination, preparation for and installation of Finish Hardware by a certified Architectural Hardware Consultant (AHC).

B. Related Sections: Section 08110: Hollow Metal Work

1.02 REFERENCES

A. ANSI/BHMA: Product standards for all specified items.

B. Door and Hardware Institute (DHI):
   1. Basic Architectural Hardware.
   2. Abbreviations and Symbols.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe every product proposed for use.

C. Shop Drawings: Submit hardware list and schedule prepared by a certified Architectural Hardware Consultant in accordance with DHI recommendations.

D. Manufacturer's Instructions: For mounting, installing and adjusting hardware.

1.04 QUALITY ASSURANCE

A. Qualifications: Hardware Supplier:
   1. Engaged in supplying builder's hardware for projects of comparable size and shape.
   2. Has a full-time certified Architectural Hardware Consultant (AHC) on staff who will prepare the hardware submittal and supervise installation of all finish hardware.

B. Regulatory Requirements:
   2. Federal and State handicapped access and use requirements
   3. Underwriters' Laboratories' requirements for fire-rated assemblies.
1.05 DELIVERY

A. Deliver hardware with items for each opening packed together, complete and ready for installation with necessary fittings, trim, fasteners and accessories. Mark packages with opening number for identification.

B. Deliver templates and installation instructions.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide hardware that complies with applicable fire and building codes. Provide all hardware, smoke gaskets and thresholds listed for a fire assembly of the required rating for all doors required to be fire rated.

B. Provide hardware that fits perfectly, is of uniform color, and is free of imperfections affecting serviceability or marring appearance.

C. Deliver hardware in a timely manner as required by the Contractor's Schedule. Furnish materials or templates to others when required for factory installation or preparation.

D. Provide adequate functioning hardware for all doors whether scheduled or not. See paragraph 3.02B of this Section.

E. Where the hardware manufacturer's product number specified does not provide hardware meeting fire codes, condition of use, function, hand, mounting conditions, strikes, stops, keepers or fasteners required for a satisfactory installation, provide items of equivalent or better quality meeting applicable project conditions.

F. Coordinate with the work of other trades in furnishing and placing finish hardware.

2.02 HARDWARE

A. Fasteners: Furnish all necessary screws, bolts or other fastenings of suitable size and type to anchor the hardware in position for heavy use and long life; provide fasteners that match the material and finish of the hardware. Where necessary provide expansion shields, sex bolts, screws, or other anchors appropriate for substrate that the hardware is installed on. Provide machine screws and soft metal expansion shields to fasten hardware to concrete, masonry, plaster and similar materials. Plastic or fiber inserts are not acceptable.

B. Finish: Provide all hardware with the following finish: US32 (629) bright stainless steel.
C. Locksets:
1. Mortise Locksets: Heavy duty, with 6-pin cylinder with interchangeable core matching Owner's system. Schlage "L" Series; Corbin 9700 Series; or equal. Provide lever handles. Design: Schlage 03; Corbin 779L; or equal.
3. Strikes: Furnish standard strikes with extended lips where required to protect trim from being marred by latch bolt. Provide dust boxes. Verify whether standard or ANSI cutouts are provided in metal frames.

D. Padlocks:
1. Solid brass or stainless steel, with case hardened steel shackle, 1-inch clearance, with 9-inch-long chain.
2. Keying: Interchangeable core 6-pin tumbler cylinder matching Owner's system.

E. Keys and Keying, Interchangeable Core Type:
1. All keyed locksets and padlocks shall be supplied with interchangeable core cylinders to match Owner's interchangeable core and keying system.
2. All cylinders shall be supplied with temporary construction cores for Contractor's use. Permanent cores shall be delivered directly to the Owner.
3. Furnish three keys per lock. Stamp all keys, "Do Not Duplicate."

F. Hinges: Butts, Full Mortised. Provide nonremovable pins for all exterior outswinging doors. For all labeled doors provide ball bearing steel butts for interior doors and stainless steel ball bearing butts for exterior doors that open out.
1. Unless otherwise specified, determine the size of the butts by the following table:
a. Doors 1-3/4-inch thick and up to 41-inch wide to have 4-1/2-inch.
b. Doors 1-3/4-inch thick, 42-inch to 48-inch wide to have 4-1/2-inch heavy.
2. Provide widths sufficient to clear trim projection when door swings 180 degrees.
3. Provide three hinges to 90-inch high for each door leaf: Four hinges to 120-inch high for each door leaf.
4. Provide ball bearing butts unless specified otherwise.

G. Closers:
1. Provide products of one manufacturer; non-handed double arm, smoothie style with metal covers full rack and pinion type ANSI A156.4 Grade 1 with steel spring and non-gumming, non-freezing hydraulic fluid; non-sized adjustable for interior doors to 5 feet wide and exterior doors to 4 feet wide (cylinder sizes 1 through 6).
2. Provide controls for regulating closing, latching speeds and back check non-handed double arm. Provide all closers with a cushion stop built into closer arm that can be adjusted to stop door opening at a pre-set angle.
3. Provide closers designed with spring power adjustment required for easy opening usable by the PHYSICALLY HANDICAPPED; 8.5 pounds for exterior doors and 5 pounds for interior doors.
4. Provide parallel-arm closers at reverse bevel doors and where doors swing full 180 degrees. Include all through bolts, mounting brackets, mounting plates, shoes and accessories required for proper function and installation. Furnish hold open arms when specified.
5. Provide maximum degree of opening attainable consistent with closer function specified.
6. Provide closer covers with a plated finish.

H. Exit Devices, Touch Bar Type: Heavy-duty type UL listed for accident hazard and capable of meeting UL "A" label rating, rim latch or mortise design with 3/4-inch anti-friction latch bolt. Latch bolt shall retract when horizontal pressure is exerted on touch bar. Latch bolts on vertical rod devices shall remain retracted until door closes. Plate all exposed surfaces to match hardware finishes. Provide stainless steel touch bars US32 finish.

I. Door Stop, Floor-Mounted: Stainless steel or solid brass plated to match hardware. Provide risers to increase height as required to suit conditions.

J. Door Stop, Wall-Mounted: Stainless steel or solid brass plated to match hardware. Furnish with durable high-grade shock-resistant rubber bumper.

K. Door Stop/Holder, Floor-or Wall-Mounted: Provide a strike with a hinged hook that fits flush with the strike when unit is acting as a stop only. The hook is manually lifted to engage the hold-open lug. When released, the hook drops back flush with the strike. Provide in stainless steel or solid brass finished or plated to match hardware. Note: UL requirements do not permit hold-open feature on fire-rated door assemblies.

L. Thresholds: Furnish white or yellow bronze thresholds to match other door hardware unless noted otherwise. Anodized aluminum is not acceptable.

M. Silencers: Pneumatic rubber, installed in metal frame stops. Furnish three for single doors and two for pair of doors. Omit silencers where door seal occurs and for exterior doors.

N. Provide Door Seal at All Exterior Doors: 3/16-inch x 1/2-inch sponge neoprene closed cell adhesive back tape.

O. Fire Door Smoketight Gaskets: At all doors required to have a 20-minute or greater fire rating, provide self-adhesive, silicone rubber smoketight gaskets continuous at the head and jambs for all doors and at the head, jambs, and meeting astragal for pairs of doors. Provide smoketight gaskets that comply with the requirements of UBC 1005.1 - 1005.10 for a smoke- and draft-control door assembly. Ultra Industries WS108, Sealeze JX75BLK17, or equal.

P. Manual Flush Bolts: Provide concealed manual top and bottom flush bolts on the active leaf of pairs of doors. Provide bolts designed to be mounted in the edge of the door with concealed vertical rod activators, having a 5/8-inch throw and a 7/8-inch adjustment and a spring snap lever action. Glynn-Johnson #FB-5 for aluminum doors; #FB-6 for metal doors; and #FB-6W for wood doors.
PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Be responsible for the proper location, fit and operation of all finish hardware items under the appropriate headings. Install finish hardware according to the Drawings, Specifications and finish hardware manufacturer's instruction. Place and adjust stops and or shim hinges to provide clearance for smoketight gaskets and to prevent doors from binding on stops or frames.

B. Make the right-hand door or right-hand reverse door the active leaf of a pair of doors unless indicated otherwise.

C. Fitting: Properly cut, drill, shape, reinforce and otherwise fabricate items upon which finish hardware is to be installed according to templates, physical hardware and finish hardware manufacturer's instructions to insure proper attachment and function.

D. Adjustment: Install all lock cylinders to accept keys with the teeth facing up. Adjust, shim, align all hardware to operate smoothly without binding or rubbing and so that self-closing and automatic closing doors will latch automatically.

E. Door Stops/ Holders/ Keepers:
   1. Where physical conditions do not permit installation of the specified door stop, holder or keeper without creating a tripping hazard, provide a suitable item of comparable quality that will perform the intended function and can be installed such as a wall-mounted or surface overhead door-mounted device.
   2. Locate door stops, holders and keepers so doors will be held open in the maximum open position.

F. Defective Installation: Appearance, installation, attachment and operation of finish hardware shall be subject to review by the Engineer. Replace finish hardware found unacceptable as directed.

3.02 HARDWARE SCHEDULE

A. The Contractor is responsible for providing all finish hardware together with all components, accessories and fasteners necessary for a complete and smooth operating installation.

B. Items in the following hardware table is intended to establish standards of quality and utility.

<table>
<thead>
<tr>
<th>Item</th>
<th>1st Manufacturer</th>
<th>2nd Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butts, hinges</td>
<td>Stanley</td>
<td>Hager, or equal</td>
</tr>
<tr>
<td>Locksets, latches, cylinders, padlocks</td>
<td>Schlage</td>
<td>Corbin</td>
</tr>
<tr>
<td>Closers</td>
<td>LCN</td>
<td>Sargent, or equal</td>
</tr>
<tr>
<td>Exit devices</td>
<td>Von Duprin</td>
<td>Sargent, or equal</td>
</tr>
<tr>
<td>Silencers, stops, holders</td>
<td>Glynn-Johnson</td>
<td>Builder's Brass, or equal</td>
</tr>
<tr>
<td>Item</td>
<td>1st Manufacturer</td>
<td>2nd Manufacturer</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Automatic flush bolts, flush bolts, strikes</td>
<td>Ives, Glynn-Johnson</td>
<td>Builder's Brass, or equal</td>
</tr>
<tr>
<td>Automatic door bottoms</td>
<td>Pemko</td>
<td>Reese, or equal</td>
</tr>
<tr>
<td>Thresholds</td>
<td>Pemko</td>
<td>Reese, or equal</td>
</tr>
<tr>
<td>Folding door hardware</td>
<td>Grant</td>
<td>Stanley, or equal</td>
</tr>
<tr>
<td>Cane bolts, foot bolts</td>
<td>Richards-Wilcox</td>
<td>Stanley, or equal</td>
</tr>
</tbody>
</table>

C. Schedule of Hardware Groups:
1. **Hardware Group 1**
   Doors 04, 05, 13, 21 and 22 shall each receive the following:
   1-1/2 pair butts
   1 lockset F20
   1 door closer
   1 set weatherstripping

2. **Hardware Group 2**
   Doors 01, 24, and 26 shall each receive the following:
   3 pairs butts
   1 lockset F-20
   1 set flush bolts
   1 dustproof strike
   2 sets weatherstripping
   1 threshold
   2 doorstop holders

3. **Hardware Group 3**
   Doors 6 and 12 shall each receive the following:
   1-1/2 pair butts
   1 push plate
   1 pull plate
   1 set weatherstripping
   1 door closer
   1 floor stop

4. **Hardware Group 4**
   Doors 23 and 25 shall each receive the following:
   1-1/2 pair butts
   1 lockset F01
   1 set silencers
   1 door closer

5. **Hardware Group 5**
   Doors 2 shall receive the following:
   1-1/2 pair butts
   1 lockset F20
   1 door closer
   1 set smoketight gaskets

Finish Hardware 08700 - 6
6. **Hardware Group 6**  
Doors 9, 10, and 11 shall each receive:  
1-½ pair butts  
1 passage latchset F01  
1 set silencers  
1 floor stop/holder

7. **Hardware Group 7**  
Doors 7 and 8 shall each receive:  
1-½ pair butts  
1 lockset F22  
1 set door silencers  
1 door closer  
1 door stoop

8. **Hardware Group 8**  
Door 3 shall receive:  
1 padlock

9. **Hardware Group 9**  
Doors 28 and 29 shall each receive:  
1-½ pair butts  
1 rim-type exit device, function ANSI 08 with lever  
1 door closer  
1 set weatherstripping

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. All glass and glazing including without limitation:
      a. Glazing hollow metal doors.
      b. Fixed glass, and other glazing.
      c. Glazing not covered in other sections.

B. Related Sections:
   1. Section 08520: Aluminum Windows - glazing of aluminum windows
   2. Section 09900: Protective Coatings - prime coat painting or sealing rabbets and stops

1.02 REFERENCES

C. Flat Glass Jobbers Association, Glazing Manual (FGJA).

1.03 SUBMITTALS

A. Submit in accordance with Section 01300: Product Data: Fully describe all items proposed for use.

1.04 QUALITY ASSURANCE


1.05 GUARANTEE

A. Furnish a 2-year Special Guarantee against water intrusion through installed glazing.

1.06 SPECIAL SAFETY GLAZING REQUIREMENTS

A. Conform to all applicable safety glazing regulations. Glaze all openings in locations subject to human impact including glass in doors or in lites adjacent to doors, glass adjacent to any surface normally used as a walking surface, sliding glass doors and fixed sidelites, shower doors, tub enclosures and storm doors with safety glass.
B. Glaze all openings required to be glazed with safety glazing materials by regulations cited in paragraph 1.02 with safety glass Category II conforming to CPSC 16 CFR Part 1201 regardless of whether or not safety glass is indicated on drawings or schedules.

1.07 PRODUCT DELIVERY

A. Deliver and install glass with manufacturer's label on every piece indicating type, thickness and grade.

B. Deliver sealant materials in manufacturer's labeled, unopened containers.

C. Deliver glass in vehicles equipped with racks to hold glass on edge and separated with padded spacer to prevent scratching. Move glass directly from truck or packing cases to openings to be glazed.

1.08 JOB CONDITIONS

A. Inspect Openings. Test rabbet or stops intended to receive glass to determine that they form a flat plane, that edges are straight, plumb and level and that surfaces glass will bear against are smooth. Have any deficiencies corrected before proceeding.

B. Prior to installing glass, verify that rabbets and stops have been prime painted or sealed under Section 09900.

PART 2 - PRODUCTS

2.01 GLASS

A. General: Use glass that conforms to Federal Specification DD-G-451a. Glaze interior openings with clear glass. Glaze exterior openings with Solar Bronze insulating glass unless noted otherwise. Glaze openings in fire-rated doors with wired glass. Use Solar Bronze glass that has light transmittance of approximately 50%.

B. Polished Plate or Float Glass: Provide in openings as noted. Thickness, 1/4-inch minimum.

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Maximum Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4-inch (6 mm)</td>
<td>36 square feet</td>
</tr>
<tr>
<td>5/16-inch</td>
<td>48 square feet</td>
</tr>
<tr>
<td>3/8-inch (10 mm)</td>
<td>62 square feet</td>
</tr>
</tbody>
</table>

C. Safety Glass, Tempered: 1/4-inch or thicker plate tempered to meet CPSC 16 CFR Part 1201 Category II and permanently labeled.
D. Bronze Insulating Glass:
1. Two pieces of 1/4-inch or thicker float glass separated by a 1/2-inch sealed air space.
2. Furnish insulating glass units fabricated by the Glass Manufacturer.
3. Seal two pieces of glass in a metal frame containing an air drying agent and having both primary and secondary seals, the latter being silicone. Fill the intervening air space with clean dry air.
4. Use select quality bronze tinted float glass for the outboard lite.
5. Provide an assembly that has an average daylight transmittance of 38% and a shading coefficient of 0.56.
6. Provide heat strengthened outboard lites except where glass is subject to human impact and safety glazing materials are required in accordance with paragraph 1.04 of this Section in which case both the inner and outer lites shall be fully tempered Category II
7. Use heat strengthened glass that has two times the strength of annealed glass and meet the requirements of Federal Specifications DDG 1403B.
8. Use Inboard lites that are 1/4-inch-minimum thick, clear float annealed glass, except, use fully tempered inboard lites where outboard lites are required to be tempered. Provide frosted glass inboard lites in toilet room windows.
9. Provide IGCC Certified Class CBA insulating glass. Libby Owens Ford Thermopane; PPG Industries; or equal.

2.02 GLAZING MATERIALS, OTHER

A. Glazing Tape: Polyisobutylene, butyl reinforced, Protective Treatments, Inc., #301; Hapco 616; or equal.

B. Glazing Sealant: Silicone, Shore "S" hardness of 30 durometers, Dow Corning Silastic 732-RTV; General Electric STC-1200; or equal.

C. Glazing Compound: Elastic glazing compound containing no asbestos for use in bedding and face glazing aluminum, steel and primed wood sash meeting Federal Spec TT-P-781a type 1; Pecora, DAP; or equal.

D. Setting Block: Neoprene, Shore "A" hardness of 80 to 90 durometers.

E. Centering Shims: Neoprene, Shore "A" hardness of 40 to 50 durometers.

PART 3 - EXECUTION

3.01 GENERAL

A. Obtain glass sizes from field measurements.

B. Cut glass and fabricate units in the factory to sizes required to maintain proper edge clearances for thermal movement and adequate bite to give equal and full bearing for entire width of each pane. Provide centering shims at jambs of glazing unit. Comply with UBC Table 24-B.

C. Locate setting blocks of appropriate size at quarter points.
D. Install glass in accordance with FGMA Glazing Manual and printed instructions of window and door manufacturers.

E. Thoroughly clean glass and glazing beads and prime as recommended by manufacturer. Do not touch cleaned surfaces except with gloves to assure sealant bond.

F. Position glass panels with uniform bite or overlap around perimeter.

G. Apply glazing sealant in accordance with the requirements of Section 07900.

3.02 WHERE GLASS IS INSTALLED IN RABBETS OR AGAINST FIXED STOPS

A. Apply glazing tape to opening.

B. Clean edges of glass and install.

C. Apply heal bead of sealant.

D. Apply tape to contact face of stop and install stop.

E. Apply face bead of sealant.

3.03 CLEANUP

A. Replace all broken, scratched or otherwise defective work.

B. Remove all glazing sealant and compound, dust, dirt, and other foreign material from glass, frames and adjacent surfaces.

END OF SECTION
DIVISION 9
FINISHES

09100  Metal Support Systems
09250  Gypsum Wallboard
09300  Ceramic Tile
09500  Acoustical Treatment
09650  Resilient Flooring
09900  Painting
09960  Protective Coatings

FINAL
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SECTION 09100
METAL SUPPORT SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Light gauge metal stud framing and furring systems for gypsum board.
   2. Suspension systems for gypsum board.

B. Related Sections:
   1. Section 09250: Gypsum Wallboard
   2. Section 09500: Acoustical Treatment

1.02 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe all products, materials and systems proposed for use.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

B. Comply with manufacturer's published recommendations for installation of materials used.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing brand and manufacturer's name.

B. Store all materials in protected dry storage areas. Neatly stack in flat position with spacers to prevent sagging and contact with concrete slabs.
PART 2 - PRODUCTS

2.01 FRAMING MATERIALS

A. Studs, runner tracks and furring channels for gypsum wallboard and for plaster on screw applied lath. Manufacturers shall be United States Gypsum; National Gypsum; or equal.

1. Studs: 20-gauge and 25-gauge screw type dry wall studs, "C" pattern, knurled face, hot dipped galvanized with knockouts to accept 3/4-inch or 1-1/2-inch cold-rolled steel channel reinforcement.

2. Bottom Runner Tracks: Hot dipped galvanized, 20-gauge and 25-gauge channels x 1-1/4-inch-deep flanges.

3. Top Runner Track:
   a. Deflection track designed with inward facing "V" gussets on each side to accommodate vertical structural movement without imposing axial loads on studs. Galvanized steel, same gauge and depth as studs. Superior Flex Track No. 53; or equal (Specifier knows of no equal).

B. Furring:

1. Hat Shaped Furring Channels: Galvanize, 25-gauge roll formed for screw type application of gypsum board. Slotted RC-1 single or RC-2 double leg resilient channels where required for acoustical isolation, solid hat channels for use elsewhere. Dale; Gold Bond; or equal.

2. "Z" furring channels: Galvanized steel, depth of "Z" furring web as required to accommodate insulation. National Gypsum Gold Bond; Dale; or equal.

C. Stiffening Channels: Cold-rolled steel, 3/4-inch x 16-gauge, weighing 0.3 pounds per lineal foot, meeting UBC Standards 27-1.

D. Adjustable Wall Furring Brackets: 20-gauge galvanized steel with serrated edges.

E. Fasteners for 20-gauge Components: Type S-12, self-drilling, self-tapping screws.

F. Fasteners for 25-gauge Components: Type S, self-drilling, self-tapping screws.

G. Wedge Anchor Bolts: Special machine bolts with built-in expanding wedge in size required but not less than 3/8-inch x 3-inch: Phillips Red Head Wedge Anchors type WS; Expansion products Wej-it standard expansion anchor bolts; or equal.

H. One-piece deformed spring steel drive anchor 1/4-inch minimum diameter, 1-1/2-inch minimum embedment in concrete, 2,000-lb. holding strength; RAWL-Drives; Buildex; or equal.

2.02 CEILING SUSPENSION MATERIALS

A. Carrier Channels: Cold-rolled steel, 1-1/2-inch x 16 gauge weighing 0.475 pounds per lineal foot, with rust inhibitive coating and meeting UBC Standards 27-1.

B. Cross Furring Channels: 3/4-inch x 16-gauge cold-rolled steel channels weighing 0.3 lbs per lineal foot, with rust inhibitive coating and meeting UBC Standard 27-1.


E. Furring Channels: Galvanized roll-formed, hat-shaped channels for screw type application of gypsum board.

2.03 LATERAL BRACING ASSEMBLY MATERIALS

A. Compression Strut: 1-inch EMT or larger steel tubing or "C" stud selected such that l/r is 200 or less. (See Section 09500 for table of member sizes.)

B. Connector: Flatten end of EMT and provide 3/8-inch machine bolt to connect each end or provide set screws type EMT to threaded box connector with double lock nuts. Provide 11-gauge x 2 x 6-inch angle at top attached to structural deck above with two 3/8-inch anchor bolts.

C. Strut Support Bracket: Custom made 11-gauge formed steel. Attach to EMT with 3/8-inch stove bolt.

D. Turnbuckles: 1/4-inch-diameter threaded forged steel eye bolt each end, forged steel bodies, hot galvanized finish.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect all surfaces, backing and structural systems to receive partition systems and ceiling suspension systems. Do not start work until all conditions that would adversely affect the execution and quality of the work are corrected.

3.02 COORDINATION

A. Coordinate layout with other trades having work within, adjacent to or penetrating walls or ceilings.

B. Coordinate with other trades for furnishing of blocking, backing, and special anchors for installation under this Section.

C. Coordinate with trades responsible for furnishing access panels, mechanical equipment and electrical fixtures.

3.03 INSTALLATION OF METAL STUD FRAMING

A. Accurately lay out work to provide plumb, straight-in-plane surfaces in the proper location and square with plan grid lines.
B. Vertical surface tolerance for alignment and plumb: 1/8-inch maximum variation in 10 feet from a flat, plumb, straight surface and 1/4-inch overall in entire length or height of wall.

C. Attach runners to concrete with 3/8-inch x 3-inch drilled wedge anchor bolts or 3/8-inch x 2-inch, spaced 16-inch on centers maximum. Use washer under head of fasteners.

D. Attach studs to adjoining masonry or concrete walls with 3/8-inch x 3-inch drilled wedge anchor bolts, spaced 32-inch on centers maximum.

E. At Fire-Rated Walls install wall and ceiling runner tracks abutting concrete or masonry over a continuous full stud width strip of fire retardant mineral wool sealer pad rated for use as a fire and smoke stop.

F. Space studs maximum 16-inch on centers. Studs to be continuous from floor to structural ceiling roof or floor above unless shown otherwise. Screw all studs to both sides of bottom and top runner tracks.

G. Where studs are continuous from floor to structural members above, use gusset deflection track at top. Screw attach stud to top runner.

H. Where ceiling abut walls provide horizontal "C" stud bridging cut in between and screwed to studs at top edges of drywall so that drywall can be screwed along top edge at 8-inch centers to bridging.

I. At Doors and Openings:
   1. Use double 20-gauge studs each side of openings. Run both studs to building structure above ceiling.
   2. Install a header made of 20-gauge runner track over openings. Cut flanges and bend web up 90 degrees at each end. Screw or weld to trim studs with two fasteners per side. Install jack studs over openings. Install 3/4-inch stiffening channel in stud and jack stud cutouts over opening extending through the second regular stud on each side of the opening.
   3. Install hollow metal frames by attaching 14-gauge steel floor plates welded to trim flange with two 3/8-inch x 3-inch wedge anchor bolts per jamb into concrete floor. Weld or screw trim studs to jamb anchor clips; attach header channel to head anchor clips.

J. Install continuous horizontal 3/4-inch or 1-1/2-inch stiffener channels to fit snugly in stud knockouts at 4 feet on centers vertically and within 2 feet of top of studs. Overlap channels 8 inches minimum at end joints and wire tie in two locations with double strands of 16-gauge galvanized wire.

K. Use 20-gauge studs or heavier for all exterior walls if required or recommended by manufacturer for partitions over 10 feet high and for all partitions having lath and plaster finish or ceramic tile finish. Use 25-gauge studs for partitions 10 feet or less in height finished with gypsum board.
L. At partition intersections, attach studs to each other with type S-12 screws spaced 32 inches on centers maximum.

M. Frame each side of openings for access panels with a double 20-gauge stud. Install 20gauge header at top and bottom of opening. Attach header to side studs by cutting flanges of header and bending web 90 degrees.

N. Install concealed-in-wall backing furnished by other trades for the support of equipment attached to walls.

O. Provide 16-gauge steel backing plates or solid 2-inch-thick wood backing fire retardant treated per UBC Standard 42-1 to receive all other items attached to walls unless other backing is called for. All backing plates shall be attached to a stud at each end.

3.04 WALL FURRING

A. Provide "Z" furring system to secure insulation and gypsum board to masonry or concrete walls. Install in accordance with USG Gypsum Construction Handbook, 3rd edition. Run "Z" furring channels vertically spaced as required to accommodate insulation but not over 24 inches on center. Attach "Z" furring channels to concrete or masonry walls with 1/4-inch-diameter deformed drive anchors spaced as recommended by "Z" furring channel manufacturer. Shim between channels and wall as required to achieve a flat, straight plumb surface.

B. Where furring of uneven or out of plumb wall is required or where a chase space is required between wall and finish fur by using one of the following systems:
   1. Free-standing furring employing 1-5/8-inch studs at 16 inches centers for walls up to 12 feet high in steel runner channels at the bottom and top of the wall. Brace studs 10 feet and higher in the center with adjustable wall furring brackets.
   2. Hot Shaped Furring channels run vertically at 16-inch centers wire tied to horizontal 3/4-inch cold rolled stiffener channels spaced 6 inches from the top and bottom of the wall and at 3 feet maximum centers. Attach 3/4-inch cold rolled channels to concrete or masonry wall with adjustable wall furring brackets at each end and at 4 feet maximum centers.

3.05 CHANNEL SUSPENSION SYSTEM

A. Conform to appropriate UBC Table 25 for spacing of hanger wires and spacing of carrier channels. Provide a minimum of one vertical hanger wire for each 12 square feet of ceiling area.

B. Provide two additional hangers from the structure for direct support of each ceiling mounted air diffuser and lighting fixture.

C. Provide one ceiling system support wire at each of the four corners of each access door and at every other ceiling penetration that interrupts a carrier channel.
D. At perimeter of ceiling provide supports for carrier channels and furring channels not more than 8 inches from each wall or ceiling discontinuity.

E. Secure hangers to building structure with devices having a minimum working capacity of 200 pounds per hanger. Tie wires with three (3) turns within 1-1/2-inch along length of hanger wire. Attach wires by any of the following methods:
   1. By looping around flanges of open web steel joists.
   2. By looping wire through holes drilled in downturned flanges of metal decking or by special tabs built into decking.

F. Vertical wires shall not hang more than 1 in 10 out of plumb unless a counter sloping wire is provided to the same point of connection on the carrier channel.

G. Wires shall not attach to or bend around interfering pipes, ducts or similar items. Provide a trapeze engineered to take the ultimate capacity of the suspension wires where direct suspension is not possible.

H. Level ceiling to within 1/8-inch in 12 feet, 1/4-inch overall. Level with supporting hanger wires taut. Kinking or bending hanger wires not permitted.

I. Attach wires to ceiling suspension members with a minimum of three turns within 1-1/2-inch along length of hanger wire.

J. Frame around all four sides of each access panel or other ceiling penetration with framing members at least equal to 2-1/2-inch, 20-gauge channels with 1-1/2-inch-wide flanges.

K. Saddle-tie metal hat furring channels or cross furring channels to carrier channels with one strand of 16-gauge or two strands of 18-gauge wire triple twisted. Unless otherwise noted, space furring channels 16-inch on centers.

3.06 LATERAL BRACING ASSEMBLIES

A. Space lateral bracing assemblies at 12 feet on center in each direction starting about 6 feet from ceiling perimeter. Maximum ceiling area per bracing assembly: 144 square feet. Lateral bracing assemblies are required if any dimension of a room or space exceeds 12 feet.

B. At each compression strut bracket install 4 diagonal, 8-gauge bracing wires arranged to form right angles in plan and a 45 degree angle (not less than 30 degrees nor more than 50 degrees from the horizontal) with the plane of the ceiling. Attach bracing wires to concrete slab above steel decking with 3/8-inch x 3-inch wedge anchor bolts with eye bolt head. Each bracing wire shall contain a turnbuckle for tensioning.

C. Attach compression strut top connector to concrete slab above steel decking with steel angle and two 3/8-inch x 3-inch wedge anchor bolts.

D. Attach bracing wires with triple twist tie. Wires to be straight and free of kinks. Use double nut on EMT connector or similar device for final height adjustment at.
compression strut. Use turnbuckle in each diagonal bracing wire for final tensioning. Adjust all four bracing wires in each lateral bracing assembly to have equal tension of at least 10 lbs.

3.07 REPAIRS

A. Replace all defective work including:
   1. Bent or kinked framing members.
   2. Alignment tolerances exceeding those specified.
   3. Variations in true plane exceeding specified tolerances.
   4. Other defects affecting the quality and appearance of the work.

END OF SECTION
SECTION 09250
GYPSUM WALLBOARD

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Provide gypsum board partitions, furred walls, soffits, ceilings and similar construction. Provide taping and finishing of gypsum board ready for paint or other finish coatings.

B. Related Sections:
   1. Section 09100: Metal Support Systems
   2. Divisions 15 and 16: Furnishing access doors to be installed in gypsum board

1.02 REFERENCES

A. Where sound control assemblies are shown, called for or scheduled, use assemblies listed in the "Fire Resistance and Sound Control Design Manual" 12th edition, 1989 published by the Gypsum Association, 810 First Street, Washington, DC 20002.


C. ASTM C475, Taping Compounds and Joint Tape for Gypsum Wallboard.


1.03 SUBMITTALS

A. Submit Product Data giving manufacturer's technical data for all materials and systems proposed for use.

B. For all assemblies required to be fire-rated for which a "Listed Design" is not provided in this Section, submit Drawings and Specifications of an appropriate design which has been tested and is "Listed" by a Nationally Recognized Fire Testing Agency such as Underwriters Laboratory; Warnock Hersey; or equal.

1.04 QUALITY ASSURANCE

A. Comply with the more restrictive or conservative of the following:

B. Comply with the following Regulatory requirements: Uniform Building Code, especially Chapter 47.

D. Comply with Gypsum Association GA-216-89 "Recommended Specifications for the Application and Finishing of Gypsum Board."

E. Comply with ANSI Standard Specifications A97.1 "Applications and Finishing of Wallboard."

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing brand and manufacturer's name.

B. Store all materials in protected dry storage areas. Neatly stack in flat position on spacers to prevent sagging and contact with concrete slabs.

PART 2 - PRODUCTS

2.01 DRYWALL MATERIALS


B. Water Resistant Gypsum Board "MR" (Green Board): 5/8-inch-thick, Type X, 1-hour fire-rated, Federal Specification SS-L-30D, Type VII, Grade WX (Green Core), Class 2, 48 inches wide, USG "W/R"; Gold Bond "MR"; or equal.

2.02 ACCESSORIES

A. Corner Bead: At all exterior corners, galvanized steel, 1-1/4 x 1-1/4 Dur-A Bead #103; United States Gypsum; National Gypsum; or equal.

B. Edge Trim: Use metal trim in exposed locations at intersection of drywall with other materials, and as shown, U.S. Gypsum "J" Mid #200A or "L" Mid #200B; National Gypsum; or equal.

2.03 FASTENERS

A. Gypsum Board to Metal Supports: Self-tapping bugle head screws, 1-inch-long for single layer; 1-5/8-long for second layer.

   1. Use Type S screws to 25 gauge supports.
   2. Use Type S-12 screws to 20-gauge or heavier supports.
2.04 JOINT TREATMENT AND FINISHING

A. Reinforcing Tape: USG Perf-A-Tape; NG Gold Bond; or equal.

B. Taping Compound: USG Ready-to-use joint compound-tapping; NG Gold Bond; or equal.

C. Topping Compound: USG Ready-to-use joint compound-topping; NG Gold Bond; or equal.

PART 3 - EXECUTION

3.01 GYPSUM BOARD INSTALLATION

A. General: Where fire-rated partitions are required, install gypsum board in accordance with requirements for a fire-rated assembly that has been tested and "Listed" by a nationally recognized fire testing agency in accordance with ASTM E119.

B. Where studs extend above the top edge of gypsum board and there is a fire-rated ceiling that butts into the vertical gypsum board wall surface, attach the top edge of the gypsum board to horizontal stud depth backing installed between studs.

C. Edge and ends of gypsum board shall be in moderate contact. Attach gypsum boards to metal framing members with screws and to wood member. Space fasteners as required. For non-rated assemblies, a space screws at 8 inches on center on edges of gypsum board for vertical surfaces and at 7 inches on center for horizontal surfaces. Space screws at 12 inches on center at intermediate members. Space fasteners at least 3/8-inch from panel edges or ends. Stagger fasteners in adjacent edges at joints. Drive fasteners until their heads are slightly below the surface of the gypsum board, but without breaking the cover. After all fasteners have been installed hammer on walls to detect loose fasteners and push on gypsum board adjacent to fasteners to detect movements. Drive loose fasteners tight or replace them with other fasteners approximately 1-1/2 inches away and remove loose fasteners.

D. Install corner bead at all outside corners with fasteners 9 inches on center. Install edge trim at exposed edges, where gypsum board abuts or joins other materials and where shown. Attach edge trim with fasteners 9 inches on center.

E. Cut openings for outlet boxes, pipes and similar items with a saw, router, or other device that produces a clean, tight fitting hole without tearing the paper face or back and without fracturing the gypsum core. Outlet boxes in opposite faces of acoustical or fire-rated partitions shall be at least 24 inches apart.

F. Install control or expansion joints as required and/or recommended by manufacturer.
G. Set bottom edge of gypsum board 1/4-inch above the floor. Where fire or sound rated partitions are required, fill the gap between gypsum board and floor with fire-rated sealant for fire-rated construction or with acoustical sealant for sound rated partitions.

H. Spot grout at hollow metal door frame jamb anchor clips with joint compound just before inserting gypsum board into trim return.

I. Install access panels furnished under other sections.

3.02 FINISHING AND JOINT TREATMENT

A. Mix and size joint compound in accordance with manufacturer’s instructions. Spread a thin layer of compound over joint and embed tape in compound leaving sufficient compound under tape to provide proper bond. Spot nail heads. Reinforce interior angles with perforated tape neatly folded to form straight, true corner. Reinforce exterior corners with specified corner bead. Backer board shall be taped and screwheads spotted prior to installing face layer.

B. Allow compound to dry overnight. Sand lightly. Cover tape with topping cement spread evenly and slightly beyond tapered edge of wallboard. Apply second coat to screwheads. Feather all edges of topping compound.

C. Allow compound to dry and then sand lightly. Apply a final skim coat of topping cement. Feather edges 8 inches to 10 inches each side of joint. Feather out final coat at screwheads to 10-inch diameter.

D. Sand to true even surface with very fine paper. Avoid heavy pressure that might scuff paper face of wallboard. Leave ready for painting or other wall finish.

3.03 LEVELS OF GYPSUM BOARD FINISH

A. All exposed gypsum board intended to receive a painted finish shall have a Level 5 finish.

B. Description of Levels of Finish (From GA-214-90):
   1. Level 1: All joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
   2. Level 2: All joints and interior angles shall have tape embedded in joint compound and one separate coat of joint compound applied over all joints, angles, fastener heads, and accessories. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. Apply a skim coat of topping cement to the entire surface of all MR (GR) green moisture resistant gypsum board.
   3. Level 3: All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. All joint compound shall be smooth and free of tool marks and ridges. Note: It is recommended that the prepared
4. **Level 4:** All joints and interior angles shall have tape embedded in joint compound and three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. All joint compound shall be smooth and free of tool marks and ridges. Note: It is recommended that the prepared surface be coated with a primer/sealer prior the application of final finishes. See painting/wallcovering specification in this regard.

5. **Level 5:** All joints and interior angles shall have tape embedded in joint compound and three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. A thin skim coat of joint compound, or a material manufactured especially for this purpose, shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges. Note: It is recommended that the prepared surface be coated with a primer/sealer prior to the application of finish paint. See painting specification in this regard.

END OF SECTION
SECTION 09300
CERAMIC TILE

PART 1 - GENERAL

1.01 SUMMARY
A. Section Includes: All ceramic and patio tile work including paper backing, cementitious tile backerboard mortar setting bed, grouting and expansion joint sealants.

1.02 REFERENCES

B. American National Standard Specifications for:
2. A108.5 1992 Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex - Portland Cement Mortar
3. A108.6 1992 Ceramic Tile Installed with Chemical-Resistant Water Cleanable Tile Setting and Grouting Epoxy
5. A108.11 Installation of Ceramic Tile or Other Hard Surfaces and Installation of Cementitious Backerboards
6. A118.4 1992 Latex - Portland Cement Mortar
7. A118.6 1992 Ceramic Tile Grouts
8. A137.1 1988 Ceramic Tile

C. American Society for Testing and Materials (ASTM):
1. ASTM C373 Water Absorption, Bulk Density, Apparent Porosity and Specific Gravity of Fired Whiteware Products
2. ASTM C648 Test Method for Breaking Strength of Ceramic Tile
3. ASTM C1028 Evaluating the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Pull Method

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.

B. Product Data: Fully describe all products proposed for use.

C. Samples: Physical samples of manufacturer's complete selection of color, texture and patterns available in type of tile specified. Submit physical samples of colored grouting materials.
1.04 QUALITY ASSURANCE

A. Qualifications: Perform work under this Section by a licensed Specialty Contractor with at least 5 years of experience exclusively in this type of work. Employ workers who are skilled and experienced in the installation of ceramic tile and familiar with the installation methods described in the TCA Handbook for Ceramic Tile Installation.

B. Regulatory Requirements and Recommended Standards:
   1. As a minimum comply with the more restrictive of the following:
      b. Americans with Disabilities Act (ADA) for Handicapped Accessibility.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials to the construction site packaged in sealed containers bearing the manufacturer's labels. Store all materials in a properly ventilated and watertight place, and raised above the floor or ground on pallets or wood platforms on skids. Keep dry until used.

B. Pile sand on concrete pavement or on plywood sheets and keep covered to protect against contamination by rain, dirt, and litter.

1.06 PROJECT CONDITIONS

A. Environmental Requirements: Maintain temperature in areas to receive tile at not less than 50°F. The temperature of substrate shall not exceed 100°F.

1.07 MAINTENANCE

A. Extra Materials: Provide an extra 2% of each type of tile used on the project. Deliver to the jobsite in clean, marked cartons.

PART 2 - PRODUCTS

2.01 SETTING MATERIALS

A. Portland cement, gray complying with ASTM C150, Type I.

B. Hydrated lime, complying with ASTM C206, Type S or ASTM C207, Type S.

C. Sand, complying with ASTM C144 and plaster sand complying with ASTM C35.

D. Water, potable, free from impurities injurious to tile work.
E. Cementitious Tile Backerboard: Fiber cement ceramic tile backerboard consisting of portland cement, ground silica sand, cellulose fiber or fiberglass and acrylic latex additives, 7/16-inch minimum thickness, moisture resistant, minimum flexural strength 2100 psi, minimum compressive strength 2500 psi, weight at least 3.5 lbs/per square foot. Surface burning per ASTM E-84: Flame Spread 0, Fuel Contribution 0, Smoke Developed 5, accepted by TCA, ICBO Evaluation Service, and CABO National Evaluation Service. Hardibacker 7/16 Underlayment by James Hardie Building Products; or equal. (Specifier knows of no equal.)

1. Joint treatment: Fiberglass mesh tape and latex modified portland cement mortar made by backerboard manufacturer.

F. Cleavage Membrane: 15-pound asphalt saturated organic felt.

G. Reinforcing Mesh: Galvanized wire fabric, 2-inch by 2-inch, No. 16 gauge wire.

2.03 TILE MATERIAL

A. Ceramic Mosaic Tile: Unglazed porcelain ceramic mosaic tile, standard grade complying with ANSI 137.1, impervious (less than 1/2% moisture absorption), modular 2-inch x 2-inch x 1/4-inch, eased edges, with matching trim, selected from manufacturer's Group 1 and 2 range of colors. Minimum coefficient of friction (C.O.F.) 0.60 wet or dry when measured by ASTM C1028. "Ceramic Mosaic" by American Ocean Tile; "Dresden Porcelain Tile" by Romany-Spartan; or equal. Provide tile with abrasive grain added having a minimum C.O.F. wet of 0.7 for shower floors and 0.8 for ramps.

B. Glazed Ceramic Tile: Standard grade complying with ANSI 137.1, 4-1/4-inch x 4-1/4-inch x 5/16-inch, with two vertical score lines per tile, cushion edge, matte glazed, depressed pattern back, with matching trim shapes, "Bright and Matte" glazed tile by American Ocean Tile; "Matte Glaze" glazed tile by Romany-Spartan; or equal.

C. Patio Tile: 12x12x3/8-inch fired cotto unglazed tile. Match existing patio tile as closely as possible.

D. Provide all necessary trim pieces such as caps, bullnose, cove bases, etc., in color(s) to match all tiles specified.

2.04 GROUTING MATERIALS

A. Commercial latex modified portland cement grout, white or integrally colored as manufactured by Garland-White Company; Upco Company; or equal. Comply with ANSI 118.6.

B. Latex Additives used in portland cement mortar and grout mixes in place of water or replacing part of the water content shall comply with ANSI 118.4.

C. Epoxy Grout: Meeting ANSI A118.3. See 2.01.
2.05 PROTECTIVE MATERIALS

A. Heavy-duty, nonstaining construction or kraft paper with compatible adhesive tape.

B. Neutral Cleaner: Hilyard Super Shine All by American Ocean Tile; equivalent neutral cleaner by United Ceramics; or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions: Inspect all surfaces to which ceramic tile work is to be applied. Do not install work until unsatisfactory conditions have been corrected.

B. Concrete surface to receive ceramic tile shall be dry, clean, and free of oily or waxy film or curing compound.

3.02 INSTALLATION OF CEMENTITIOUS TILE BACKERBOARD

A. Installation of Backerboard:
   1. Install in strict accordance with manufacturer's printed instructions.
   2. Verify that supports (studs or other backing) are spaced not more than 16 inches on center. Fit all joints and cutouts closely but not forced together. Attach to wood or metal framing and with screws. NAILS NOT ACCEPTABLE. Stagger end joints. Space screws maximum of 8 inches on centers and at least 3/8-inch but not more than 5/8-inch from panel edges.

B. Joint Treatment: Prefill joints with latex modified portland cement mortar, embed glass mesh joint tape in uniform coating of mortar forcing the mortar through the tape, trowel the surface to completely fill the joints and fully embed the tape and then finish the surface to produce a smooth level joint.

3.03 LAYOUT AND REQUIRED TOLERANCES

A. Layout: Lay out all tile so that no tile is less than half size in either direction. Align all joints in a grid pattern with tile joints oriented parallel to walls unless shown otherwise. Wall tile joints shall be laid out with the vertical joints plumb and the horizontal joints level. Each individual tile shall be set with equal width parallel joints all around and with its surface exactly flush with the plane of the wall or floor in which it lies. Bring surface of tile to a true plane by "beating in" with a rubber-faced block of wood and mallet.

B. Fitting Around Adjacent Work: Fit tile closely around electrical outlets, fixtures and other penetrations so that plates, escutcheons and other covering devices overlap the edges of the tile. Cut and drill tile neatly without marring the tile. Rub all cuts smooth with a fine carborundum stone.

C. Allowable Tolerances:
1. Finished tile wall shall conform to a smooth flat plane with joints of uniform width installed plumb and level and with inside and outside corners plumb and straight, to within 1/8-inch in 8 feet and 1/16-inch in 2 feet.

2. Finish tile floor shall be sloped uniformly to drains. No portion of the tiled floor plane shall deviate more than 1/16-inch in 2 feet from a uniform slope.

3. Tile joints shall be of uniform width and in a straight line. Maximum variation in width of joint shall be ±1/32-inch. Joints shall not deviate from a straight line by more than 1/8-inch in 8 feet or 1/16-inch in 2 feet.

3.04 MORTAR AND GROUT MIXES

A. Ceramic Mosaic Floor Tiles at Concrete Slabs:
   1. Bond coat: Waterproofed portland cement mixed with water and latex additive to a creamy consistency. Rework from time to time. Additional water or cement shall not be added after initial mixing. Discard bond coat after initial set is reached. Comply with ANSI A118.4. Dry-set mortar not permitted.
   2. Grout for floor tile: Factory prepared latex modified portland cement grout.

3.05 WALL TILE INSTALLATION (TCA W244)

A. Set tile on backerboard with a latex-modified portland cement-based coat bond in accordance with TCA Method W244, ANSI A108.5, and as follows:
   1. All horizontal and vertical joints and corners of the backerboard units shall have a 1/8-inch spacing that shall be filled solid with latex modified portland cement mortar.
   2. Embed 2-inch-wide glass fiber mesh tape in a skim coat of mortar over the joints and corners.
   3. Float bond coat over area no greater than can be covered with tile while bond coat remains plastic. Cover evenly with no bare spots. Comb mortar with a notched trowel 10 minutes prior to applying tile. Finished mortar bond coat shall be 3/32 to 1/8-inch after beating in of tile.
   4. Tile shall not be soaked. Press tile firmly into freshly notched mortar. Fit tiles so that the joint spacers on the tile edges touch each other. Bring all tiles to a true plane. Thoroughly beat in all tile while the mortar is still plastic.
   5. The beating shall fill the entire space between ribs in back of tile with mortar.
   6. Grouting of wall tile: Comply with ANSI 108.10. Force grout into joints filling all voids. Fill grout to depth of the bottom of the cushion or radius on cushion edged tiles. Before grout sets strike or tool joints with a smooth plastic jointing tool to densify the grout and strike it off to a smooth concave surface at the proper depth.
   7. Clean tile with sponges and cloth. Damp cure for 72 hours minimum.

3.06 PATIO TILE INSTALLATION ON A PLASTIC MORTAR SETTING BED (TCA F111 OR F121)

A. Cement Mortar Over Waterproof Membrane: Set patio tile in portland cement mortar over a waterproof membrane over a depressed slab. Install in accordance with TCA Method F111 or F121, ANSI A108.1, and as follows:
1. Install waterproof membrane before placing mortar bed. Spread mortar bed in two equal thickness layers with 2x2-inch reinforcing mesh in between. Firmly tamp and screed to proper depth. Trowel a 1/16-inch to a 1/8-inch thick bond coat of latex Portland cement paste over a still plastic (not cured) mortar bed.

2. Presoak tile and drain surface dry.

3. Set tile firmly into bond coat with joint widths spaced uniformly and not greater than 1/4-inch. Bring tiles to proper elevations. Thoroughly beat-in all tile while the mortar is still plastic. Let set for 48 hours before grouting tile joints.

4. Grouting floor tile: Comply with ANSI 108.10. Force grout mixture into joints, filling all voids and bring flush to surface of square edged tile using squeegee, sponge, and trowel. Before grout sets strike or tool joints smooth.

5. Clean tile with sponges and cloth. Damp cure for 72 hours minimum.

3.07 EXPANSION JOINTS

A. Provide expansion joints in floors where shown or required in accordance with TCA Method EJ711. Seal expansion joints with 2-part polyurethane sealant applied in accordance with Section 07900.

3.08 REPAIRS

A. Replace all defective work including but not limited to:
   1. Loose tile
   2. Chipped tile
   3. Cut tile with chipped, flaked or undressed edges
   4. Split tile
   5. Cracked tile
   6. Wide joints
   7. Narrow joints
   8. Variation in true plane exceeding specified tolerances
   9. Tile out of level or alignment with adjacent tile
   10. Uneven tooling of grout joints
   11. Other defects affecting the quality, utility and appearance of the work

3.09 PROTECTION AND CLEANING

A. Rinse tile work thoroughly with clean water.

B. Apply a protective coat of neutral cleaning solution, one part cleaner to one part water to all tile work.

3.10 PROTECTION

A. Protect tile work from damage by subsequent construction operations. Prohibit all foot and wheel traffic from using the newly tiled floors for at least seven days. Cover all tile floors with heavy-duty non-staining construction paper, taped in place. Where use of newly tiled floor is unavoidable, use large flat boards for walkways and wheelways for at least seven days.
B. Just before final acceptance of work, remove paper and rinse neutral cleaning solution from tile work.

END OF SECTION
SECTION 09500
ACOUSTICAL TREATMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   2. Suspended acoustic ceiling systems.

B. Related Sections:
   1. Section 07200: Insulation
   2. Section 09101: Metal Support Systems

1.02 REFERENCES

A. American Society for Testing Materials:
   1. A307 Specifications for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
   2. C423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
   4. E84 Test Method for Surface Burning Characteristics of Building Materials

B. American National Standards Institute: B18.22.1, Plain Washers


1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe all items proposed for use.

C. Shop Drawings: Show layout of suspension system, light fixtures, air registers, ceiling hangers and seismic bracing assemblies. Include details of seismic bracing assembly.

D. Samples:
   1. Acoustical tile and panels showing texture and color.
   2. Material and fasteners.
1.04 QUALITY ASSURANCE


PART 2 - PRODUCTS

2.01 LAY-IN ACOUSTIC PANEL SUSPENSION SYSTEM

A. Suspension System: Exposed tee grid system complying with UBC Standard 25-2 and ASTM C635 "heavy duty" class, double web, 15/16-inch-wide face. Chicago Metallic Series 1800; Donn; or equal. Joints between cross runners and main runners and end splices in main runners shall be capable of withstanding a 200 lb. tensile force with a factor of safety of 2.5. Provide spring steel cross runner seismic connector clips or equivalent devices to positively attach cross runner to each other and to main runners. Chicago Metallic #415, or equal. (Specifier knows of no equal.)

B. Vertical Hanger Wires: 10-gauge-annealed galvanized steel minimum spaced not over 4 ft. on center in each direction.

C. Provide enamel finished heavy gauge steel wall channels and/or double angles and related trim finished to match grid. Provide custom fabricated metal shapes required in connection with ceiling work. Where one-hour rated ceilings are required, provide trim required to maintain one-hour rating.

2.02 SEISMIC BRACING ASSEMBLIES

A. Each seismic bracing assembly shall be capable of resisting at least a 400 lb. force applied in any horizontal direction in the plane of the ceiling and a 300 lb. force applied up or down, all with a factor of safety of at least 4.0

1. Diagonal bracing wires: 10-gauge galvanized annealed steel wire. Provide a 1/4-inch double eye galvanized steel turnbuckle with forged steel eye bolts and body for each diagonal bracing wire.

2. Fasteners:
   b. Self-Drilling, Self-Tapping Screws: Hex/washer head Teks in No. 12 and 1/4-inch-14 size with thread spacing and drill length as recommended for the thickness of material connected. When joining metal of different thickness screw through thinner into thicker metal.
   c. Use enough fasteners for all joints to develop a 500 lb. safe working load capacity in shear or pullout as applicable for the loads imposed. Safe working load of fasteners shall not exceed one-fourth of the tested average ultimate capacity.
2.03 MINERAL LAY-IN PANELS


PART 3 - EXECUTION

3.01 LAY-IN CEILING SUSPENSION SYSTEM

A. Conform to UBC Standard 25-2 for spacing and size of hanger wires except that wire hangers shall not be smaller than No. 10 gauge and shall be spaced no further apart than 4 feet on center in both directions. Install fire resistive rated ceilings in accordance with fire resistance "listing" data published by fire testing laboratory.

B. Coordinate providing work required by paragraphs 3.01 C and D below with work performed under Divisions 15 and 16.

C. Provide one extra ceiling hanger wire at each corner of every ceiling opening for light fixtures, air registers or grilles, access doors, and all other openings or penetrations. Install fixtures and registers in conformance with manufacturers instructions and Underwriters Laboratories requirements for one-hour fire rating. Provide required fire rated construction to enclose top surface of lighting fixtures and ceiling air supply and return registers.

D. Provide a minimum of two additional hanger wires from the building structure directly attached to each opposite corner of every ceiling mounted air register or lighting fixture. Attach each light fixture and air register to main runner channels with four 1/4-inch-diameter bolts or Tek's. Support and brace lighting fixtures weighing more than 56 lbs. directly from the structure above using approved hangers. Support pendant lighting fixtures directly from the building structure on rigid braced assemblies designed to withstand the applicable vertical and seismic loads. Provide additional hanger wires where main runners are interrupted by light fixtures, registers or other items.

E. At perimeter of ceiling, provide support wires within 8 inches of edge of ceiling. Use double angle or "U" type edge trim to prevent ceiling uplift but do not attach ceiling runners to edge trim at two adjacent walls. Where ceiling runners are not attached to edge trim, attach runners to metal spacer channel or angle on top of ceiling runners and parallel to wall.

F. Secure hanger wires to building structure with devices having a safe rated working capacity of at least 400 lbs. and a factor of safety of 4.

G. Hanger wires shall not hang out of plumb more than 1 in 10 unless a counter sloping wire is provided to same point of connection.
H. Hanger Wires shall not attach to or bend around pipes, ducts or similar items. Provide at least 6 inches of clearance between hanger wires and unbraced ducts, pipes or conduits. Provide a trapeze engineered to take required loads where direct suspension is not possible. Do not support conduit on hanger wires.

I. Level ceiling to a flat level plane to within 1/8-inch in 10 feet or 1/4-inch overall. Level with support hanger wires taut so that all wires take an equal share of vertical loads. Kinking or bending wires not permitted.

J. Hanger wires shall pass through holes in ceiling suspension members and through holes in eye bolts or holes in steel attachment angles or brackets securely attached to structural building elements above ceilings. Bend wires sharply around elements being attached and wrap the free end of the wire tightly around the supporting wire making a minimum of three turns with 1-1/2 inches for supporting wires and four turns for bracing wires. Pull supporting members down hard after attaching wires to set wires in place. Do not splice hanger wire.

3.02 LATERAL BRACING ASSEMBLIES

A. Brace lay-in panel suspended ceilings with lateral bracing assemblies spaced 12-feet maximum on centers each way. Space first and last row of bracing assemblies within 6 ft. of ceiling edge. Lateral bracing assemblies are required in all rooms, corridors or spaces if any dimension exceeds 12 feet.

B. Attach compression struts to building with cold-formed angle brackets. Attach angle brackets to building structure above with two 3/8-inch-diameter lag screws into wood structural members, or two 3/8-inch-diameter wedge anchor bolts into stone aggregate concrete, or, four 1/4-inch diameter. Teks into double thickness of 18-gauge minimum metal decking. Attach bracing wire to building structure with a 3/8-inch eye expansion anchor bolt into concrete or an angle bracket to other materials as required above for attachment of compression struts.

C. Attach lower connector bracket to main ceiling runner at the intersection of a cross runner using two 1/4-inch bolts or two 1/4-inch Teks.

D. Attach one vertical support/compression strut and four 45-degree bracing wires to connector bracket and to structure above. Install two bracing wires parallel in plan view to main ceiling runner channels and two bracing wires parallel to cross runners. Slope bracing wires not less than 30 degrees nor more than 50 degrees from the horizontal. Provide a 1/4-inch turnbuckle in each bracing wire. Attach bracing wire to turnbuckle eye, connector bracket, eye bolt or connector anchor with four turns of wire within 1-1/2 inches of wire length. DO NOT SPLICE bracing wires. Tension all bracing wires uniformly and to at least 10 lbs.

3.03 LAY-IN ACOUSTIC PANELS

A. Align tee runners to form a grid parallel to room axis. Install all stock and custom fabricated metal shapes required in connection with ceiling.
B. Lay out to pattern shown on the Drawings. If not shown, lay out symmetrical about center lines of rooms. Use a minimum of 1/2 panel at walls.

C. Coordinate with mechanical and electrical trades for spacing of lighting fixtures and air diffusers.

D. Align textured pattern of acoustic panels in direction as directed.

E. Provide plastic grid ceiling panels for air transfer where shown.

F. Install hold-down clips on panels if required for one-hour rating.

G. Install panels without damaging or soiling face. Replace unsatisfactory panels before completion.

3.04 CORRECTION OF DEFICIENCIES

A. Replace any damaged, chipped or soiled units.

B. Correct uneven surfaces, misaligned joints and open joints.

END OF SECTION
SECTION 09650
RESILIENT FLOORING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. All resilient flooring.
   2. Resilient base.

1.02 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe manufacturer's product.

C. Shop Drawings: Large scale drawings of floors to be laid in a decorative pattern.

D. Samples: Physical samples of manufacturer's full line of colors and patterns for selection. NOTE: When color of product wanted is specified under PART 2 of this Section, the colors offered by manufacturers proposed will be a major consideration in determining acceptability of product submitted.

1.03 QUALITY ASSURANCE

A. Manufacturer's Recommendations: Comply with the latest published recommendations of the manufacturer of the material selected.

1.04 JOB CONDITIONS

A. Environmental Requirements: Maintain all rooms, subfloors, resilient floor coverings, and adhesives at a minimum temperature of 70°F for at least 48 hours before and after installation. Maintain room temperature at 55°F minimum thereafter.

1.05 EXTRA MATERIAL

A. Furnish Owner with extra material from the same manufacturing run for future repairs.
   1. For resilient tile, provide at least 1% of the quantity installed but not less than 10 pieces of each color selected.
   2. For resilient base, provide at least 1% of quantity installed.
PART 2 - PRODUCTS

2.01 MATERIALS

A. Do not use material containing asbestos.

B. Vinyl Composition Tile: 12-inch x 12-inch x 1/8-inch-thick resilient flooring, color and pattern continuous through tile thickness. Armstrong Excelon Tile, Imperial Series; GAF Thru-Chip series; or equal.

C. Resilient Base: Solid virgin vinyl top set cove wall base, 4-inch and 6-inch-high x 1/8-inch-thick, thin toe profile, Armstrong Vinyl Wall Base; GAF Fashioncove; or equal. Supply in 100-foot rolls or length required to minimize end joints.

D. Reducer Strip: Mercer Plastics Company No. 63; Flexco No. 92; or equal.

E. Floor Filler/Underlayment: Portland cement type. Duratex or equal.

F. Adhesives: As recommended by manufacturer of material being applied for the specific substrate.

G. Two-Part Epoxy Nosing Compound for Stair Treads: As recommended by the tread manufacturer.

H. Floor Cleaning Compound: Hillyard Powerstrip; Armstrong S-321 Spruce-up; or equal.

I. Acrylic Sealer/Undercoater: Hillyard HIL-TEX #343; Armstrong; or equal.

J. Non-Skid Floor Wax: Hillyard Super Hil-Brite #500; Armstrong; or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Install materials according to the manufacturer's instructions. Allow concrete slab to cure as long as practicable before installing resilient flooring. Perform 48 hour test with 2-foot-square piece of sheet rubber to determine if concrete is adequately dry.

2. Examine surfaces to receive resilient flooring for:
   a. Defects that will adversely affect the execution or quality of the work.
   b. Deviations beyond allowable tolerances for flatness or level of surfaces.
   c. Do not start work until unsatisfactory conditions have been corrected.

3. Preparation: Remove grease, dirt, paint spots, paraffin, wax, and other foreign material; fill all cracks, minor holes, and crevices. Apply floor filler/underlayment as required to bring floor to a smooth level plane to within 1/8-inch in 10 feet and 1/16-inch in 2 feet. Grind surface smooth.
B. Vinyl Composition Tile:
1. Install tile in designated areas.
2. Lay tile parallel to room axes and symmetrical about centerlines of rooms. Use a minimum of 1/2 tile at walls. Run grain pattern of tile all in the same direction and in the direction as directed. Longitudinal and transverse joints shall meeting at the same points.
3. Match tiles for color and patterns by using tile from cartons in the same sequence as manufactured.
4. Lay tile with tight even joints. Scribe neatly at all projections, penetrations, vertical surfaces and transitions to other materials.
5. Ensure tile is tightly and uniformly adhered to the substrate and shows no open cracks, voids, raising or puckering in the field or at seams and joints.
6. Use latex-type underlayment to build up concrete subfloor adjacent to top stair tread so that finish surface of resilient floor tile is at same elevation as finish surface of stair tread. Taper the underlayment for at least 24 inches to provide

C. Reducer Strips: Install at joints between resilient flooring and carpet and at edges of resilient flooring where resilient flooring does not abut walls or other finish flooring of equal or greater thickness. At doorways, install so that edging is under door.

D. Resilient Base:
1. Smooth out surfaces to receive base with underlayment compound or by removing bumps.
2. Make joints tight; install base with top, bottom, and edges in firm contact with walls and floor and other vertical surfaces. Scribe base accurately to trim at built-in furniture, doors and pilasters. Use preformed outside corners. Make inside corners by notching and bending; install in accordance with manufacturer's recommendations. Install base with minimum number of end joints.

3.02 CLEANUP

A. Immediately after installation, remove all adhesive from the face of the floor and base and from adjacent surfaces. After adhesive has dried thoroughly, wash the floor with floor cleaning compound and power scrubber to remove any factory finish and construction soiling.

B. Apply two coats of acrylic sealer undercoater in accordance with manufacturer's instruction. When dry apply two coats of buffable non-skid wax buffing each coat with a power buffer.

C. Protect completed floors from damage and traffic wear until project acceptance.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. A painter's finish on all exterior and interior surfaces, except:
   a. Integrally finished materials such as ceramic tile, glass, concrete, laminated plastic, resilient flooring, carpet, etc.
   b. Factory finished items such as acoustic panels, exposed T-grid suspension systems, anodized aluminum, light fixtures, etc.
2. Back prime woodwork prior to installation. See Section 06100 and 06200.
3. Prime coat paint all exposed and concealed surfaces of sheetmetal flashings prior to installation including the inside of galvanized steel rainwater gutters and downspouts. See Section 07600.

B. Related Sections:
1. Section 05100: Structural Metal Framing - metal fabrications - shop priming of structural steel
2. Section 06100: Rough Carpentry - back priming
3. Section 06200: Finish Carpentry - back priming
4. Section 07600: Flashing and Sheetmetal - priming prior to installation
5. Section 08110: Hollow Metal work - shop priming of hollow metal doors and frames
6. Section 09960: Protective Coatings - special high performance engineering coatings
7. Section 08200: Wood Doors - sealing cutouts

1.02 REFERENCES

A. Where standards of surface preparation are described by citing SSPC specification numbers reference is made to the "Steel Structures Painting Manual" Volume 2 published by the Steel Structures Painting Council.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data:
1. Submit complete technical data on all materials to be used on the project for review prior to ordering material. Include manufacturer's brand name and type of material for each coat of each system to be used.
2. If products manufactured by makers other than the first named product by the first named maker listed in Part 2 of this Section are submitted, submit supporting performance test results prepared by an independent paint testing
laboratory for comparison with the performance of the first named product by the first named maker.

3. If the Contractor's second submittal of a proposed equivalent material is not favorably reviewed the Contractor will be back-charged by the Owner for the cost of subsequent reviews.

C. Manufacturer's Certification: That products furnished meet applicable Air Quality Management District regulations as to allowable VOC content for the place of application and use intended.

D. Samples: For paints submit two 8-1/2 by 11-inch brush-outs of each paint system and each color on cardboard. For stains and transparent finishes submit two complete sample finishes on 8-1/2 by 11-inch pieces of the wood that will be used on the project.

1.04 QUALITY ASSURANCE

A. Contractor Qualifications: The Contractor is cautioned that the application of High Performance Architectural Coatings (HPAC) specified under this Section requires special skill, knowledge and equipment. In submitting his bid, the Contractor represents that he is skilled and experienced applying these coatings, has studied the material manufacturer's application requirements for the materials specified, agrees that the materials is suitable for intended use, and has included in his bid the coat of all labor and material required to achieve a successful coating system meeting the performance requirements of the contract documents.

B. Regulatory Requirements: All work, material, procedures and practices under this Section shall conform with requirements of the Federal Standard 40 CFR on air quality control, and the requirements of the local Air Resources Board or Air Quality Management District having jurisdiction. Coatings or primers applied at locations other than the project site shall be done in accordance with local air quality regulations in effect at the place the coating is applied.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in unopened containers with manufacturer's label. Label shall state VOC content.

B. Store in assigned area. Maintain storage area clean and fire safe. Dispose of used rags and clean buckets daily. Store solvents in closed approved storage containers.

C. Submerge solvent soaked rags in water.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Provide ambient temperatures recommended by manufacturer of material to be applied.
   2. Provide adequate ventilation.
3. Provide 40- to 50-foot candles of illumination on all surfaces in areas to be painted including floors, walls and ceiling even though they do not require painting.

4. Use temporary dust barriers to close off areas being painted from areas where other work is being performed.

1.07 COLORS AND COLOR SAMPLES

A. Before starting work, submit colors for selection by the Owner. The colors selected will be standard colors for the manufacturer whose materials are being used. "Deep tone" highly pigmented accent colors may be selected for up to 10% of the area painted.

B. Colors are to be factory or machine mixed, using light-fast colorants proportioned by accurate measurement into a proper tinting base. The color formula for each color shall be submitted to facilitate future color matching.

C. Exterior deep tone colors are to be factory ground into the pigment for maximum color fastness.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Coatings used shall be "top of the line" and of the type recommended by the manufacturer for the intended use and substrate.

B. Applicable Air Quality Management District regulations prohibit the manufacture, sale or application of Architectural Coatings and Specialty Coatings having greater than stipulated levels of volatile organic compounds.

C. The Contractor shall base his bid on using the products specified. If the products specified are not available in formulations that meet applicable Air Quality Management District regulations on maximum VOC levels, the Contractor shall submit products of equivalent quality and function that comply with regulations in effect at that time.

D. If the Contractor applies any coatings for which it has not submitted certificates indicating the VOC content and that the product complies with applicable Air Quality Management District regulations, or if it applies coatings that have been modified or thinned other than as recommended by the manufacturer, the Contractor shall be responsible for any fines, costs, remedies, or legal actions that may result.

E. The Contractor shall not submit or use any material containing Trichloroethylene III because of its potential cancer causing properties. If any of the materials specified in this Section contain trichloroethylene, they shall be considered deleted from this Specification.
2.02 SPECIALTY COATINGS: PRIMERS, STAINS, SEALERS AND CLEARS

A. Products and makers listed establish type of material and level of quality. Equivalent products manufactured by ICI Dulux Paint Stores, Sherwin-Williams, or equal may be submitted for review.

B. Specialty Coatings: Coatings listed under this category include primers, sealers, stains and clear coatings. All products provided shall comply with the maximum allowable VOC limit assigned to that category of product by the Air Quality Management District having jurisdiction.

1. ALKYD RUST INHIBITING PRIMER
   Solvent thinned, oxide red primer Maximum allowable VOC limit 350. ICI Rust Guard 4150, Sherwin-Williams Kromik Metal Primer E41N1, Valspar 13-R-49 Intermediate Field Coat Primer, or equal.

2. ALKYD PHENOLIC GALVANIZED METAL PRIMER
   Solvent thinned, alkyd phenolic galvanized metal primer. Maximum allowable VOC limit 350. XIM Gutter Primer, Tnemec 90-97, Universal Alkyd Metal Primer, ICI Ultra-Hide 4160, or equal.

3. ALKYD INTERIOR ENAMEL UNDERCOAT
   Solvent thinned, high build, sandable, prime coat for use over interior wood trim and cabinet work that will receive a latex or alkyd enamel topcoat. ICI Alkyd Enamel Undercoat, Ultra-Hide No. 1120, or ICI Internal/External Stain Killer Ultra-Hide No. 3210.

2.03 ARCHITECTURAL COATINGS

A. Coatings listed under this category consist of decorative and protective coatings used to protect surfaces and provide color for buildings and other structures.

B. Products and makers listed establish type of material and level of quality. Equivalent products manufactured by Glidden, Sherwin-Williams, ICI Dulux, Devoe Coatings, or equal may be submitted for review.

1. HIGH GLOSS EXTERIOR LATEX ENAMEL
   100% acrylic latex exterior enamel with excellent color and gloss retention and excellent weather resistance. Maximum allowable VOC limit 250. Devoe Coatings Interior/Exterior Waterborne Acrylic Gloss Enamel Devflex No. 4208, Sherwin-Williams, or equal.

2. SEMI-GLOSS EXTERIOR LATEX ENAMEL
   100% acrylic latex (medium gloss) exterior house and trim enamel with excellent color and gloss retention and weather resistance. Maximum allowable VOC limit 250. ICI Dulux Exterior 100% Acrylic Semi Gloss Finish 2406, VOC: 187 g/L, Sherwin-Williams, or equal.

3. EGGSHELL ACRYLIC LATEX INTERIOR ENAMEL
   Maximum allowable VOC limit 250. A scrubbable low sheen eggshell latex enamel. Sheen 8 to 12 at 60°, ICI Dulux Interior Acrylic Wall and Trim Enamel Eggshell, Dulux Ultra No. 1403, Sherwin-Williams, or equal.
PART 3 - EXECUTION

3.01 CONDITION OF SURFACES TO BE PAINTED

A. Examine areas to receive work of this Section. Make certain that surfaces are even, smooth, sound, clean, dry, and free from defects or substances that might affect application.

B. Arrange for repairs or major cleaning as required. Starting work indicates acceptance of surfaces as satisfactory to achieve required result.

3.02 PREPARATION OF SURFACES

A. Check that hardware, trim, plates, lighting fixtures and similar items have been removed before starting work; coordinate with work under sections installing such items. Check that equipment adjacent to walls shall be disconnected and moved to permit wall surfaces to be painted before starting work under this Section.

B. Wash metal surfaces with solvent or cleaner to remove dirt or grease, and clean off rust or scale with wire brush or sandpaper.

C. Bare or Shop Coated Steel: Remove rust and scale by wire brushing or sandblasting; wash with solvent or cleaner.

D. Galvanized Steel: Etch with phosphoric solution such as Galvaprime, Galva-prep, or equal; flush surface clean with water and allow to dry.

E. Prepare all surfaces in accordance with the more stringent of the coating material manufacturer's recommendations, other requirements in this paragraph 3.02 or referenced or applicable requirements for surface preparation in the Steel Structures Painting Manual, Volume 2, published by the Steel Structures Painting Council and summarized below:

1. SSPC-SP1 - Solvent Cleaning: Removal of all oil, grease, soil, drawing compound, cutting compound and other soluble contaminates from the surfaces with solvents and/or commercial cleaners by wiping, dipping, steam cleaning or vapor degreasing.

2. SSPC-SP2 - Hand Tool Cleaning: Removal of all loose mill scale, rust, paint and other loose detrimental foreign matter by the use of non-powered hand tools.

3. SSPC-SP3 - Power Tool Cleaning: Removal of all loose mill scale, rust, paint and other loose detrimental foreign matter by the use of power-operated portable tools.

4. SSPC- SP6 - Commercial Blast Cleaning: Removal of all oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter by compressed air nozzle blasting, centrifugal wheels or other required methods. Remaining discoloration stains shall not exceed 33-1/3% of each square inch of surface.

5. SSPC-SP7 - Brush-Off Blast Cleaning: Removal of all oil, grease, dirt, dust, loose-mill scale and loose paint by compressed air nozzle blasting. Centrifugal wheels or other required means.
F. Gypsum Board: Sand joint and nail finishing compound lightly with fine sandpaper, dust clean.

G. Interior Woodwork, Painted Finish: Hand sand with 150-grit aluminum oxide paper to remove all tool marks and scratches; dust clean. Seal knots and pitch pockets with knot sealer. Fill nail holes and cracks after first coat. Sand work between coats with 180-grit paper.

H. Woodwork Transparent Finish: Same preparation as for painted finish except do final sanding with 220-grit sandpaper and sand with 220-grit paper between coats.

I. Exterior Woodwork: Remove all tool marks and splinters. Sand with 150-grit sandpaper. Seal pitch pockets and knots.

J. Dust all surfaces and wipe clean with a tack rag just prior to coating.

3.03 APPLICATION

A. Apply all material in strict accordance with manufacturer's instructions. Apply first coat immediately after surface preparation.

B. Do not apply coatings when temperature is below 55°F. Do not apply exterior coatings in damp or rainy weather. Do not apply exterior coatings on damp wood.

C. Brush out each coat to a uniform, even coating; lay material on in one direction and brush out at right angles. Special application techniques may be required for new coatings with low VOC content. Apply such coatings in strict accordance with manufacturer's detailed instructions. Allow material to dry 48 hours between coats unless longer period specified by manufacturer.

D. Sand between coats for enamel and varnish finishes.

E. Do necessary puttying or filling of nail holes, cracks and other blemishes after first coat has been applied. Finish putty or fill flush with adjoining surface in neat, workmanlike manner. Putty or fill nail holes in wood to be stained, with colored putty to match finish.

F. Back prime all interior and exterior wood trim before installation. Prime all exposed and concealed surfaces of sheetmetal flashing prior to installation.

G. Paint items and surfaces before installation that will be difficult or impossible to paint after installation.

H. Coat all six surfaces of wood doors with the specified coats. Seal mortises and cut-outs for locks, hinges and other hardware with varnish.

I. Apply not less than the number of coats specified. Apply additional coats if required for uniform coverage and full hiding. Apply finishes in their factory original consistencies. Do not thin unless specifically recommended by the manufacturer.
J. Finish work shall be uniform in color, full coverage, smooth and free of sags and brush marks. Varnish work shall be done so that an entire surface is coated while maintaining a wet edge so that there are no lap marks or areas of uneven color.

K. Do all cutting in to a sharp, true line. Repaint if necessary to correct over runs.

L. Do not paint over Underwriters' labels, fusible links, sprinkler heads, or fire alarm devices.

M. Paint access panels, electrical panels, air registers and similar items prior to installation to prevent edges from peeling or chipping when panels are removed.

N. Repaint factory finished electrical panels, air registers, and other items to match adjacent painted surfaces.

3.04 EXISTING WORK TO BE REPAIN TED

A. Some existing work is to be repainted or refinished without removing or stripping existing finished to bare substrate.

B. Major depressions, chips, holes and so forth in substrates shall be repaired under this Section. Fill all holes and depressions with vinyl spackling compound. Sand the existing finish to remove bumps and ridges and give it an overall tooth. Wash with trisodium phosphate, rinse clean and dry. Spot prime bare areas. Give entire surface an alkyd based bonding coat. Give the entire surface the second coat recommended by the manufacturer and the finish coat of the scheduled system.

C. Woodwork shall be repaired under Section 06200. On wood to receive a transparent finish, blend in bare wood, patches, etc. with stain. Steel wool entire surface to remove all impurities and give the existing finish a tooth. Seal bare areas with a clear sealer and apply the second coat and final finish coat as recommended by the manufacturer of the scheduled finish coat.

3.05 PROTECTION, CLEANING AND COMPLETION

A. Protect finish work by suitable covering or other method as job progresses.

B. Remove paint or varnish spots from floors, glass and other surfaces, upon completion of work. Remove rubbish, empty containers and other accumulated materials from premises. Leave work in clean, orderly, acceptable condition.

C. Check work of this Section at completion of project. Touch-up or refinish marred or damaged surfaces. Replace glass damaged by operations under this Section. Leave entire area with finish free from imperfections.

3.06 PAINTING SYSTEMS AND SCHEDULE: ARCHITECTURAL COATING SYSTEMS

A. See Finish Schedule or notes on Drawings for location of surfaces to receive paint systems.
B. Characteristics of paint materials are described in Part 2 of this Section. First-named products are listed in this Schedule. Equivalent products by other manufacturers may be submitted for review in accordance with paragraphs 1.03 and 2.02 of this Section.

C. System "A": EXTERIOR/INTERIOR HIGH-GLOSS LATEX ENAMEL
1. First Coat:
   a. Shop primed ferrous metal: Touch-up with ALKYD RUST INHIBITING PRIMER.
   b. Or, where shop prime coat is not suitable for overcoating with latex systems, re-prime entire surface with ALKYD PHENOLIC PRIMER.
   c. Unprimed ferrous metal: ALKYD RUST INHIBITING PRIMER.
   d. Galvanized Metal: Pretreat with phosphate solution and prime.
   e. Wood: ALKYD EXTERIOR WOOD PRIMER.
2. Second and Third Coats: Two coats of HIGH GLOSS EXTERIOR LATEX ENAMEL

D. System "B": EXTERIOR/INTERIOR SEMI-GLOSS LATEX ENAMEL.
1. First Coat:
   a. Shop primed ferrous metal: Touch-up with ALKYD RUST INHIBITING PRIMER. Where shop prime coat is not suitable for overcoating with latex system, re-prime entire surface with ALKYD PHENOLIC PRIMER.
   b. Unprimed ferrous metal: ALKYD RUST INHIBITING PRIMER.
   c. Galvanized Metal: Pretreat with phosphate solution and prime with ALKYD PHENOLIC GALVANIZED METAL PRIMER.
   d. Aluminum: Pretreat with metal etch and prime over aluminum.
2. Second and Third Coats: Two coats of SEMI-GLOSS EXTERIOR LATEX ENAMEL.

E. System "C": EGGSHELL ACRYLIC LATEX INTERIOR ENAMEL
1. First Coat:
   a. On gypsum board: PVA SEALER.
   b. On plaster: ALKYD PRIMER SEALER.
   c. On wood: ALKYD INTERIOR ENAMEL.
   d. On metal: ALKYD RUST INHIBITING PRIMER.
2. Second and Third Coats: EGGSHELL ACRYLIC LATEX INTERIOR ENAMEL

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Use of the necessary tie and barrier coats between incompatible systems. All facilities and equipment shall be painted as described in the Specifications or on the Drawings. It is the intent of these Specifications to provide a complete job of first-class appearance and yielding a high degree of protection.

B. Unless specifically excluded all new surfaces shall be coated with one of the specified paint systems. Surfaces generally not requiring painting unless otherwise indicated are:

1. Metal completely embedded in concrete (except aluminum).
2. Piping buried in ground or encased in concrete.
3. Hot-dipped galvanized brackets, hangers, supports, grating frames, and bolts, except as noted herein.
4. Chain link fence and galvanized fence gates.
5. Plastic pipe, including: polyvinyl chloride, polyethylene, and polypropylene piping, except as noted.
7. Bronze, brass.
8. Nameplates, grease fittings, Underwriter's labels, fusible links, sprinkler heads, and fire alarm devices.
9. Factory finish coated items such as electrical panels, except for touch-up, or as noted. This does not include factory-primed surfaces.
10. Factory fusion epoxy coated items (except for field touchup).
11. Aluminum or galvanized ductwork enclosed inside furred ceiling spaces.
13. Fiberglass grating and covers.
14. Concrete, except as defined herein, as specified elsewhere, or as shown on the Drawings.
15. Exposed insulated piping with aluminum jacket and buried insulated piping.
16. Integrally finished materials such as ceramic tile, brick, glass, laminated plastic, resilient flooring, etc.
17. Factory finished items such as acoustic panels, acoustic tile, exposed T-grid suspension systems, toilet partitions, light fixtures, etc.
18. Anodized or Kynar-coated aluminum surfaces except at contact surfaces of dissimilar materials.

1.02 REFERENCES

A. Where standards of surface preparation are described by citing SSPC specification numbers reference is made to the "Steel Structures Painting Manual" Volume 2 published by the Steel Structures Painting Council.
B. American Society of Testing and Materials (ASTM):
1. ASTM D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
3. ASTM D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
4. ASTM F1249 Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

1.03 DEFINITIONS

A. Dry Film Thickness (DFT) - The prime coat and the sum of all fully cured applied coats for the paint system.

B. Exterior Surface - Surface that is not inside a building or structure and is exposed to the weather. Epoxy surfaces that are affected by the ultraviolet rays from the sun shall be considered an exterior surface if the sun can shine on the surface.

C. Stripe Coat - Coating applied to the edge, corner, welds or bolts, which is applied prior to application of additional system coats.

D. Submerged - Surfaces that are under water or the vertical extension of those walls that are partly under water during normal operating conditions.

1.04 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Prior to ordering material, submit a complete schedule of materials to be used. Include manufacturer's brand name, product name, and designation number for each coat of each system to be used.

C. Prior to commencing work, submit a detailed list of all surfaces and equipment items upon which the Contractor intends to apply protective coatings.

D. Provide the following information on each paint product:
   1. Abrasion resistance, ASTM D4060, 1 kg load at 1000 cycles, CS-17 wheel.
   2. Impact resistance, ASTM D2794, direct and reverse.

E. If materials other than those listed are submitted, submit additional information to fully define the proposed substitution. The Engineer may further require the Contractor to furnish additional test results from an independent paint laboratory comparing the proposed substitution with one of the named products, at no additional cost to the Owner. For substituted materials, provide a list of references, including contact person and phone number, where proposed substitute paint
system has been used in similar exposures. Provide a minimum of five references (no duplicate owners or agencies).

F. Provide Material Safety Data Sheets (MSDSs) for all products.

G. Submit a full range of the manufacturer's standard and let down finish colors for review and selection by the Engineer. After final colors have been selected, submit two 8-1/2- x 11-inch samples on cardboard of each color indexed as to manufacturer and color designation. Color chips 3/4-inch x 1-1/2-inch may be used for pipe color codes.

H. Submit four pipe and equipment color-code charts, 11 x 14 inches in size, with typed labels and using color chips. Upon favorable review, frame charts and mount under glass, suitable for hanging in work areas. Submit color formula for each selected color to facilitate future color matching.

I. Submit product information on testing support equipment described in this Section.

1.05 QUALITY ASSURANCE

A. Do not paint when the ambient temperature is below that which is recommended by the coating manufacturer or during periods of high humidity.

B. Provide adequate ventilation and heating.

C. Provide 40 to 50 foot-candles of illumination on all surfaces in areas to be painted.

D. Apply not less than the number of coats or minimum dry film thickness (DFT) specified.

E. Use temporary dust barriers to close off areas being painted from areas where other Work is being performed.

F. Coating applicators must have completed a minimum of 5 projects of comparable size or have experience with the systems specified.

1.06 WARNINGS

A. Be advised that application of paint, epoxy and protective coating materials may be hazardous. Take all necessary precautions to ensure the safety of workers and property.

B. Be advised that as a part of this work abrasive blasting is required. This may require the use of special equipment. Become familiar with the existing site conditions and take all steps necessary to protect adjacent facilities and personnel, at no additional cost to the Owner. In addition, abrasive blasting and painting is called for in, on or around mechanical equipment, which may be damaged by grit, dust, or painting overspray. Mask, wrap, enclose, and provide all protection required to safeguard this equipment at no additional cost to the Owner.
C. Perform abrasive blasting activities in a manner that will not cause a nuisance to adjacent public and private property and equipment.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver all coating materials in unopened containers with manufacturer’s label, which must include name, batch number, date and VOC content.

B. Store in an assigned area onsite with concurrence from the coating manufacturers. Maintain storage area clean and fire safe. Dispose of used rags, thinner and buckets daily. Store solvents in closed approved storage containers.

C. Submerge solvent soaked rags in water.

1.08 COLORS AND SAMPLES

A. Before starting work, obtain favorably reviewed color schedule.

B. Colors are to be factory mixed, using light-fast colorants proportioned by accurate measurement into proper type base. All coatings must be formulated to perform in the climate and environment to which they will be exposed.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Paints used in each system to be the product of one manufacturer.

B. Coatings used shall be top of the line and as recommended by the manufacturer for the intended use and surface.

C. Shop applied prime coats shall be compatible with the systems included in these specifications.

D. Substituted coating systems shall be of the same generic type as those specified.

E. Coating systems shall not contain lead.

F. Abrasives shall not be classified a hazardous material.

G. Paints and protective coatings listed in the Paint Systems and the Schedule in Part 3 of this Section refer to the following manufacturers and are specified as levels of quality. It is understood that the words "or equal" are included herein.

Ameron (A)  
CRC Industries (CRC)  
Kop-Coat Co. (K)  
Protecto Wrap (PW)  
Roto Metals (RG)
## 2.02 PAINT SYSTEMS

### A. General:
Paint systems shall be as noted below with all dry film thickness referring to the total DFT of the system, unless specified otherwise in these specifications or shown differently on the Drawings.

#### System 1: General Ferrous (Exposed to Atmosphere)

<table>
<thead>
<tr>
<th>Coats</th>
<th>Type</th>
<th>Brand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st coat</td>
<td>Organic Zinc Rich Primer (T)</td>
<td>Series 90-97 Tneme-Zinc</td>
</tr>
<tr>
<td>DFT = 2.5-3.5 mils</td>
<td>(T)</td>
<td>Amercoat 68HS</td>
</tr>
<tr>
<td>2nd coat</td>
<td>High Solids Epoxy</td>
<td>Series 66 Hi-Build Epoxoline</td>
</tr>
<tr>
<td>DFT = 4-6 mils</td>
<td>(A)</td>
<td>Amercoat 385</td>
</tr>
<tr>
<td>Finish coat</td>
<td>Aliphatic Polyurethane (T)</td>
<td>Series 73 Endura-Shield III</td>
</tr>
<tr>
<td>DFT = 3-5 mils</td>
<td>(A)</td>
<td>Amercoat 450 HS</td>
</tr>
</tbody>
</table>

#### System 2: Galvanized Metal Surface Repair

| To be unpainted: | Eutectic type repair (RG) | ReGalv (TW) | Gal-Viz |
| To be painted:   | High zinc content (ZRC)    | Cold Galv. Compound (CRC) | Zinc It |
| DFT = 2 mils     |                            |                     |         |

#### System 3A: Submerged Ferrous Metal (Non-Potable Water)

| 1st coat:         | Organic Zinc Rich Primer (T)   | Series 90-97 Tneme-Zinc |
| DFT = 2-3 mils    | (A)                             | Amercoat 68HS          |
| Two coats:        | High Solids Epoxy (T)           | Series 66              |
| DFT = 10-12 mils  | (A)                             | Amercoat 385           |

#### System 3B: Submerged Ferrous Metal (Potable Water)

| 1st coat:         | Organic Zinc Rich Primer (T)   | Series 90-97 Tneme-Zinc |
| DFT = 2-3 mils    | (A)                             | Amercoat 68HS          |
| 2nd coat:         | High Solids Epoxy (T)           | Series 20 Pota-Pox     |
| DFT = 4-6 mils    | (A)                             | Amercoat 395FD         |
| Finish coat:      | High Solids Epoxy (T)           | Series 20 Pota-Pox     |
| DFT = 4-6 mils    | (A)                             | Amercoat 395FD         |

#### System 4: Ductile Iron (Not buried)

| 1st coat(s):      | High Solids Epoxy (A)           | Amerlock 400           |
| DFT = 3-5 mils    | (T)                             | Series 66              |
| 2nd coat          | High Solids Epoxy (A)           | Amerlock 400           |
| DFT = 4-6 mils    | (T)                             | Series 66              |
| Finish coat:      | Aliphatic Polyurethane (A)      | Amercoat 450HS         |
| DFT = 2 mils      | (T)                             | Series 73              |
|                   |                                   |                       |
System 5: Prefinished Machinery Coating (Other than prime coat)
One coat: Aliphatic Polyurethane (T) Series 73
DFT = 2 mils (A) Amershield

System 6: Galvanized Surfaces and Non-Ferrous Metals
1st coat: High Solids Epoxy (T) Series 66 Hi-Build Epoxoline
DFT = 4-6 mil (A) Amerlock 400
2nd coat: High Solids Epoxy (T) Series 66 Hi-Build Epoxoline
DFT = 6-10 mils (A) Amerlock 400
Finish coat: Aliphatic Polyurethane (T) Series 73 Endura-Shield III
DFT = 3-5 mils (A) Amercoat 450 HS

System 7: Miscellaneous Service Coating
One or two coats: Coal Tar (T) 46-465
DFT = 10 mils/coat (K) Bitumastic 33

System 8: Plastic Surfaces (Exposed to Sunlight)
1st coat: High Solids Epoxy (T) Series 66
DFT = 2-3 mils
2nd coat: Aliphatic Polyurethane (T) Series 73
DFT = 2-3 mils

System 9: Buried Valves
One full brush coat: (PW) 160/160 H Mastic
DFT = 20-30 mils (TC) TC Mastic

System 10: Heat Resistant
Two coats: High-Heat Silicon Alkyd (A) PSX 892HS
DFT = 6 mils (SW) B59S8

System 11: Not Used

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Check that hardware, trim, plates, lighting fixtures and similar items have been removed before starting Work. Coordinate Work with other trades. Check that equipment adjacent walls is disconnected and moved to permit wall surfaces to be painted before starting Work.

B. Perform surface preparation in accordance with Paragraph 3.07 below and the latest revision of the following requirements or manufacturer's requirements, whichever is more stringent:
2. Brush Clean: Remove dirt, dust, loose rust, and foreign matter in accordance with specification SSPC-SP 2, "Hand Tool Cleaning."

3. Solvent Clean: Solvent clean metallic surfaces to be painted to remove all oils or grease in accordance with specification SSPC-SP 1, "Solvent Cleaning." Use solvents recommended by manufacturer of paint to be used in each area. In addition, lightly hand sand copper piping.

4. Abrasive Blast: Conform to the requirements of SSPC-SP 10, "Near White Blast Cleaning" and SSPC-SP 6 "Commercial Blasting Cleaning." Paint all blasted surfaces within 8 hours of blasting unless the Engineer gives specific permission to do otherwise. Remove all weld spatter by grinding or chipping prior to sandblasting.

5. When sandblasting ductile iron pipe use the following color description:

<table>
<thead>
<tr>
<th>Standard Description</th>
<th>Ductile Iron Color Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brush off blast</td>
<td>bluish-gray</td>
</tr>
<tr>
<td>Commercial blast</td>
<td>near black</td>
</tr>
<tr>
<td>Near White blast</td>
<td>gray white</td>
</tr>
</tbody>
</table>

6. Wash metal surfaces with mineral spirits to remove dirt or grease, and clean off rust or scale with wire brush or sandpaper.

7. High-pressure waterblasting: Remove all dirt, dust, foreign matter, and all but the most tightly adhered rust, mill scale, and paint. Minimum waterblasting pressure and flow: 5,000 psi and 15 gpm.

8. Detergent wash and rinse: All Class II finishes to receive coatings shall be washed with detergent strong enough to remove oils and grease. Rinse thoroughly with clean water and allow to dry completely before application of coating.

C. Dust all surfaces and wipe clean with a tack rag just prior to coating.

3.02 APPLICATION

A. All steel coating application to be done in accordance with the latest revision of SSPC-PA.

B. Apply all material in strict accordance with manufacturer's instructions. Apply first coat immediately after surface preparation. Keep all paints at a consistency and applied in accordance with the printed directions of the manufacturer. The painting shall be done by hand, spray or roller as approved by the Engineer in conformance to individual paint manufacturer's recommendations. The Engineer will review all surfaces to be painted on the job prior to application of any coatings. Once the Contractor begins undercoating or priming, this will be his guarantee that the surface is acceptable to paint. All painted surfaces are to be free from drips, ridges, and brush marks. The following stipulations also apply:

1. Thinning permitted only when recommended by the manufacturer and only with thinner recommended for use with the particular product.

2. The use of additives to improve working characteristics or to lengthen or shorten set time is prohibited.

3. Items difficult or impossible to paint after installation are to be painted before installation and touched up after installation. Particular attention shall be paid to materials, which will be joined so closely as to effectively prohibit proper
paint application after assembly. These surfaces shall be painted prior to assembly. All surfaces subject to corrosion shall be coated.

4. Apply each coat to a uniform, even coating; lay material on in one direction and finish at right angles. Allow material to thoroughly dry between coats. Scuff, sand and remove all runs, sags, overspray, surface roughness, and other defects between each coat. Dust and wipe surface clean before applying next coat.

5. Cutting in is to be sharp and straight, free from overlaps or fuzzy edges. Redo any imperfect work.

6. Apply not less than the number of coats or dry film thickness specified. Apply additional coats if required for uniform coverage, full hiding, and to achieve film continuity. Finished work to be uniform in color, full coverage, smooth and free of sags and brush marks.

7. Do not apply coating when temperature is below 55°F or when the temperature of the surface to be painted is less than 4°F over the dew point temperature. Perform coating operations only under favorable environmental conditions. Take all steps necessary to protect and completely cure the work. Correct defective work to the full satisfaction of the Engineer.

8. Apply the last finish coat on all work after all major construction is complete and the work areas have been cleaned up and are dust free.

9. Coat all six (6) of surfaces of doors with the specified coats. Seal mortises and cutouts for locks, hinges, and other hardware.

10. When successive coats of paint of the same colors are specified, tint alternate coats sufficiently to produce enough contrast to indicate complete coverage of the surface.

3.03 PIPE AND EQUIPMENT IDENTIFICATION

A. Identify all piping and equipment exposed to the atmosphere, both interior and exterior by a combination of color coding, stenciling or pressure-sensitive tape and direction arrows.

B. Identify pipe by stenciling identification names and directional arrows as described in Section 10400 and in this section. Place names and arrows every 16 feet and wherever a pipe enters or leaves a room or a pipe trench. Provide lettering size as follows:

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Lettering Size (Height)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/4&quot; or less</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>1-1/2&quot; to 2&quot;</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; to 6&quot;</td>
<td>1-1/4&quot;</td>
</tr>
<tr>
<td>8&quot; to 10&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>Over 10&quot;</td>
<td>3-1/2&quot;</td>
</tr>
</tbody>
</table>

C. Provide pipe identification names as listed in the Piping Schedule on Sheet G4 of the Drawings, except that the Engineer will abbreviate any names exceeding 20 letters. Directional arrows are to be in black and be proportional to lettering. Color of equipment and pipe shall be as shown on a schedule to be provided by the Engineer. Gloss enamel is to be used for stenciling.
D. The Engineer will prepare a color schedule after the protective coatings are favorably reviewed. Notify the Engineer 30 days before the color schedule is needed. Colors will require special mixing. The number of different colors needed will be as indicated by the following schedule.

<table>
<thead>
<tr>
<th>Process</th>
<th>Each one a different color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals</td>
<td>Each in a different color</td>
</tr>
<tr>
<td>Air</td>
<td>All the same color</td>
</tr>
<tr>
<td>Water</td>
<td>Each one a different color</td>
</tr>
<tr>
<td>Drain</td>
<td>All the same color</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Diesel fuel one color</td>
</tr>
</tbody>
</table>

E. Paint equipment in the same color as the pipe to which it is connected.

F. Paint conduit and ductwork in colors to match adjacent walls/ceilings. See Section 09900.

3.04 FIELD QUALITY CONTROL

A. Pinhole and Continuity Testing:
   1. After the application of the prime and finish coats of Paint System 1, 3, 6, 8, and 9 surface protective coating systems on metal surfaces, perform continuity and pinhole checking by means of a low voltage electrical resistance meter and check thickness with a magnetic thickness gauge. Demonstrate to the Engineer that pinhole free condition and specified film thickness of the paint system has been achieved over all of the painted surfaces. Repair all deficiencies in film integrity and thickness in accordance with the manufacturer's instructions.
   2. The Engineer or an independent testing consultant may perform its own continuity and pinhole checking and thickness checks in addition to the Contractor's required tests. The appropriate equipment and necessary support, if requested, is to be provided by the Contractor. Repair any additional deficiencies in film integrity and thickness per the manufacturer's instructions and to the satisfaction of the Engineer.
   3. THE CONTRACTOR'S ATTENTION IS DIRECTED TO THE FACT THAT PAST USE OF THIS INSTRUMENT HAS DEMONSTRATED THAT THE PAINTER MUST APPLY AT LEAST TWO (2) AND USUALLY THREE (3) OR MORE STRIPE COATS ALONG ALL EDGES AND ANGLES AND CREVICES FORMED BY JOINING MEMBERS IN ADDITION TO THE COATS SPECIFIED IN ORDER TO ACHIEVE A PINHOLE FREE SURFACE.

B. Adhesion Testing: Where there is a question of paint or coating adhesion to surfaces, demonstrate to the Engineer's satisfaction that the coating adhesion to the area in question is equal to or greater than that which the paint manufacturer
literature states may be achieved by his product. An "Elcometer Adhesion Tester" is to be used by the Contractor to accomplish this demonstration.

C. Continuity, Pinhole and Adhesion Testing Support: Provide scaffolding, ladders, lighting and labor as required to facilitate the Engineer's check. Repair any areas damaged during and by the testing operation.

D. Testing Equipment: Prior to starting work, provide the following testing equipment to the Engineer for the duration of the job. Equipment shall be new and unused. Provide similar equipment to the painters at the site for quality control.
   1. Visual sandblasting standards:
      a. Type: Swedish Standards approved by SSPC and ASTM.
      b. Number: One.
   2. Surface Profile Comparative Equipment:
      a. Type: Visual with 0.5, 1, 2, 3, and 4 mil wheels.
      b. Comparator shall be suitable for the blast abrasive.
      c. Model: Keane Tator Surface Profile Comparator Model 127 or equal.
      d. Number: One.
   3. Wet film thickness gauge:
      a. Type: Nordson Wet Film Gauge or equal.
      b. Number: Six.
   4. Dry film thickness measuring gauge with certified thickness calibration standards.
      a. Type: Magnetic.
      b. Range: 0 to 40 mils.
      c. Accuracy: ±0.1 mil for 0 to 5 mils.
      d. Model: Elcometer 245 or equal.
      e. Number: One.
   5. Temperature gauges:
      a. Two steel surface temperature gauges.
   6. Sling Psychrometer:
      a. Model: Elcometer 116 or equal.
      b. Number: One.
   7. Wet sponge holiday tester:
      a. Measuring range: 0 to 20 mils.
      b. Model Elcometer 269, equivalent Tinker Razor model or equal.
      c. Number: One.

3.05 CLEANING AND COMPLETION

A. At the completion of this portion of the work, remove all debris, remove all paint and stains from work for which paint finish is not intended, touchup all marred surfaces, and leave all buildings and structures in a clean condition, ready for use.

B. Refinish all damaged or imperfect painting to the satisfaction of the Engineer prior to final acceptance of the facility.

C. Finish work, except waterproofing mastics, is to present an even, pleasing, and uniform color and appearance. Surfaces exhibiting coatings with shadows, streaks,
overlap marks, sags, drips, roughness, or non-uniform sheen will be considered as improperly applied and will not be considered acceptable.

D. Leave all machinery nameplate data tags clean and readable and all grease fittings clean and usable.

3.06 SPARE PAINT

A. Furnish one-gallon (minimum) container of each type and color of finish product used. Label containers. Each product shall have a minimum of 11 months of shelf life at project completion. Provide MSDS sheet with each container.

3.07 APPLICATION SCHEDULE

A. Provide coatings in accordance with the following exposure schedule:

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Surface Preparation</th>
<th>Paint System</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>General iron and steel exposed to atmosphere (bare metal)</td>
<td>Commercial blast, shop prime, solvent clean</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>General iron and steel exposed to atmosphere (shop primed)</td>
<td>Degrease</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Galvanized metal surface repair</td>
<td>Brush clean</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Submerged ferrous metal</td>
<td>Abrasive blast</td>
<td>3A or B</td>
<td>3</td>
</tr>
<tr>
<td>Ductile iron (not buried)</td>
<td>Commercial blast, clean, and dry</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Machinery and equipment furnished with shop enamel</td>
<td>Brush clean, spot prime</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Galvanized surfaces</td>
<td>Degrease</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Exposed copper piping and other non-ferrous metals</td>
<td>Degrease, lightly hand sand</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>CISP vents</td>
<td>Hand tool clean</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Metal mounted in contact with concrete and CMU surfaces</td>
<td>Brush clean</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Concrete vault exteriors and below grade exterior concrete surfaces of buildings</td>
<td>Brush off blast</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Plastic piping</td>
<td>Hand sand, rinse clean, dry</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Buried valves, flanges, etc.</td>
<td>Solvent clean and brush clean</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Engine exhaust</td>
<td>Brush clean</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Factory finish coated items not requiring field painting</td>
<td>Touch-up</td>
<td>-</td>
<td>12</td>
</tr>
</tbody>
</table>
Notes to Application Schedule

1. These surfaces include, but are not limited to: general miscellaneous ferrous metal; black (carbon) steel pipe; machinery; pumps; blowers; pipe supports; valve handwheels and stands; valve bodies; piping systems; galvanized sheet metal; structural steel; steel elements; except where other systems in this schedule are more specifically applicable or prefinished items as noted or specified.

2. Use galvanize-repair paint to repair-galvanize surfaces to be painted. Use eutectic-type repair to repair-galvanize surfaces to remain unpainted.

3. Apply this system to both ferrous metal and galvanized metal submerged in or suspended over wastewater or sludge. These surfaces include but are not limited to machinery parts, piping, valves, brackets and supports, and miscellaneous supports, braces, and pump columns. Do not blast clean galvanized surfaces. Coat inaccessible surfaces prior to erection.

4. Apply this system to all cast or ductile iron pipe, fittings, valves and valve stands that are exposed. All exposed ductile or cast iron shall be supplied without an asphaltic coating. Commercial blast or better for non-immersion service. Near white blast or better for immersion service. Factory prime the pipe and fittings.

5. All piping, valves, pumps, drives, machinery, and equipment that have factory finish coats that will be exposed to atmosphere. This system provides for repair of above named items and color uniformity with rest of field coat items.

6. Exposed galvanized ducts, exposed metal electric conduit, downspouts, wall ventilators, building trim and flashing, other galvanized steel items except those specifically excluded, exposed copper pipe and other non-ferrous metal items.

7. All cast iron soil pipe and associated flashing above the building roof. Also coat metal items, which are surface mounted on exterior, basement or gallery masonry walls, plaster walls and concrete surfaces. Coat such metal items only on the contact surfaces unless otherwise specified; specifically include electrical panels, control cabinets, fixtures and guardrail support brackets.

8. Apply two coats to the exterior below grade portion of precast concrete vaults. Allow concrete to cure a minimum of 28 days prior to coating.

9. This system is to provide a protective coating against ultraviolet light for all outdoor plastic pipe and vents.

10. Buried steel and cast-iron valves, operators, steel flanges, and other buried ferrous metals.

11. Exterior surfaces of engine exhaust, rain hood and rain cap.

12. All panels and equipment with factory finishes identified elsewhere as not requiring field paint, damaged during shipping, storage, or installation: touch-up in the field in a manner compatible with the factory coating with respect to paint type, color, and texture. Touch-up fusion epoxy-coated items only with material provided by the fusion epoxy fabricator. If more than 5% of the surface requires touchup, return the items to the fabricator for recoating.

END OF SECTION
DIVISION 10

SPECIALTIES

DIVISION 10:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10050</td>
<td>Building Specialties</td>
</tr>
<tr>
<td>10200</td>
<td>Louvers</td>
</tr>
<tr>
<td>10400</td>
<td>Identifying Devices</td>
</tr>
<tr>
<td>10500</td>
<td>Lockers</td>
</tr>
</tbody>
</table>

FINAL
January 2004
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SECTION 10050
BUILDING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Precast concrete site accessories.
   2. Fire extinguishers and fire extinguisher cabinets.
   3. Insulating "P" trap covers.
   4. Rubber switchboard mats.
   5. Toilet room accessories.
   7. Other building specialties and miscellaneous items not covered in other sections.

B. Related Sections: Section 10500: Metal Lockers

1.02 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe all products proposed for use.

C. Shop Drawings: For identifying devices.

D. Manufacturers Instructions: For installation of all items.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Provide multi-purpose 4A60BC (shipping weight 18 lbs). Shell of extinguishers shall be painted OSHA Red. All extinguishers shall be by one manufacturer and shall have a State Fire Marshal's inspection and fill tag dated within 90 days of project acceptance and issued by the Fire Marshal of the State in which the extinguisher is installed. Provide wall-mounting bracket. Larsen Architectural Series; J. L. Industries; or equal.

2.02 RUBBER SWITCHBOARD MATS

A. Provide corrugated fiber reinforced rubber mats, which conform to ASTM D178 and ANSI J6.7, Type I, oil resistant. Mats shall meet OSHA requirements. Mats for low voltage (below 1 kV) switchboards and switchgear and motor control centers shall be rated for protection for 17,000 volts minimum to ground. Mats for medium voltage (1 kV to 15 kV) switchgear shall be rated 17,000 volts. Test voltage: 30,000 volts.
B. Mat shall be a minimum of 1/4-inch-thick and black in color with beveled edges. Mats shall extend the full width of the equipment (minimum 30 inches). Mats shall be 4 feet deep in front of low voltage equipment and 6 feet deep in front of medium voltage equipment. Provide mats for all switchboards and motor control centers whether shown or not.

C. Installation: Install at locations shown on the Drawings and in front of all switchboards and motor control centers.

2.02 GARBAGE DISPOSAL

A. Continuous feed; 3/4 HP motor; 2700 RPM with Super Deluxe sound deadening insulation. Glass filled polyester drain housing. General Electric GFC1000G; or equal.

2.03 PRECAST CONCRETE SITE ACCESSORIES

A. Parking Lot Wheel Stop: Precast concrete, triangular cross section, 3 feet long. Christy Concrete Products; Architectural Precast; or equal.

B. Concrete Rainwater Splash Blocks: Precast concrete, 10 inches wide, 18 inches long with a recess in the top surface to channel water away from the building. Christy Concrete Products; Architectural Precast; or equal. Provide one for each rainwater downspout.

2.04 INSULATING “P” TRAP COVER

A. Provide the following for all handicapped accessible lavatories and sinks. Replaceable insulating “P” trap hot water valve and supply pipe cover. ADA approved. Made in two halves of molded fire retardant foam and provided with reusable plastic strap ties. Seal and Guard; Skald Guard; or equal. Use Handiguard where there is no molded trap cover that fits the trap that is to be insulated.

2.05 TOILET ROOM ACCESSORIES

A. Grab Bars:
   1. Brobrick B-6206, American Dispenser Company 907; or equal. Configuration as shown or as required for handicapped compliance.
      a) Concealed mounting on walls: Provide 12-gauge anchor plate of required length and fasteners for thickness of wall finish.

B. Mirrors: Sizes as shown on the Drawings. Satin finish type 304 stainless steel angle frame, welded mitered corners, 20-gauge galvanized steel back, 1/4-inch plate glass mirror, concealed wall hangers. Bobrick B-290 series; Bradley; or equal. Where shown on Drawings, provide integral stainless steel shelf. Bobrick B-292; Bradley; or equal.
C. Stainless Steel Shelves: Satin finish, 18-gauge, type 304 stainless steel; 5-inch-deep shelves, lengths as shown on the Drawings, 3/4-inch minimum shelf edges. 16-gauge stainless steel brackets. Bobrick B-295; Bradley; or equal.

D. Soap Dispensers: Surface-mounted soap, detergent or lotion dispenser: Satin finish type 304 stainless steel, 40-ounce capacity. Bobrick B-2111; Bradley or equal.


F. Toilet Seat Cover Dispenser: Surface-mount: Type 304 stainless steel with a capacity of 250. Bobrick B-211; Bradley; or equal.

G. Napkin-Tampon Disposal: Surface-mounted, satin finish stainless steel, piano-hinged top. Bobrick B-270; Bradley; or equal.

H. Paper Towel Dispenser: Surface-mounted: Dispenses 400 C-fold or 525 multifold towels. Satin finish type 304 stainless steel. Bobrick B-262; Bradley; or equal.

I. Waste Receptacle: Surface-mounted, satin finish, 22-gauge type 304 stainless steel with reusable polyvinyl liner, 21-gallon capacity. Bobrick B-275; Bradley; or equal.

J. Mop Rack: Rack shall be 36 inches long with four anti-slip mop holders, satin finish stainless steel. Bobrick B-223; American Dispenser Company No. 519; or equal.

K. Robe Hooks: Contoured 4-inch wide bar, concealed fasteners, polished stainless steel. Bobrick; Bradley; or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fire Extinguishers: Comply with NFPA Standard No. 10. Install cabinets and mount extinguishers where directed or where shown.

B. Install rubber switchboard mats as described in Part 2. and where directed.

C. Toilet Room Accessories:
   1. Install in locations shown on the Drawings, following the manufacturer’s recommendations. Install robe hooks in Shower Room where shown.
   2. Furnish any special backing plates, anchor plates or hardware to other trades for installation wall framing prior to gypsum board and tile installation. Verify that backing has been properly installed before finish materials are installed. Clean and polish metal surfaces and mirrors prior to acceptance.

END OF SECTION
SECTION 10200

LOUVERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Wall louvers.

B. Related Sections: Section 15800: Heating, Ventilating and Air Conditioning - HVAC systems

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01300.

B. Product Data: Fully describe all items proposed for use.

C. Shop Drawings: Custom prepared for this project.

D. Certified Test Data: Air and acoustic performance of louvers.

1.03 QUALITY ASSURANCE


B. Air Control Division of the Air Movement and Control Association (AMCA) Standard 500 for measuring air performance, water penetration and air leakage and Standard 411 for the AMCA Certified Ratings Program.

PART 2 - PRODUCTS

2.01 STATIONARY EXTRUDED ALUMINUM FRAMED LOUVERS

A. Manufacturer: Louver style K6774 exposed vertical mullion type manufactured by Airolite; Construction Specialties; or equal.

B. Design Criteria: Design and test louvers to AMCA Standard 500 for air performance and water penetration. Test a 4x4-foot louver with a minimum free area of 7.89 square feet to pass at least 800 FPM through the free area at a pressure drop not exceeding 0.15 in W.G. Limit water penetration to 10 ounces of water per square foot of free area when tested at 720 FPM for 15 minutes per AMCA Standard 500.
2.02 MATERIALS/FABRICATION

A. Provide extruded aluminum framed louvers with exposed jambs and mullions 4 inches deep with blades spaced 3 inches on center. Use aluminum alloy 6063-T52 for all parts.

B. Use extruded blades, 12-gauge (0.81 inches) thick, having a downward turned stiffening leg along the front bottom edge and an up turned leg with a forward facing lip to stop water migration along the top rear edge. Use blades that have an extruded hood on their bottom surface to interlock with mullion support brackets. Set louver blades at a 30° degree angle for exhaust and 45° degree angle for intake.

C. Contain louver blades in a frame made of 3/4 x 4-inch extruded aluminum "C" sections. Where mullions are required conceal them behind the louvers and make use of cantilevered brackets to support the louvers.

D. Provide louvers that have all joints concealed.

E. Continuously weld all joints in the louver assembly using a shielded arc process.

F. Provide 1/2 x 1/2 x 14-gauge aluminum bird screens in folded extruded aluminum frames. Where ductwork is attached to the interior side of louver provide holder for screen frame that can be built into duct work and so arranged that by opening a door in duct, screen can be slid out for cleaning without disassembling duct work. Where there is no ductwork attached to interior of louver, provide a holder for bird screen frame designed so that screen can be removed for cleaning and replaced without using tools.

G Provide all related break shape and extruded aluminum sills, flashings and sub-frames. Flashings shall be 0.050 or thicker as indicated.

H. Provide matching 1/8-inch-thick dark bronze anodized aluminum backing plates to cover the rear of decorative louvers and portions of louvers outside of air intake or exhaust ductwork.

I. Provide all required aluminum angles, tees, plates and other shapes required for a complete installation.

2.03 FINISH

A. Finish all parts with a dark bronze anodized finish at least 0.7 mils thick conforming to NAAMM AA-M10C22A44.

2.04 PREFABRICATED ROOF CURBS FOR LOUVER PENTHOUSES

A. Provide for louver penthouses, 14-inch-high insulated roof curb fabricated from a 12-gauge galvanized steel "C" box section with a bottom attachment flange, internally reinforced, mitered and welded corners. The upper edge shall be finished with a 2 x 2-inch pressure preservative treated wood nailer. The inside of the curb
shall be insulated with 1-1/2-inch-thick, 6-pound density rigid fiberglass with attached vapor barrier as specified for roof of louver penthouses in this Section. Custom Curb, Inc.; Thy Curb by Thy Bar Corporation; or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Protect all aluminum in contact with concrete, masonry, steel or galvanized metal with a coating of bituminous paint.

B. Install louvers as shown in the Contract Drawings and as shown in Plates 137B and 139A of the 4th Edition of the SMACNA Architectural Sheet Metal manual.

C. Provide bird screens on all louvers. Install on the interior side. Use stainless steel screws throughout.

D. Install sill flashing as shown detailed and as required to provide a watertight installation.

E. Install sheet metal drip at head of louvers where shown.

F. Apply sealant "B" all around frame, inside and outside in accordance with the requirements of Section 07900.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY
   A. Section Includes: Signs, decals, and tags.
   B. Related Sections:
      1. Section 08700: Finish Hardware
      2. Section 09900: Painting - pavement marking
      3. Section 09960: Protective Coatings - pipe markers
      4. Section 10050: Building Specialties.

1.02 REFERENCES
   B. National Fire Protection Association (NFPA) No. 704, System for the identification of the fire hazards of materials.

1.03 SUBMITTALS
   A. Submit in accordance with Section 01300.
   B. Product Data: Fully describe all items proposed for use.
   C. Shop Drawings: Scaled drawings or photostats of custom-made signs, showing style and size of lettering and colors.
   D. Samples: Manufacturer's standard color palette for selection.

1.04 QUALITY ASSURANCE
   A. Regulatory Requirements: Comply with the following:
      1. Americans with Disabilities Act (ADA).
      2. Uniform Building Code
      3. Federal Occupational Safety and Health Act (OSHA): Referenced sections, specifications for accident prevention signs and tags and exit signs.
   B. Comply with the manufacturer's published recommendation for installation of materials used.
PART 2 - PRODUCTS

2.01 SIGNS

A. Architectural Handicap Access Signs:
   1. Vomar Products, Inc.; PF 100 Series; Apco Graphics IM System; or equal.
   2. Sign characteristics:
      b. Frame and plaque in contrasting colors separated by a 1/16-inch reveal. Colors as selected from manufacturer's standard palette. Rectangular shape unless noted otherwise. Self-adhesive backing.
      c. Text Helvetica Bold all caps: Size shown.
      d. Sign size shall be as shown unless a larger size is required to accommodate lettering.
   3. Schedule of signs required:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Text</th>
<th>Size in Inches</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 each</td>
<td>RESTROOM, text size 1-1/2&quot;</td>
<td>12-inch triangle</td>
<td>Triangular shape inside circle with international unisex handicapped symbol Mount on door in conformance with Handicap Access requirements</td>
</tr>
<tr>
<td>1 each</td>
<td>SHOWER ROOM text size 1-1/2&quot;</td>
<td>12-inch triangle</td>
<td>Triangular shape inside circle with international unisex handicapped symbol. Mount on door in conformance with Handicap Access requirements</td>
</tr>
</tbody>
</table>

B. Room Identifications Signs:
   1. Vomar Products, Inc.; PF 100 Series; Apco Graphics IM System; or equal.
   2. Sign characteristics:
      b. Frame and plaque in contrasting colors separated by a 1/16-inch reveal. Colors as selected from manufacturer's standard palette. Rectangular shape unless noted otherwise. Self-adhesive backing.
      c. Text Helvetica Bold all caps: 1" text height
      d. Sign size shall be sized to accommodate lettering.
   3. Schedule of signs required:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Text</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 each</td>
<td>JANITOR</td>
<td>Operations Building</td>
</tr>
<tr>
<td>1 each</td>
<td>LABORATORY</td>
<td>Operations Building</td>
</tr>
<tr>
<td>1 each</td>
<td>CLOSET</td>
<td>Operations Building</td>
</tr>
</tbody>
</table>

C. Fire Extinguisher Location Signs:
   1. Comply with Federal and OSHA.
   2. Seton Nameplate Company; W.H. Brady Company; or equal.
5. Text: Bright, fade-resistant red on white downward facing directional arrow on red field. Text is shown on schedule below.
6. Schedule of signs required:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Text</th>
<th>Seton</th>
<th>Brady or Equal</th>
</tr>
</thead>
<tbody>
<tr>
<td>One for each</td>
<td>&quot;FIRE EXTINGUISHER&quot;</td>
<td>FSM33</td>
<td>95343</td>
</tr>
<tr>
<td>Fire Extinguisher. See</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drawings for locations</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D. Caution and Danger Signs:
1. Size: 14 inches wide by 10 inches high. For Sodium Hypochlorite Signs use 14" x 14" size signs.
2. Material: Enamel or vinyl on aluminum, 40 mil minimum thick. Sign shall be UV and weather fade resistant
3. Text, format, and color:
   b. Danger signs conforming to OSHA 1910.145(d)(2).
   c. Text as scheduled below.
4. Provide eyelet holes at each corner for mounting.
5. Schedule of signs required:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Text</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 each</td>
<td>CAUTION EYE PROTECTION AREA</td>
<td>Hazardous Chemical Shed, Hypochlorite Tank area</td>
</tr>
<tr>
<td>12 each</td>
<td>CAUTION THIS EQUIPMENT STARTS AUTOMATICALLY</td>
<td>Blowers, generators, sludge pumps, clarifier drives, brush rotors, mixers, and fine screen, etc.</td>
</tr>
<tr>
<td>2 each</td>
<td>CAUTION WEAR EYE PROTECTION, RUBBER GLOVES AND APRONS WHEN HANDLING CHEMICALS</td>
<td>Hazardous Chemical Shed, Hypochlorite Tank area</td>
</tr>
<tr>
<td>1 each</td>
<td>SODIUM HYPOCHLORITE – WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. CAUSES SUBSTANTIAL, BUT TEMPORARY EYE INJURY</td>
<td>Hypochlorite Tank area</td>
</tr>
<tr>
<td>2 each</td>
<td>CAUTION NO SMOKING</td>
<td>Where directed</td>
</tr>
<tr>
<td>2 each</td>
<td>CAUTION EAR PROTECTION AREA</td>
<td>Sludge Pumping Room, Blower Room</td>
</tr>
<tr>
<td>1 each</td>
<td>DANGER SODIUM HYPOCHLORITE</td>
<td>Hypochlorite Tank area</td>
</tr>
<tr>
<td>2 each</td>
<td>DANGER HIGH VOLTAGE</td>
<td>MCC Room Door and Inside of MCC Room</td>
</tr>
<tr>
<td>6 each</td>
<td>DANGER DO NOT DRINK WATER (Size: 10&quot;w x 7&quot;h)</td>
<td>Where directed</td>
</tr>
</tbody>
</table>
E. NFPA Fire Hazards of Materials Signs:
1. Seton Nameplate Company; W.H. Brady Company; or equal.
2. Sign characteristics: 4-color background, blue, red, yellow, white; diamond shape; 7-1/2 inches by 7-1/2 inches; 3-inch-high black hazard numerals scheduled below; conform to NFPA No. 704, System for identifying fire hazards of materials.
4. Where mounted to concrete or other porous materials provide 3/4-inch-thick AB Marine grade Douglas Fir plywood backing, sealed edges, painted. Eyelet holes at corners for mounting.
5. Schedule of signs required:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Hazardous Material</th>
<th>Blue (Health)</th>
<th>Red (Fire)</th>
<th>Yellow (Reactivity)</th>
<th>White (Specific Hazard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 each</td>
<td>Sodium Hypochlorite</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>ox</td>
</tr>
<tr>
<td>1 each</td>
<td>Diesel Fuel</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>1 each</td>
<td>Liquid Polymer (e.g., Polyacrylamide)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>--</td>
</tr>
</tbody>
</table>

G. Chemical Signs:
1. Seton Nameplate Company; Style SCS; Legi-Sign; or equal.
2. Size: 10 inches wide by 14 inches high.
4. Characteristics: Red text on white background. Text shall include chemical name, precautionary measures, signal word, statement of hazards, and antidote. Sign shall include NFPA No. 704, Hazard Identification System.
5. Where mounted to concrete or other porous materials, provide 3/4-inch-thick AB marine grade plywood backing, sealed edges, painted. Eyelet holes at corners for mounting.
6. Schedule of signs required:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Chemical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 each</td>
<td>Sodium Hypochlorite</td>
</tr>
<tr>
<td>1 each</td>
<td>Diesel Fuel</td>
</tr>
<tr>
<td>1 each</td>
<td>Liquid Polymer</td>
</tr>
</tbody>
</table>

2.03 PIPE MARKERS

A. Pipe markers shall be as described in Section 09960 for supplementary information.

B. Seton Nameplate Company; SetMark, W.H. Brady Company; Piper Marker System 1; or equal.
C. Pipe Markers conforming to ANSI A13.1. See paragraph 3.03 for required locations.

D. Material: Acrylic plastic snap-around type or pressure sensitive vinyl, temperature tolerance range of -40°F to 250°F, non-fade, colored fields, lengths as shown below.

E. Text: Non-fade ink, lettering size, as defined in section 09960.

F. Provide directional arrows to indicate flow direction as defined in section 09960.

G. Pipe Marker Schedule:

<table>
<thead>
<tr>
<th>Text</th>
<th>Field Color</th>
<th>Letter Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alum</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Bypass</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Backwash Supply</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Deionized Water</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Filter Inlet</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Filtered Water</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Filter To Waste</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Overflow</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Ozone Contactor Sample</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Ozonated Water</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Raw Water</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Sample</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Sample Drain</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Thickened Sludge</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Treated Water</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Waste Cooling Water</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Waste Washwater</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Washwater Return</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Phosphate</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Caustic</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Ozone Gas - Toxic – Oxidizer</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Hydrogen Peroxide</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Corrosion Resistant Vent</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Spare</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Sludge</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Sludge Underdrain</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Storm Drain</td>
<td>Yellow</td>
<td>Black</td>
</tr>
</tbody>
</table>
### PART 3 - EXECUTION

#### 3.01 SIGN INSTALLATION

A. Install signs where directed by the Resident Engineer.

B. Install signs after painting surfaces to receive signs. Follow manufacturer's written installation instructions.

C. Use fasteners as follows:

1. To concrete and masonry materials: 4-1/4-inches diameter expansion anchors.
2. To sheet metal (gauges 28 to 6) #10 sheet metal screws.
3. To gypsum board: Adhesive backing tape.
4. To chain link fencing: Wire ties at each corner.
5. To plywood backing boards: #10 wood screws.
6. To machinery: Fasteners as suitable.

D. Set sign posts in concrete.

3.02 TAGS

A. Do Not Drink Water Tags: Tie to faucets of non-potable water hose bibs as directed by Resident Engineer.

B. All Other Tags: Deliver to the Owner in properly identified boxes or envelopes.

3.03 PIPE MARKERS

A. Pipe Markers shall be applied where piping enters or leaves the wall or floor of a structure, adjacent to tanks or other hydraulic containments, at each valve, at each piping change in direction, and shall be applied along piping runs not exceeding 16 feet on center.

B. Directional Arrows: Point in the direction of flow.

C. Locate pipe markers for easy reading. Where pipes are located above normal line of vision, the lettering and directional arrows shall be placed below the horizontal centerline of the pipe. Where pipes are below normal line of vision, lettering and directional arrows shall be above the horizontal centerline of the pipe.

END OF SECTION
SECTION 10500
LOCKERS

PART 1 - GENERAL

1.01 SUMMARY
A. Section Includes: Metal lockers.
B. Related Sections: Section 10050: Building Specialties

1.02 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Product Data: Fully describe every product or item proposed for use.
C. Samples: Manufacturer's standard colors.
D. Directory: Locker numbers and combinations for each door lock.

1.03 QUALITY ASSURANCE
A. Qualifications: Provide lockers manufactured by a firm specializing in the manufacture of metal lockers and installed by a firm specializing in their installation.

PART 2 - PRODUCTS

2.01 LOCKERS
A. Manufacturers: Republic Steel "Standard" lockers; Penco "Vanguard Standard" lockers; or equal.
B. Size: Single tier 18 inches wide by 12 inches deep by 72 inches high.
C. Material: Cold-rolled sheet steel, phosphatized and primed to inhibit corrosion.
D. Doors: 16 gauge with flanged edges. Provide ventilating louvers top and bottom.
E. Hinges: Five knuckle, 2 inches long, welded to frame and bolted to door. Provide three hinges per door.
F. Door Frames: 16 gauge formed to a channel shaped with continuous door strikes and rubber silencers.
G. Top: Provide 18-gauge sloped top.
H. Base: Provide 6-inch-high closed bases for locker fronts and exposed sides.
I. Interior Equipment: 24-gauge top shelf and three garment hooks.

J. Locking Devices: Lift type handle with locking device engaging the door frame at three points. Automatic self-latching. Eyehole for combination lock.

K. Trim: Provide all necessary trim, clips, splice plates, filler panels and wall scribes, hardware and fasteners as required for a complete installation.

L. Name Plates: Furnish a number plate riveted to the door of each locker. Arrange each locker so that locker numbers are in consecutive order.

M. Finish: Factory applied baked enamel, interior and exterior, color as selected from manufacturer's line of standard colors.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's written installation instructions.

B. Lockers: Fasten to floor and walls and as required to resist a force of 500 pounds acting in any direction. Install fillers, trim and bases filling all gaps and voids.

END OF SECTION
## DIVISION 11

### EQUIPMENT

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>11001</td>
<td>General Equipment and Mechanical Requirements</td>
</tr>
<tr>
<td>11002</td>
<td>Electric Motor Drives</td>
</tr>
<tr>
<td>11190</td>
<td>Equipment for Secondary Clarifier</td>
</tr>
<tr>
<td>11201</td>
<td>Flow Control Gates</td>
</tr>
<tr>
<td>11215</td>
<td>Utility Water Pumping System</td>
</tr>
<tr>
<td>11220</td>
<td>Mixing Equipment</td>
</tr>
<tr>
<td>11240</td>
<td>Sodium Hypochlorite Feed Equipment</td>
</tr>
<tr>
<td>11303</td>
<td>Submersible Wastewater Pumps</td>
</tr>
<tr>
<td>11305</td>
<td>Scum Pump</td>
</tr>
<tr>
<td>11306</td>
<td>Polymer Feed System</td>
</tr>
<tr>
<td>11310A</td>
<td>Vertical Non-Clog Centrifugal Pumps</td>
</tr>
<tr>
<td>11310B</td>
<td>Dry Pit Submersible Vertical Non-Clog Centrifugal Pumps</td>
</tr>
<tr>
<td>11319</td>
<td>Rotary Lobe Centrifuge Feed Pump</td>
</tr>
<tr>
<td>11320</td>
<td>Grit Removal</td>
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<tr>
<td>11330</td>
<td>Screening Equipment</td>
</tr>
<tr>
<td>11364</td>
<td>Decanter Centrifuges</td>
</tr>
<tr>
<td>11375</td>
<td>Oxidation Ditch Equipment (Brush Rotor Aerators and Effluent Weirs)</td>
</tr>
<tr>
<td>11620</td>
<td>Laboratory Equipment</td>
</tr>
</tbody>
</table>
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: The general requirements for all of the Equipment and Mechanical work in the scope of the Project, included in Divisions 11, 12, 13, 14, and 15, and elsewhere wherever specifically mentioned in these Specifications.

B. Direct the attention of all subcontractors and suppliers of equipment and related appurtenances for the work to the applicable provisions in the Contract Documents wherever they may occur.

1.02 REFERENCES

A. American Gear Manufacturers Association (AGMA).

B. American Institute of Steel Construction (AISC).

C. Washington Administrative Code, Title 296 (WISHA).

D. Hydraulic Institute.

E. National Electrical Manufacturers Association (NEMA).

F. Occupational Safety and Health Act (OSHA).

1.03 STANDARDS FOR THE WORK

A. Complete Systems: Provide pipe, fittings, wiring and supports to produce complete, operable systems with all elements properly interconnected. If a specific dimensioned location is not shown for interconnections or smaller system elements, select appropriate locations and show them on Shop Drawing submittals for review.

B. Provide equipment and material new and without imperfections. Install equipment that is; aligned, leveled, cleaned and adjusted for satisfactory operation; installed in accordance with the recommendations of the manufacturers and the best standard practices for this type of work so that connecting and disconnecting of piping and accessories can be readily made and so that all parts are easily accessible for inspection, operation, maintenance, and repair. Locate oil and lubrication fittings clear of and away from guards, base, and equipment and within reach from the operating floor. Coordinate location of all motor connections in order to properly orient encased electrical conduits. In order to meet these requirements with equipment as furnished, minor deviation from the Drawings may be made as favorably reviewed by the Engineer.
C. The recommendations and instructions of the manufacturers of products used in the work are hereby made part of these Specifications, except as they may be superseded by other requirements of these Specifications.

1.04 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Shop Drawings: Submit Shop Drawings to the Engineer and receive favorable review prior to fabrication, construction or delivery to the project site in accordance with Section 01300 of these Specifications. Show sizes and arrangement of equipment, foundations and anchor bolts required, performance characteristics, fan curves and pump curves, control diagrams, wiring diagrams, motor data sheets, methods of assembly, pipe hanging details, ductwork layouts, and connections to other work. Date and sign drawings as certified for use in construction of this project. The arrangement of mechanical equipment and appurtenant piping shown on the Drawings may be varied as necessary to fit the favorably reviewed certified manufacturer's installation drawings. However, manufacturers' drawings shall not deviate in substance from the Contract Drawings and Specifications as to location, size, type, and design of equipment. The following minimum requirements shall accompany all equipment submissions:

1. Overall dimensions.
2. Mounting arrangement and dimensions.
3. Description of materials.
4. Connection sizes and orientation.
5. Capacity and location of lifting eyes.
6. Motor arrangement showing location of electrical connections.
7. Rating data - Mechanical and Electrical as applicable.
8. Detail electrical wiring diagrams, showing component designation and rating.
9. Seismic design certifications and anchorage descriptions as required by Section 01190.
10. Motor data as specified in Section 11002.
11. List of special tools and/or spare parts to be furnished, if any.

C. Each piece of equipment, for which certified witnessed or non-witnessed performance tests are required, shall be accompanied by a completed form containing at least the following information:

1. Owner's name and location of project.
2. Contractor's name and subcontractor if applicable.
3. Name of item being submitted.
4. Specification reference by section, paragraph, and page.
5. Data on item (manufacturer, general descriptive data, dimensions, size of connections, speeds, performance curves, serial number). A specific list of the test results plus a list, which shows the values that differ from Specifications.
6. Motor data, type, voltage, frequency, phase, full load amperes, starting method, frame size, enclosure insulation type (NEMA Code letter), dimensions, service factor, serial number.
7. Date and signature of person certifying the performance.
D. Instruction Manuals: Prepare and submit instruction manuals covering installation, operation and maintenance of all equipment and machinery specified in Divisions 11, 12, 13, 14 and 15. Refer to Section 01300, paragraph 1.08.

E. Manufacturers' Affidavits: Where called for in the Specifications, each equipment manufacturer, or his authorized representative, shall submit an affidavit conforming to the requirements of Section 01650, paragraph 1.04.

1.05 RESPONSIBILITY AND CARE OF EQUIPMENT

A. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested, and accepted in accordance with the requirements of these Specifications.

B. The Contractor shall make his own provisions for properly storing and protecting all material and equipment against theft, injury, or damage from any and all causes. Damaged material and equipment shall not be used in the work.

PART 2 - PRODUCTS

2.01 DESIGN

A. General: Design all equipment for the service intended, of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection and during continuous or intermittent operation. Adequately stay, brace and anchor, and install equipment in a neat and workmanlike manner. Give consideration to appearance and safety, as well as utility, in the design of details. Use cathodically compatible materials of construction.

B. Seismic: Refer to Section 01190 of the Specifications for the seismic design criteria.

C. Controls: Unless noted otherwise, the design of the electric control of any equipment system and/or equipment package shall be the responsibility of the manufacturer of the equipment system and/or equipment package. The elementary control diagrams as shown on the Electrical Drawings and the diagrams shown on the Instrumentation Drawings are illustrative of control and monitoring requirements pertaining to various equipment of this project. The manufacturers shall design their own functional electric control devices and circuitry, in consultation with the specific elementary control diagrams and other project specifications, to meet the equipment control requirements. All such systems and package controls shall be furnished by the equipment manufacturer, except that controls shown in motor control centers and process controllers, remote control devices, and their interconnecting wiring shall be provided under Divisions 16 and 17. Provide heating, ventilating and air conditioning controls, both 24-volt and line voltage type, by a HVAC controls specialist.
2.02 MATERIALS AND STANDARD SPECIFICATIONS

A. Materials: Design, fabricate, and assemble equipment and systems with new materials and in accordance with acceptable modern engineering and shop practices. Manufacture individual parts to standard sizes and gauges so repair parts can be installed in the field.

B. Uniformity: Unless otherwise specified, equipment or material of the same type or classification used for the same purpose shall be the product of the same manufacturer and shall be the same model.

2.03 LUBRICATION

A. Provide lubricants of types recommended by equipment manufacturers, in quantities sufficient for consumption prior to completion, testing, and final acceptance.

2.04 STRUCTURAL METAL FRAMING

A. Details of fabrication shall be in accordance with Section 05500.

B. Weld submerged steel surfaces, which butt or bear against each other, to seal the surfaces against the penetration of the liquid. Weld all gaps between adjacent submerged steel surfaces less than 1/32-inch wide to seal the surfaces. Weld size shall be not less than the thickness of the thinnest member of the lapped or joined assembly.

2.05 EQUIPMENT BASES AND BEDPLATES

A. Mount equipment assemblies on a single heavy cast iron or welded steel bedplate unless otherwise shown or specified. Provide bases and bedplates with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Round or chamfer and grind smooth all corners. Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to grouting. Mount all equipment bases and baseplates on reinforced concrete pads at least 3 inches high.

2.06 ANCHORS

A. Each equipment manufacturer shall furnish an anchor bolt pattern and the required anchor bolts, nuts and washers of adequate design for securing bases and bedplates to concrete bases. Provide anchor bolts of length to allow for 1-1/2-inch of grout under baseplates and adequate anchorage into structural concrete unless otherwise shown or specified.

B. Provide anchor and assembly bolts and nuts of ample size and strength for the purpose intended. All bolts shall be standard machine bolts, with cold pressed hexagon nuts. Provide suitable degauling compounds for bronze and stainless steel
threaded components. Any space wholly or partially underground, or having a wall or ceiling forming part of a water channel, is classified as a moist location. Unless otherwise specified or noted on the Drawings, provide materials as follows:

1. Bolts and nuts in submerged locations or submerged and embedded in concrete or buried in earth: Type 304 stainless steel.
2. Bolts and nuts for supports or equipment in dry or moist locations: Galvanized steel (hot-dipped), with oversize nuts.
3. Use other bolting materials where specifically called for in the Specifications or on the Drawings.

C. Anchor all motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive. Do not provide expansion type anchors for motor-driven equipment.

D. Anchor all non-motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive except that, where specifically allowed by note on the Drawing, expansion type anchors may be used.

E. Refer to Section 05500 for technical specification requirements of drilled-in anchors set in epoxy adhesive and for expansion bolt anchors. Refer to Section 05500 for cast-in-place anchors.

2.07 SAFETY GUARDS

A. Cover belt or chain drives, fan blades, couplings, nip points, exposed shafts and other moving or rotating parts on all sides with safety guards conforming to all Federal, State; and local codes and regulations pertaining; conform to the most restrictive requirement. Design guards for easy installation and removal, complete with necessary supports, accessories, and fasteners, all hot-dip galvanized. Design guards in outdoor locations to prevent entrance of rain and dripping water. Provide tachometer test opening in line with ends of shafts. Typically guards shall be expanded metal on a structural steel frame except that outdoor guards may be of solid material. Provide hinged doors with latch for service and lubrication access.

B. Cover all pipes, manifolds, heaters, and other surfaces which have a surface temperature sufficient to burn human tissue with a thermal insulating material or otherwise guard against contact.

C. Guards to comply with WISHA standards.

2.08 LIFTING EYES

A. Supply all equipment weighing over 100 pounds with lifting eyes. Parts of equipment assemblies, which are normally serviced separately, such as motors, to have lifting eyes of their own.

2.09 DRIVES

A. General: Provide all drive units with a AGMA rating and service factor suitable for 24 hours per day operation under the operating load.
B. Electric Motors: Conform to the requirements of Section 11002.

C. V-Belt Drives: Equip each V-belt drive with suitable tension adjustment. Provide drives having a service factor of at least 1.6 with arc length correction at maximum torque using nameplate rating of driving motor.

2.10 NAMEPLATES

A. Manufacturer’s Nameplate: Furnish each piece of equipment and its driver with a corrosion-resistant metal nameplate fastened to the item in a readily readable position. This nameplate to contain the manufacturer’s name, equipment rating, capacity, size, model, serial number, and speed. All information written or printed to be in English.

B. Direction of Rotation: Furnish each piece of rotating equipment with a direction of rotation arrow.

C. Functional Identification: Label each piece of equipment using a plastic laminate label with the functional name and number of the equipment.

1. Fasten labels to the equipment, its base or other acceptable location:
   a. Letters: At least 1/2-inch high with the border trim on all sides not less than 1/4-inch.
   b. Color: Green background with white letters.
   c. Fasteners: Brass or stainless steel screwed into inserts, anchor shields or tapped holes in equipment or base.

2.11 PROTECTION AGAINST ELECTROLYSIS

A. Where dissimilar metals are used in conjunction with each other, provide suitable insulation between adjacent surfaces so as to eliminate direct contact and any resultant electrolysis. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings, or bushings.

2.12 SPECIAL TOOLS

A. For each type of equipment to be furnished, provide a complete set of all special tools (including grease guns or other lubricating devices), which may be necessary for the adjustment, operation and maintenance of such equipment.

2.13 FINISHES

A. Conform to applicable requirements of Section 09900 and Section 09960.

B. Factory Painting: On pumps, motors, drives, starters, control panels and other similar self-contained or enclosed components, apply a factory protective paint system unless otherwise noted. Paint or otherwise protect surfaces that are inaccessible after assembly by a method, which provides protection for the life of the equipment.
C. Shop Priming: Except where field sandblasting is required, apply one or more shop coats of metal primer on surfaces to be finish painted at the site, of sufficient thickness to protect surfaces until finished. Primer shall be compatible with finish coat.

D. Rust Preventive: Coat machined, polished, other ferrous surfaces, and non-ferrous surfaces that are not to be painted with rust preventive compound.

2.14 NOISE AND VIBRATION

A. Mechanical and electrical equipment, as installed in this project, shall not create sound levels that are in excess of that permitted by WISHA for 8 hours per day worker exposure unless otherwise noted for the specific piece of equipment involved. If the required sound level cannot be achieved by bare equipment in its designated environment, provide sound attenuating enclosures. Sound attenuating enclosures shall have necessary ventilation to prevent equipment overheating and shall be constructed for easy removal to permit maintenance. Devices necessary for day-to-day operation shall pierce the enclosure or otherwise be accessible without need to remove the enclosure.

B. Equipment which when operating has obvious excessive vibrations shall be repaired or replaced as directed by the Engineer. Baseline vibration measurements shall be made where specified.

2.15 FACTORY TESTS

A. Perform factory tests for each piece of equipment where specifically called for in the section specifying that equipment. Note that factory tests are inherent in many reference standards. The requirement for a factory test in a referenced standard is hereby made a part of these Specifications. Conduct factory tests at the same speeds and other conditions at which the equipment will operate in the field, except as noted.

B. Where specifically noted, performance tests may be witnessed by the Engineer or his representative. Inform the Engineer in sufficient time to allow arrangements to be made for witness of such tests. When non-witnessed tests are performed, supply certified results.

C. Perform factory testing of pumps in accordance with the requirements and standards of the Hydraulic Institute.

D. Tests of other equipment shall conform to the requirements set forth in these Specifications.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Inspect each item of equipment for damage, defects, completeness, and correct operation before installing.

3.02 PREPARATION

A. Prior to installing equipment, ensure that the areas are clean. Maintain the areas in a broom-clean condition during installation operations. Clean, condition, and service equipment in accordance with the approved Instruction Manuals and specific recommendations of the equipment manufacturer.

3.03 INSTALLATION

A. Structural Fabrications: Conform to the AISC Code and Specification referenced in Article “Structural Steel Fabrications,” and conform to Section 05500.

B. Equipment: Conform to approved Instruction Manuals. Employ skilled craftsmen experienced in installation of the types of equipment specified. Use specialized tools and equipment, such as precision machinist levels, dial indicators, gauges, and micrometers, as applicable. Produce acceptable installations free of vibration or other defects. Align and pin to common bedplate equipment and drivers connected by flexible couplings.

C. Anchor Bolts: Deliver bolts with templates or setting drawings and verify that bolts are correctly located before structural concrete is placed.

D. Base and Bedplate Grouting: Do not place grout until initial fitting and alignment of connected piping is completed. Level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Bevel exposed grout at 45 degree angle, except round exposed grout at horizontal surfaces for drainage. Trowel or point exposed grout to a smooth, dense finish and damp cure with burlap for three days. When grout is fully hardened, remove jacking screws and tighten nuts on anchor bolts. Check the installation for alignment and level, and perform approved corrective work as required to conform to the tolerances given in the applicable Instruction Manual.

1. Make an allowance of at least 1-1/2 inches for grout under the equipment bases, whether or not shown on the Drawings. Use steel shims to level and adjust the bases. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise approved, all grout shall be a favorably reviewed non-shrink, non-metallic grout.

2. Grout: Dimensionally stable, inorganic, premixed and resistant to acids, alkalis, and salt water, and unaffected by water and oil. It shall have high strength even when used as a pourable mixture, and shall bond well with steel and cured concrete or be compatible with a suitable bonding agent which shall then be used to effect the bond. Use in strict accordance with the manufacturer's recommendations. Provide Five Star Grout as manufactured by U.S.
Grout Corporation, Bonsal Construction Grout as manufactured by Bonsal Company, or equal. Submit for favorable review by the Engineer prior to use.

3. Where practicable, place the grout through the grout holes in the equipment base and work outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

E. Architectural Metals: Handrails, guardrails, stairs, and other architectural metals furnished as a part of equipment shall conform to the requirements of Section 05500.

3.04 EQUIPMENT STARTUP AND ADJUSTMENT

A. Arrange for an authorized factory-trained representative of the company or companies supplying the various items of equipment to check the installation and adjust and test the equipment furnished before the acceptance of the work by the Owner. Said representative shall be experienced and knowledgeable of the equipment being tested. Furthermore, he shall assist and instruct the operating staff in adjusting and operating the equipment during the initial plant operation period.

1. Provide initial lubrication for all equipment.

2. Test and demonstrate to the Engineer that all equipment operates properly and specified performance has been attained. For pumps, include measurement of suction and discharge pressure at the pump and measurement of pumping rate by volumetric means or through a suitably calibrated meter for two points on the performance curve. For adjustable-speed pumps, conduct tests at a minimum of two speeds. Furnish any test equipment or measuring devices required, which are not part of the permanent installation.

3. In addition, demonstrate that the entire facility is in full operating condition prior to the acceptance of the work. Should any equipment or part thereof fail to operate as intended, immediately remove and replace it, all at the Contractor's expense. Pay for all tests involved in this Section.

4. Pressure test equipment and connections thereto as required by these Specifications.

5. For each electrical motor, measure terminal voltage, line current, power factor, and watts at motor terminals while running at full load.

3.05 PERFORMANCE TESTS

A. Upon completion of the work, and after all systems are set and balanced, conduct performance tests in accordance with Division 1 and other applicable sections of these Specifications. Submit test conditions, test data and results to the Engineer for review.

3.06 SOUND LEVEL TESTING

A. Measure the sound level developed by all mechanical and electrical equipment provided. Perform testing in all rooms and spaces containing such equipment during the final operation test program with all equipment operating. Use OSHA approved instrument and record the highest sound level developed when measured.
according to OSHA standards in each room and space. Deliver a copy of records to the Owner.

3.07 TOOLS, LOOSE PARTS, AND LUBRICANTS

A. Tools and Loose Parts Supplied: Provide an inventory of tools and loose parts required to be supplied under the project. Turn over inventory and parts to the Owner. The Owner's written acknowledgment of receipt is required for project completion. Loose parts are defined as items such as special tools, keys, safety equipment, and portable equipment. Refer to Section 01700 and relevant technical sections of these Specifications for additional instructions.

B. Recommended Spare Parts: Furnish a complete list of recommended spare parts and supplies for each equipment furnished with current prices and a source of supply.

C. Provide a list of all recommended lubricants not listed in the O&M Manuals.

END OF SECTION
1.01 SUMMARY

A. Section Includes: Provide motors to drive equipment specified in other sections and Divisions, including, but not limited to, Divisions 11, 12, 13, 14, 15, and 16. Refer to driven equipment sections for additional requirements. Requirements of the driven equipment Specifications shall take precedence over the requirements of this Section, where conflict occurs. This Section applies to all electric motors furnished for this project, unless otherwise noted.

B. Related Sections:
   1. Section 11001: General Equipment and Mechanical Requirements
   2. Section 16010: General Electrical Requirements
   3. Section 16920: Motor Control Centers
   4. Section 16924: Adjustable Frequency Drives (AFD)

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA) Standard:
   1. MG 1 Motors and Generators

B. Institute of Electrical and Electronics Engineers (IEEE) Standard:
   1. 112 Test Procedure for Polyphase Induction Motors and Generators

C. Underwriters Laboratories (UL) Publication: Recognized Component Directory

1.03 SUBMITTALS

A. For each motor, include the following data in the shop drawing submittal for the driven equipment:
   1. Manufacturer's name.
   2. Manufacturer's type and frame designation.
   3. Horsepower output.
   4. Time rating.
   5. Maximum ambient temperature rating.
   6. Insulation system designation.
   7. Rpm at full load.
   8. Voltage, number of phases, frequency and full load amperes.
   9. Code letter for locked rotor kVA.
   10. Service factor at 40°C ambient.
   11. NEMA design letter.
   12. Enclosure type.
   13. Lubrication requirements, including type and frequency.
   14. KW input power and power factor at 75% and 100% of rated horsepower output.
15. Guaranteed minimum efficiency and nominal efficiency per MG1-12.55.

B. Provide installation, operation and maintenance instructions, and renewal parts list as required for maintenance manuals under Section 01300, Paragraph 1.08.

1.04 COORDINATION

A. General: Coordinate motors with driven equipment requirements. Unless otherwise specified, equipment manufacturers or suppliers shall select and provide motors for their equipment in conformance with these Specifications. Give particular attention to coordination of requirements for:
1. Power.
2. Starting torque.
3. Speed.
4. Bearing load.
5. Ambient temperature.
6. Frequency of starting.
7. Moisture exposure.
8. Adjustable speed control, where applicable.

B. Suppliers of motors to be used with adjustable speed systems shall:
1. Provide all relevant motor data to the adjustable speed control manufacturer for analysis. Provide motors in conformance with and compatible with the adjustable speed control manufacturer's equipment and requirements.
2. Provide all relevant motor data to the pump manufacturer for vibration, reed critical frequency and other required analyses.

1.05 SPECIFIC REQUIREMENTS

A. The following motor characteristics are specified with the driven equipment in all cases:
1. Speed.
2. Horsepower or supplier responsibility to determine.
3. Horizontal or vertical arrangement.
4. Indoor or outdoor location.

B. Additional motor characteristics are specified with the driven equipment only where the required motor differs from the typical characteristics described below or where additional properties or characteristics are required that are not specified in this Section.

PART 2 - PRODUCTS

2.01 GENERAL

A. Motors shall be designed, built, and installed in the driven equipment, to provide long, trouble-free life in industrial service and shall be rated in conformance with NEMA MG1. Motors rated 100 horsepower or less and rated 600V or less shall be listed in UL Recognized Component Directory or shall be listed and labeled by other organizations acceptable to the authority having code enforcement jurisdiction.
B. Unless otherwise specified with the driven equipment, provide motors with the following typical characteristics:

1. Motors shall be single speed, and designed for continuous duty and full voltage starting. Motors shall provide standard starting torque.
2. Voltage Ratings:
   a. 1/2 horsepower or less: 115 volts, single phase, 60 Hz, capacitor start. Small fan motors may be split phase or shaded pole type if standard for the equipment.
   b. Above 1/2 horsepower: 460 volts, three phase, 60 Hz, squirrel cage induction motors.
3. All motors shall have a service factor of 1.15 in an ambient temperature of 40°C at 6,000 feet elevation.
   a. Exceptions: Motors, which have special enclosures or winding configurations, may carry a Unity (1.0) Service Factor. Examples are totally enclosed, explosion proof, or submersible motors.
4. Windings shall be copper.
5. Provide ground lug inside the terminal box.
6. Provide lifting eye on each motor weighing more than 50 pounds.
7. Each motor shall be suitable for six starts per hour (5 minutes on and 5 minutes off, continuously) when powering the specific driven equipment required for this project.
8. Each motor shall have an overall sound power level at no load not greater than given in NEMA MG1-12.49.
9. Motors, which have special operating characteristics such as multi-speed, high torque/high slip, short time intermittent ratings shall be nameplated to show how these characteristics differ from standard design.

C. Motors used with adjustable frequency drives shall have inverter duty complying with NEMA MG-1, Section IV, Part 31.

2.02 NAMEPLATE

A. Provide stainless steel nameplate for each motor, attached to the motor by stainless steel screws or drive pins. Nameplates shall indicate clearly the information required by NEMA MG1, Part 10 and Part 12.

2.03 ENCLOSURE TYPE BY LOCATION

A. Unless otherwise specified with the driven equipment, provide motors with the following typical enclosures:

1. Indoors: Horizontal motors shall be open, drip-proof; vertical motors shall be drip-proof with guard.
2. Outdoors: Vertical motors shall be weather-protected type I. Horizontal motors shall be totally enclosed, fan cooled. All motors shall have the following features:
   a. Bearing protection.
   b. Anti-corrosion treatment of external hardware and internal metal parts.
   c. Weatherproof terminal box with gaskets between the motor, terminal box and terminal box cover.
d. Guard screens on ventilation openings.

e. Moderate moisture resistant insulation, specified hereinafter.

f. Interior and exterior corrosion protection coatings.

g. Special attention to leads into terminal box.

B. When specifically called for in the Specifications for the driven equipment or required by Code, provide the following enclosure types:

1. Hazardous locations: Motors shall be explosion-proof and shall be UL listed for Class I, Division 1, Groups C and D locations; motors shall bear the UL label.

2. Severe duty: Motors shall have the following features:

a. Totally enclosed, fan cooled enclosure.

b. Stainless steel nameplate.

c. Cast iron housing, bearing brackets and fan guard.

d. Cast iron conduit box with threaded conduit entrance.

e. Corrosion resistant fan.

f. Corrosion resistant hardware.

g. Automatic breather/drain.

h. Ground lug.

i. Regreasable bearings.

j. Provision for excluding water and dust from bearings.

k. Class F insulation.

l. Service factor of 1.15.

m. Epoxy coating on all external surfaces.

3. Submersible: Submersible motors shall comply with the following:

a. Air filled or oil filled squirrel cage induction type.

b. Service factor of 1.15 or better.

c. Class F insulation, Class B temperature rise.

d. Rated for 6 starts per hour.

e. Listed by either UL or FM for Class 1, Division 1, Groups C and D hazardous locations.

f. Suitable for operating in free air continuously (i.e., not submerged in sewage).

g. Bearing B10 life 18,000 hours minimum.

h. Tungsten carbide seals.

i. Lower bearings of either the ball or roller type.

j. If required by the manufacturer to not void the motor warranty, provide a moisture detection system and a motor winding thermostat system. These systems shall be complete, including all necessary interfaces, control panels, conduits, and wires, even though these may not be shown on the Drawings.

2.04 INSULATION

A. Unless otherwise specified with the driven equipment, provide motors with Class B or F insulation, non-hygroscopic. In single phase motors 1/2 horsepower or smaller, provide Class A insulation or better.

B. Where called for in the Specifications for the driven equipment, provide the following type of insulation:

1. Moderate Moisture Resistant: Provide extra dip and bake of epoxy or polyester varnish to resist somewhat higher than normal moisture in the atmosphere.
A. The maximum permissible motor loading:
   1. Motors with service factor 1.15 or greater: 100% of nameplate horsepower.
   2. Motors with service factor less than 1.15: 90% of nameplate horsepower.

**TABLE 11002-1**

**MOTOR NOMINAL EFFICIENCIES AT FULL LOAD**

<table>
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<tr>
<th>HP</th>
<th>900 RPM</th>
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<td>1</td>
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<td>3</td>
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<td>1.5</td>
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<td>Total Enclosed Fan Cooled Motors</td>
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**Final January 2004**

037012.10

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Electric Motor Drives
B. Probable motor horsepower ratings have been specified or shown on the Drawings. Changes from the specified horsepower may be accepted, if necessary to assure that motors do not exceed their maximum permissible loading, as defined above, under normal operation. Motor horsepowers shall not be less than those specified in driven equipment sections. If a larger horsepower rating is required by the driven equipment, provide all changes required to motor starting and control equipment and to the conduit and wiring system without any additional cost to the Owner.

2.06 EFFICIENCY

A. For motors 1 Horsepower and Larger:
   1. Provide premium efficiency motors unless otherwise specified. Premium efficiency motors shall have nominal efficiencies at full load not less than those listed in Table 11002-1.
   2. Guaranteed minimum efficiencies of premium efficiency motors shall correspond to nominal values as tabulated in NEMA MG-1, Table 12-8.

B. Efficiencies shall be determined by using the IEEE 112, Test Method B using segregated loss determination.

C. Single-phase fractional horsepower motors 1/4 HP through 3/4 HP motors shall be high-efficiency split-capacitor types having minimum efficiency ratings of not less than 64% and power factors of not less than 94.5%.

2.07 LOCKED ROTOR KVA - CODE LETTER

A. Provide motors with locked rotor kVA values less than or equal to those corresponding to the following:

<table>
<thead>
<tr>
<th>Horsepower</th>
<th>Code Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤5</td>
<td>M</td>
</tr>
<tr>
<td>7-1/2-10</td>
<td>H</td>
</tr>
<tr>
<td>≥15</td>
<td>G</td>
</tr>
</tbody>
</table>
2.08 THERMAL PROTECTION

A. In each motor to be used with adjustable speed drives, in all motors 60 horsepower and larger, or where called for in the Specifications for the driven equipment, provide integral thermostats or other approved devices to protect the motor from overheating. Thermostats or other devices shall be normally closed and rated 125 Vac, 1 amp.

2.09 FACTORY TESTS

A. Conduct factory tests on all motors in conformance with NEMA MG 1-12.55. All tests shall be made in accordance with IEEE Standard 112.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install motors in driven equipment in conformance with motor manufacturer's recommendations and requirements. Motor nameplate shall be visible when installed on the driven equipment.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:
   1. This section specifies secondary sedimentation tank equipment as follows:
      Sludge and scum collection equipment, scum troughs, drive equipment,
      bridges for access to the drive equipment, and miscellaneous appurtenances
      as shown and specified. The equipment shall be suitable for use in the gravity
      separation of mixed liquor solids from the activated sludge process.

B. Type:
   1. Equipment furnished under this section shall be suitable for installation in
      circular secondary sedimentation tanks. The equipment shall have an energy
      dissipating center feedwell supplied from the center column and hydraulic type
      sludge collectors. The equipment shall be specifically designed for the
      conditions described and shown.
   2. All below water components shall be fabricated of 304 stainless steel. The
      clarifier walkways shall be fabricated of mill-finished Aluminum or 304 stainless
      steel. No priming or painting of these components is necessary.

C. Definitions:

   The following definitions apply to this section.
   1. Continuous operating torque: the continuous operating torque is defined as the
      AGMA design torque which is the torque load that is assumed to be
      continuously applied on the drive system through a 24-hour operating period,
      365 days per year for a 20-year life.
   2. Alarm torque: The torque at which an alarm sounds to serve as a warning of
      increased torque loading. The alarm torque is defined to be equal to 110
      percent of the continuous operating torque.
   3. Cutout torque: The torque load at which a motor cutout switch is activated to
      shut down the unit. The cutout torque is defined to be not less than 120
      percent of the continuous operating design torque.
   4. Momentary peak torque: The maximum or peak torque of the drive unit
      assumed to be equal to twice the calculated AGMA torque rating of the spur
      gear set or 3 times calculated AGMA torque rating of the worn gear set,
      whichever is lower.

D. Performance and Design Requirements:
   1. All structural members shall be designed in accordance with AISC standards
      and shall be capable of transmitting the momentary peak torque without undue
      deflection.
2. Mixed liquor will be conveyed to the sedimentation tank in an 18-inch pipe from the Mixed Liquor Splitter Box.

3. Sludge accumulations shall be removed from the floor of the tank through the combined operation of the continuously rotating sludge collection mechanism and the return sludge pumping system. The header and orifice design shall achieve hydraulic balance through the sludge collection mechanism and uniform removal of sludge from the floor of the tank through the application of controlled head loss at the orifices.

4. The orifices in the sludge collection mechanism shall be spaced at not more than 30-inch intervals. Orifices shall be spaced along the header or adjusted in size such that the orifices withdraw sludge volumes proportional to their respectively swept areas of the tank. The minimum orifice size shall be 2 inches in diameter. A fluidizing vane shall be provided on the bottom of the header to direct sludge on the floor of the tank to the area of influence of each orifice. Calculations shall be provided under Product Data, which demonstrate achievement of these requirements taking into account the criteria set forth in this paragraph and paragraph 11190-1.01F. The calculations shall be complete, with adjustments for changing orifice driving head along the length of the header, the tank area served by each orifice, changes in orifice size, the effect of velocity head in the header, and changes in sludge viscosity.

5. The central influent pier and column assembly shall be designed to support the drive mechanism, the sludge collection mechanism, scum removal system components, utility piping, access bridge beams and walkway. No vertical thrust load shall be placed on any underwater bearing. All drive gears shall be located above water level and all gearing shall be completely enclosed and oil lubricated. The drive cage, each sludge collector arm, and associated supports and connecting members shall be designed to withstand application of 200 percent of the continuous operating torque at the AISC allowable stresses.

6. The access bridge and operating platform shall be designed for a live load of 100 pounds per square foot. Deflection under full live load and dead load shall not exceed 1/360 of the span.

7. Other specific design requirements are as follows:
   a. Internal tank diameter, feet
   b. Sidewater depth, feet
   c. Freeboard at maximum flow, feet
   d. Influent column internal diameter, inches
   e. Flocculation skirt:
      Diameter, feet
      Depth below water surface, feet
   f. Sludge collection header, number
   g. Continuous operating torque, minimum, ft-lbs. applied at output of drive unit
   h. Motor output, horse power

E. Operating Conditions:
1. The equipment shall be designed and operable for the following conditions per clarifier:

   a. Maximum inlet flow, mgd (peak flow with maximum sludge return) 4
   b. Minimum inlet flow, mgd (minimum flow with minimum return sludge return) 0.4
   c. Maximum return sludge flow, mgd 1.0
   d. Minimum return sludge flow, mgd 0.2
   e. Maximum overflow, mgd 3.0
   f. Minimum overflow, mgd 0.2
   g. Maximum center column mixed liquor inlet port headloss at maximum inlet flow, feet 0.25
   h. Maximum headloss through collector orifices and arms to sludge collection sump at center column, feet 1
   i. Minimum velocity through sludge collection header at minimum return sludge flow, feet per second 0.5
   j. Mixed liquor suspended solids; concentration range, mg/l 1,000-10,000
   k. Maximum sludge collector peripheral speed, feet per minute 8
   l. Sludge viscosity, N-sec/m² 0.001-0.01

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. In the case of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABMA-9-90</td>
<td>Load Ratings and Fatigue Life for Ball Bearings</td>
</tr>
<tr>
<td>AGMA 2001-C-95</td>
<td>Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth</td>
</tr>
<tr>
<td>AGMA 6010-E-88</td>
<td>Standard for Spur, Herringbone, and Bevel Enclosed Drives</td>
</tr>
<tr>
<td>AGMA 6019-E-89</td>
<td>Gearmotors Using Spur, Helical, Herringbone, Straight Bevel or Spiral Bevel Gears</td>
</tr>
<tr>
<td>AGMA 6034-B-92</td>
<td>Enclosed Cylindrical Worm Gear Speed Reducers and Gear Motors</td>
</tr>
<tr>
<td>AISI-85</td>
<td>Pocketbook of AISI Standard Steels</td>
</tr>
</tbody>
</table>
ASTM A36/A36M-90  Structural Steel
ASTM A48-REV A-94  Gray Iron Castings
ASTM A536-84  Ductile Iron Castings
ASTM B247-93  Aluminum-Alloy Die Forgings, Hand Forgings and Rolled Ring Forgings
ASTM E18-94  Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
AWS D1.1-94  Structural Welding Code – Steel
NEMA 250-91  Enclosures for Electrical Equipment

B. Standards
1. Structural Steel and Welds: All structural steel used for equipment fabrication shall conform to the requirements of the Standard Specifications for Steel for Bridges and Buildings and ASTM A36. All welding shall conform to the latest standards of the American Welding Society (AWS). Continuous seal welds shall be provided at all welded joints. Skip welds will not be permitted.

2. Structural Design: All steel structural components shall be so designed that the stresses developed under the specified conditions will not exceed the allowable stresses defined by the AISC standards and the aforementioned standards. Except where specifically indicated otherwise, all plate and structural members designed for submerged service shall be steel, with a minimum thickness of ¼ inch.

C. Unit Responsibility:
1. The Contractor shall assign unit responsibility as specified in paragraph 11000-1.02 C to the secondary sedimentation equipment manufacturer for the equipment specified in this section and the launder cleaners specified in Section 11192. A certificate of unit responsibility shall be provided.

1.03 SUBMITTALS

The following information shall be submitted in accordance with Section 01300:

1. Certificate of Unit Responsibility attesting that the Contractor has assigned unit responsibility in accordance with the requirements of this section and paragraph 11000-1.02 C. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.

2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked “no changes required”. Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

3. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each
paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and therefore, requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

4. General arrangement drawings showing the entire assembly. This shall include a materials list and descriptions of all major components such as all gears, structural members, sludge collection members, and the scum removal system (sizes, piping connections, ASTM designations where appropriate, thicknesses and construction.

5. Rating, AGMA, and ASTM designations, construction, and detailed descriptions of all gears, reducers and drives.

6. Calculations substantiating the torque rating of the gear assembly as specified in paragraph 11190-2.03 D.1.

7. Bearing manufacturer, bearing model, and ABMA L-10 life data.

8. Motor data form 11060-A as required in paragraph 11060-1.03.

9. Proposed on-site testing and start-up procedures including sketches and calculations for torque test as specified in paragraph 11190-3.03.

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODUCTS

A. Secondary sedimentation equipment shall be Eimco Type C3D; Envirex Incorporated Tow-Bro; WesTech Engineering Inc., CLC series or equal, modified to provide the specified features and to meet the specified operating conditions.

2.02 MATERIALS

A. Materials of construction shall be as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Center column</td>
<td>ASTM A304</td>
</tr>
<tr>
<td>2. Steel plate</td>
<td>ASTM A304</td>
</tr>
<tr>
<td>3. Structural steel shapes</td>
<td>ASTM A304</td>
</tr>
<tr>
<td>4. Sludge Collection Header</td>
<td>ASTM A304</td>
</tr>
<tr>
<td>5. Scum Collection Box</td>
<td>ASTM A304</td>
</tr>
</tbody>
</table>
6. Scum Skimmer Arm  
7. Squeegees  
8. Drive cage  
9. Main spur gear  
   a. Ductile iron  
   b. Forged steel  
10. Worm  
11. Worm gear  
12. Pinion  
13. Main bearing balls  
14. Submerged fastening hardware including anchor bolts  
15. Scum wiper blades

2.03 EQUIPMENT

A. Influent Structure:
1. The tank influent structure shall consist of the center column and the influent diffusion well. The center column shall be a hollow steel cylinder with its base flanged for fixing to the concrete floor of the tank. Its top shall also be flange and stiffened for supporting the sludge collection mechanism, the drive mechanism, and the access bridge beams. Ports shall be provided for discharging the mixed liquor from the center column into the influent diffusion well. The top of the ports shall extend 3 inches above the maximum water surface elevation in the center column to allow scum to exit the center column.

2. The influent diffusion structure shall be designed to provide even distribution of flow into the tank and shall consist of a set of an outer concentric flocculation well. The flocculation well shall be fabricated of minimum ¼ inch thick steel plate.

3. The influent well will be baffled to promote effective mixing and tapered flocculation. Flow exiting the center pier will impinge a recession of three (3) overlapping vertical target baffles with a series of four (4) increasing port areas designed to provide a velocity gradient "G" within the flocculation well not exceeding 65 fps/ft at a minimum water temperature of 10E C at maximum influent flow. Horizontal shelf baffles will prevent downward movement in the flocculation zone. Baffles will bolt to the center cage and well support beams.

4. The flocculation well shall be stationary and shall be supported from the bridge framework, or the collector center cage. Additional supporting members shall be provided if required. Scum ports to allow scum to pass outside the flocculation well shall be located as shown on the drawings.

B. Drive Cage:
1. Torque shall be transmitted from the drive unit to the sludge collection arms and scum skimmers by a drive cage. The drive cage shall encompass the center column and shall be fabricated of structural steel shapes of sufficient strength to transmit and/or carry all loads and stresses associated with 200 percent of the continuous operating torque. Calculations shall be provided showing the related stresses developed in the drive cage at that torque.

C. Sludge Collector Mechanism:

1. The sludge collector shall consist of a rotating fabricated steel center outlet manifold, with a fabricated steel header located parallel to the tank bottom. The steel header shall be complete with a series of inlet orifices and a fluidizing vane designed to sweep the entire tank bottom clean every revolution. The fluidizing vane shall be attached to the steel header and shall extend to the bottom of the tank. The mechanism shall collect the sludge from the tank bottom and carry it through the header to the outlet manifold and to the opening of the sludge withdrawal conduit. The complete sludge collection mechanism shall be capable of handling the return sludge as specified in paragraph 11190-1.01 F.

2. The fabricated steel center outlet manifold shall encompass the center column. The manifold shall be rigidly attached to the drive cage and be provided with seals to prevent passage of liquid between the tank and the outlet manifold. The inside bottom of the manifold shall be open and completely cover the opening into the sludge withdrawal conduit at all times.

3. Sludge collectors shall be designed to operate continuously or intermittently. To provide for uniform sludge drawoff velocities throughout, steel headers, consisting of rectangular shaped tapered tubes, shall vary in size from a maximum near the tank center to a minimum at the outer end. The headers shall be fabricated of minimum 1/4-inch thick SS 304 steel plate. Standard or fabricated incremental pipe sizes will not be acceptable for use in the sludge withdrawal header.

4. The collectors shall be supported from the drive cage by steel tie bars to hold the header in alignment in a vertical and horizontal plane. The skimmer support arm shall be designed to withstand 200 percent of the continuous operating torque developed from uniform loads applied to the structure. In addition, the arm shall be designed to withstand a point load applied at its extreme end that produces cutout torque. Uniform loads and the point loading shall be applied separately. Calculations shall be provided showing the related stresses developed in the skimmer support arm under both conditions. The truss arm shall be of box or triangular truss construction, fabricated from rolled structural steel angles or sections having a minimum thickness of 1/4 inch.

5. To trap the lower sludge layer and minimize agitation, the longitudinal cross-sectional axis of rectangular headers shall be mounted at an angle of 45 degrees with the tank bottom. The leading edge of each rectangular header shall extend forward and down 2 inches at an angle of 45 degrees to provide an equalizing vane as an integral part of the header and to direct the sludge into the orifice's area of influence. A neoprene squeegee with a steel backing plate shall be attached to the vane. The squeegee shall have slotted holes for 1-inch vertical adjustment. Inlet orifices shall vary in size from a minimum near
the tank center to a maximum at the outer end and shall be accurately drilled in each header. A flange shall be provided at the inner end of each header for connecting to the fabricated steel center outlet manifold.

D. Drive Mechanism:
1. General: The drive assembly shall include an electric gear motor, worm gear, and worm gear reducer, pinion gear, turntable type main spur gear, drive base, shear pin hub coupling, steel roller drive chain, and torque overload protection system. The spur gear set shall be designed in accordance with AGMA 2001-C. The worm gears shall be designed in accordance with AGMA 6034-B for a service factor of 1.25 applied to the continuous operating torque.

The drive mechanism shall be mounted on the influent column with the top of the spur gear housing capable of supporting the total access bridge load by means of equally loaded, removable output sprockets and chain to allow operation of the collector mechanism at 66, 80 and 100 percent of the speed specified in paragraph 11190-1.01 F. Drive mechanism components shall be designed for the rated torque specified in paragraph 11190-1.01 E. Calculations shall be provided that substantiate the torque rating (including momentary peak torque) of the gear assembly. Numerical values shall be shown for all terms used in the AGMA rating equations.

2. Gear Motor: The drive motor shall be 1,800 rpm conforming to Section 1060. The motor shall be designed for continuous duty, Class II applications in accordance with AGMA 6019-E. The motor shall be Type 2 as specified in Section 11060. Motor bearings shall be rated for a minimum L-10 life of 50,000 hours.

Power transmission between the gear motor and a special, single-reduction worm gear reducer shall be made through a roller chain and sprocket drive assembly. The chain drive shall be enclosed by a removable chain guard, constructed of a minimum 14-gage hot-dip galvanized steel or molded polyethylene and conform to OSHA requirements.

3. Worm Gear: The special worm assembly shall consist of a through hardened and ground alloy steel worm and a centrifugally cast bronze worm gear. The worm gear assembly shall be vided complete with oil fill, level, and drain fittings and a sight gage. The drain shall be at the lowest point of the oil reservoir and shall be accessible.

The worm gear torque capacity shall be determined according to AGMA 6034-B for service factor of 1.25 applied to the continuous operating torque.

4. Pinion Gear: The pinion and pinion shaft which drive the internal spur gear shall be made from heat treated forged alloy steel and designed in accordance with AGMA 6010-E. The pinion shall be rigidly supported by bearings located above and below the pinion gear. Overhung pinions shall not be acceptable.

5. Spur Gear Assembly: The spur gear shall be AGMA Quality 5 and shall be designed and rated in accordance with AGMA 2001-C. If the spur gear is of a split gear design, the two halves shall be provided with precision mating surfaces with self-registering and indexed fits.

The spur gear housing shall be made of cast iron or A36 steel. A felt or neoprene seal and dust shield shall be included with each spur gear housing in
two locations; a lower seal located between the stationary drive base and main gear and an upper seal located between the main gear and stationary drive cover. The spur gear housing shall be designed to allow submergence of the gear face in the oil bath sufficient to provide complete lubrication of the gear assembly. When the main spur gear is manufactured from forged steel, a minimum 75 percent of the gear face shall be submerged in oil. The gear case shall be complete with an oil fill and drain components. Drain piping shall tap the lowest point in the oil reservoir for removal of oil and condensate, shall be valved, and shall be conveniently accessible. An extension operator shall be provided for operation of the drain valve form the walkway level above. A dip stick extending from the walkway level to the bottom of the drain or oil level sight glasses at gear and bearing housings shall be provided to indicate oil level and the presence of condensate.

The drive assembly shall be firmly mounted to a cast iron turntable base with a minimum wall thickness of 1/2 inch. The drive base shall be mounted on the center column and be provided with a positive leveling feature. The drive base shall be suitable for supporting the entire load of the drive mechanism and access bridge. To permit inspection and maintenance of components in the interior of the drive unit housing, each assembly shall have an access opening. A cover plate shall be provided for the opening. The base shall be formed to provide a sump with a valved drain and sight glass not less than 1-5/16 inches deep to allow for the collection and disposal of condensate. The sump shall be designed to trap condensate before it comes in contact with bearing housings.

6. Main Bearing: The entire sludge collector mechanism shall be suspended from the turntable which in turn shall be supported on a ball bearing assembly that uses hardened carbon corrected, vacuum degassed alloy steel bearing balls. The bearing balls shall run in an oil bath on replaceable carbon corrected, high carbon steel lines hardened to 38-46 Rockwell C as specified in ASTM E18 and placed in annular raceways in the gear and turntable bases. A cross-contact or four-point angle contact bearing arrangement is prohibited.

7. Torque Overload Protection: The drive mechanism for the sludge collector shall be provided with an overload protection device and an overload alarm system. The overload protection device shall be designed to measure thrust of the worm gear shaft and be provided with an indicator showing the load on the mechanism. The indicator shall be visible from the access bridge, shall read in ft-lbs torque or percent continuous operating torque and shall cover the range of torques specified up to 200 percent of the continuous operating torque.

The overload device shall include two switches, the first to activate a remote alarm, and the second to shut down the unit. The overload device shall be enclosed in a watertight cast iron or aluminum housing. The switches shall be NEMA 4X DPDT, rated at 10 amps and 250 volts AC. The device shall be factory calibrated to activate the alarm switch such that it is 110 percent of the continuous operating torque and activate the cutout switch (normally closed) at 120 percent of the continuous operating torque.

A backup shear pin shall be provided in a shear pin hub mounted on the output shaft of the gear motors. The shear pin shall be selected to break when the load on the mechanism achieves 140 percent of the continuous operating
torque specified. A NEMA 4X limit switch shall be provided to activate when the shear pin breaks.

8. Provide an ON/OFF push button station for control of the drive mechanism motor complying with the requirements of Division 16. The push button station shall be a “maintain contact station” that will remain in the ON position following a power outage. Locate the station on the handrail adjacent to the drive motor mechanism. The push button station to be provided by the clarifier equipment manufacturer.

E. Scum Removal System:

1. The mechanism shall be provided with components to remove surface scum from the outer annular space between the flocculation skirt and the scum baffle. All surface scum in the inner annular space shall be directed to the outer annular space through the scum port in the flocculation skirt. Refer to the drawings for the location and details of the opening. All surface scum in the outer annular space shall be moved to an outer scum trough for removal from the secondary clarifier by gravity flow. Skimmer mechanism design shall be coordinated with the design of the launder brush cleaners specified in Section 44192 that will be attached to the outer scum skimming arm. There are no launder brush cleaners required on the skimming arm.

2. One skimming arm located shall be provided. The arm shall collect and remove surface scum from the entire surface of both annular spaces. Flexible wipers shall be located at the ends of the skimming arm to assure continuous contact with the side of the secondary baffle and with the scum baffle adjacent to the inboard effluent weir.

3. A stationary antirotation arm shall be suspended at the water line in the outer annular space to prevent the surface scum from rotating. The arm shall act in conjunction with the rotating skimmer to “wedge” the surface scum outward toward the scum trough. The antirotation and skimming arm shall be offset and angled with respect to tank radii as required to optimize the wedging effect. Provisions shall be incorporated into the design of the antirotation and skimming arms to permit adjustment of their position with respect to penetration into the liquid within the tank.

4. A hinged assembly forming a pocket to tap the scum shall be located at the outer end of the skimming arms in the outer annular space. The assembly shall transport the trapped scum up the sum trough beach, deposit it in the trough, and then be lowered back to the liquid surface by return guides.

5. A scum trough shall be provided as shown for the outer annular space. It shall include a box fabricated from ¼ inch minimum SS 304 plate, a beach, skimmer assembly return guides and a connection for the scum piping specified. The scum trough shall be painted after fabrication in accordance with the requirements of Section 09900 for submerged service.

6. A limit switch located on the spray arm shall be provided to start scum hopper sprays based on scum skimmer arm position. The limit switch shall be DPDT, rated at 10 amps and 250 volts AC, and protected in a NEMA 4X enclosure.

F. Weirs and Scum Baffles:
1. Effluent weirs shall be 9-inches high and a minimum of ¼-inch thick fiberglass as shown on the drawings. The V-notches shall be 2-½ -inches deep, 90 degrees at 6-inch intervals. The weir sections shall be flat to fit the inside of the launder walls. They shall be fastened to the walls with 316 stainless steel anchor bolt, nuts and washers, allowing for vertical adjustment. The launder wall shall be coated with mastic to prevent leakage between surfaces.

2. Baffles shall be a minimum of ¼-inch thick fiberglass and be 12-inches high. The scum baffle shall be supported from the thank wall by fiberglass angle brackets secured with 316 stainless steel cinch anchor bolts and hex nuts allowing for vertical and radial adjustments. At the scum box, the baffle shall be 18-inches deep to out to 6 –feet on either side. The scum baffle support system shall be fabricated in accordance with the requirements of Section 06600.

G. Walkway and Operating Platform:
1. Access bridges shall be provided as shown for the sludge collector mechanism and shall consist of structural aluminum beams or truss sections interlaced for rigidity shall consist of structural aluminum or 304 stainless steel beams and truss sections. All walkway surfaces shall be at the same elevation. The access bridge shall be supported on the main spur gear housing which in turn shall be supported by the center column support structure. Clearance of 24 inches shall be provided around the drive. The bridge shall span from tank wall to the center of the tank, as shown. The bridge shall include a 36-inch wide aluminum grating walkway complete with 3/16-inch by 4-inch high toe plates. The operating platform shall include a similarly constructed walkway encircling the exposed portion of the drive unit. Grating shall be as specified in Section 05500 and on the drawings.

2. The walkway and operating platform shall be provided with handrail conforming to the requirements of Section 05724.

H. Finishing Requirements:
1. All aluminum shall be mill-finished.
2. All fabricated steel or ferrous metal shall be fully prepared with shop-applied prime and field-applied final coats in accordance with the requirements of Section 09900. Preparation of steel and ferrous surfaces shall comply with requirements specified in Section 05100 and Section 09900.
3. Test areas of any shop-applied prime coats shall be selected by the Construction Manager for removal to verify compliance. Spark testing shall be conducted following application of the final finish coat.

2.04 SPARE PARTS

A. Spare parts shall be provided as follows:

1 set All bearings and bearing seal rings for drive unit, except the main turntable bearing
1 set All gaskets for drive unit
1 set Spur gear seal and replaceable bearing races
1 set Neoprene seal rings for sludge withdrawal manifold
1 set       Shear pins
1 set       Any special tools required to assemble, disassemble, or maintain the equipment

Spare parts shall be tagged and stored in accordance with paragraph 11000-2.12.

2.05      PRODUCT DATA

A. The following information shall be provided in accordance with Section 01300:
   1. Calculations sizing the orifices and headers for uniform sludge withdrawal and other data as specified in paragraph 111901.01 F.
   2. Calculations sizing and locating the center column mixed liquor inlet ports.
   3. Calculations showing stresses in the drive cage and sludge collection arms as specified in paragraphs 11190-2.03 B and -2.03 C.
   4. Shop primer and coating data for all shop-coated components.
   5. Applicable operation and maintenance data in accordance with Section 01730.
   6. Motor data as specified in paragraph 11060-2.05.
   7. Installation Certification Form 11000-A as specified in paragraph 11190-3.01.
   8. Training Certification Form 11000-B as specified in paragraph 11190-3.02 A.

PART 3 - EXECUTION

3.01      INSTALLATION, FIELD TESTING, AND START-UP

Equipment furnished under this section shall be installed, checked, and adjusted as recommended by the manufacturer. The installation shall be certified on Form 11000-A as specified in Section 01999.

3.02      FIELD TESTING AND START-UP

A. General:
   1. In addition to the installation and acceptance tests specified in other portions of the project manual, the equipment furnished under this section shall be subject to the following field performance tests. All performances tests shall be performed under the on-site supervision of personnel trained by the manufacturer. All equipment and instrumentation necessary to complete the testing procedures outlined below shall be provided by the Contractor. Performance testing shall include operating seals, and torque load testing. Failure to complete the testing program, as outlined in the following paragraphs, shall be sufficient cause for rejection. In addition, a factory representative shall start up the equipment and train plant personnel in operating and maintenance procedures for not less than 8 hours. Training shall be certified on Form 11000-B as specified in Section 01999.

B. Operating Tests:
   1. Each secondary sedimentation tank shall be filled with potable water to its operating level and the mechanism shall be operated continuously at its
maximum speed for a period of not less than 48 hours. At no time during the operating test shall the equipment fail on torque overload or exhibit indications of binding or uneven operation. The Contractor shall record torque values as resisted on the drive mechanism torque indicator and motor amperage (all three phases) at 3-hour intervals.

2. If the mechanism should fail on torque overload or, in the opinion of the Construction Manager, the mechanism should exhibit indications of binding or improper adjustment, the Contractor shall immediately halt the tests and remedy the problem. After completion of necessary repairs or adjustments, the tests shall be repeated. Failure to successfully complete the test in six attempts shall be considered sufficient cause for rejection.

C. Sludge Collector Seal Tests:

1. As part of the installed test program, each secondary sedimentation tank sludge collector shall be given a sludge collector seal test. The test shall be performed by establishing and maintaining a differential head of 5 feet between the water surface elevation in the tank and the water surface elevation in the RAS pump inlet piping. The Contractor shall furnish equipment and personnel to monitor the water levels at all times for a period of 24 hours and to measure the volume of water added to the tank to maintain the specified differential head. Leakage through the seal over the 24 hour period shall not exceed one percent of the maximum return sludge flow specified under paragraph 11190-1.01 F. Should leakage through the seal exceed this rate, the Contractor shall adjust, replace or modify the seal and repeat the test. Failure to successfully complete the test after six successive attempts shall be considered sufficient to require the Contractor to replace the collector mechanism with one which will meet the requirement. The cost of all retest work, including water, shall be borne by the Contractor.

D. Torque Test:

1. The Contractor shall load test the entire collector mechanism by anchoring collector arms individually. Each arm of the collector mechanism shall be tested individually by using a single attachment point at the end of the arm to achieve a point load condition during the test. In successive tests, the Contractor shall demonstrate the sludge collection mechanism’s (including drive unit, cage, gears, and structures) capability to withstand all loads and stresses associated with the cut-out torque. Prior to initiating the test, the Contractor shall furnish the Construction Manager with sketches and calculations illustrating the test procedure and demonstrating how the specified torque will be applied to satisfy this requirement.

END OF SECTION
SECTION 11201
FLOW CONTROL GATES

PART 1 - GENERAL

1.01 SECTION INCLUDES
A. Furnish and install complete, tested and operating, the equipment as shown on the Drawings (Mechanical Drawings) and as specified herein.

B. Work included in this section:
   1. Slide Gates with operators.
   2. Stop Gates

1.02 SUBMITTALS
A. Shop Drawings: Submit shop drawings in the Product Review category for the equipment specified herein. Submit construction details, dimensions and construction materials. Include sufficient data to show that equipment conforms to Specification requirements. Submit shop drawings as a complete initial package.

B. Manuals: Furnish manufacturer's installation, lubrication, and maintenance manuals, bulletins, and spare parts lists.

C. Affidavits: Furnish affidavits from the manufacturer stating that the gates and operators have been properly installed and tested and are ready for full time operation.

1.03 QUALITY ASSURANCE
A. All equipment furnished under this Section shall be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least 5 years. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.

1.04 SEISMIC CERTIFICATION
A. Seismic anchorage certifications and descriptions are required in accordance with Section 01190.

PART 2 - PRODUCTS

2.01 SLIDE GATES
A. General: Provide rising stem, self-contained slide gates complete with slide guides, stems, operators and all appurtenances to provide complete operational slide gate
as shown in the Slide Gate Schedule on the Mechanical Drawings and as specified herein.

1. The complete system comprising the gate, slide, guides and appurtenances shall be furnished by the gate manufacturer, who shall be responsible for the compatibility of components and functional integrity. The size of each slide gate shall be suitable for the clear opening shown on the Drawings.

2. The slide gate as a whole and all their components shall be suitable for service in raw sewage. The gate shall be designed for manual operation with heads under five feet.

3. Slide gates shall conform to AWWA C513 except as modified herein.

B. Slide Gate Type: The slide gate shall be of the flange back, self-contained type. The gate shall be by Waterman Industries, Rodney Hunt; Hydrogate Corporation; Golden Harvest, Inc.; or equal.

C. Slide Gate Construction:

1. Frame and guides: The gate frame shall be a rigid unit made of plates and structural shapes. The yoke supporting the operator shall not deflect more than 1/360th of the yoke span under the design thrust. The frame shall be constructed of Type 316 stainless steel. Provide J-bulbs seals.

2. Slide (Disk): The slide shall be plate reinforced with cast in structural shapes. The slide shall not deflect more than 1/360th of the maximum dimension under conditions shown on the Drawings. The slide shall be constructed of cast iron with bronze seat facings.

3. The handwheel shall be cast iron construction and finished with a grey, machinery enamel factory applied coating.


5. Stem: The stem shall be Type 316 stainless steel with a diameter capable of withstanding in compression twice the rated output of the operator at 40-pound pull. The stem shall be supported so that the unsupported L/R ratio does not exceed 200. Stems shall have rolled threads with a max roughness of 16 micro inches.

6. Manually operated lifts shall be of the handwheel pedestal type conforming to applicable provisions of AWWA Standard C501 as amended herein. After the gate has been "cracked" from its wedging devices, a maximum hand pull of 25 pounds shall be required to open the gate under the specified operating heads.

   a. Provide handwheel lift units with cast iron cap, handwheel and pedestal and a cast bronze lift nut. The lift nut shall be flanged and shall have ball thrust bearings above and below it to take the thrust developed during opening and closing of the gate. Adequate grease fittings shall be provided to lubricate the bearings and other moving parts. The rim of the handwheel shall be cast smooth and be free of sharp edges. An arrow shall be cast in the rim of the handwheel with the word "open" to indicate direction of rotation to open the gate.

   b. All lifts shall be equipped with a transparent rigid butyrate stem cover with permanent marking to indicate full open, full closed, and gate level in 1-inch
graduations. Lift nut shall be threaded with left hand threads for standardized valve operation.

2.02 STOP GATES

A. General: Provide stainless steel stop gates complete with guides, seals, sliding disk, and handles as shown on the Drawings and as specified herein.
   1. The complete system shall be furnished by the gate manufacturer, who shall be responsible for the compatibility of components and functional integrity. The size of the stop gates shall be suitable for the clear openings shown on the Drawings.
   2. The stop gates as a whole and all associated components shall be suitable for service in raw sewage.

B. Stop Gate Types: The slide gates shall be embedded in the channel walls as shown on the Drawings. The gates shall be manufactured by Waterman Industries, Rodney Hunt, or equal.

C. Stop Gate Construction:
   1. Guides: The gate frame shall be a rigid, welded unit with a clear opening the same size as the waterway opening, unless specified. The guides shall be of stainless steel shapes. The guides will be the length specified. Additional members will be added to the frame as required for flushbottom closure and J-bulb seals.
   2. Slide: The slide shall be plate reinforced with structural shapes welded to the plate. The slide shall not deflect more than 1/360 of the span of the gate under maximum head.
   3. Flush bottom closures: When indicated on the Drawings or the Gate Schedule, gates shall be furnished with a flush seal arrangement. A resilient neoprene seal shall be securely attached to the frame along the invert, and shall extend to the depth of the guide groove.
   4. Seals: Gates shall be furnished complete with high molecular weight (U.H.M.W) polymer seals which contact the slide face.

D. Stop Gate Materials: The stop gates shall be constructed of the following materials:
   1. Slide Gates - Stainless Steel, type 316
   2. Fasteners - Stainless Steel, type 316
   3. Seals - (U.H.M.W) polymer seals
   4. Finish – Mill finish on all stainless steel
PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions. Installation of sluice gates and operators, flap gates and slide gates shall be in accordance with the requirements of AWWA C501 and as amended herein. The manufacturer of the sluice gates shall furnish all gates, suitably designed, so that anchorage to thimble can be performed at the designed locations.

3.02 FIELD SERVICE

A. The manufacturer of the gates shall supply a competent field service engineer to thoroughly check and inspect the slide, sluice, and flap gates after installation, place the gates in operation and make necessary adjustments, and instruct plant personnel in proper operating and maintenance procedures.

3.03 FIELD PAINTING

A. Non-submerged ferrous metal shall be painted in accordance with Section 09960. Submerged surfaces need not be field painted but shall be touched up if required.

3.04 FIELD LEAKAGE TESTS

A. All slide gates shall be given a field leakage test under the head conditions listed in the gate schedules on the Drawings or in these specifications. A qualified representative of the manufacturer shall be present to direct any adjustments required to reduce leakage to the specified amounts.

B. The leakage for slide gates shall not exceed 1.0 gpm per foot of seating or unseating perimeter at the design heads shown in the Schedule. If "J" seals are used, this shall be reduced to 0.5 gpm.

C. For individual gates, the absence of a leakage test requirement for either seating or unseating head in the Schedule or the fact that the test heads are lower than the expected operating heads shall not relieve the requirement for satisfactory functioning at operating conditions. The tests and test levels are limited by expected limitations on water levels that will be available at the time the tests must be performed.

END OF SECTION
SECTION 11215
UTILITY WATER PUMPING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Provide complete, tested and operating vertical turbine pump (P-401) with variable speed controller and hydropneumatic tank and submersible pump (P-402) as shown on the Drawings and as specified herein.

B. Related Sections:
   1. Section 11001: General Equipment and Mechanical Requirements
   2. Section 11002: Electric Motor Drives
   3. Section 15050: Piping, Valves and Accessories

1.02 REFERENCES

A. Hydraulic Institute.

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit the following as a single complete initial submittal in accordance with Section 01300:
   1. Product data to demonstrate that the equipment conforms to the Specifications.
   2. Motor data.
   3. Seismic anchorage certification and related sketch.
   4. Pump layouts and dimensions.
   5. Pump performance curves.

B. Performance Testing: Submit certified non-witnessed factory performance test results in accordance with the Hydraulic Institute. Receive favorable review of test results prior to shipping the equipment.

C. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

D. Affidavits: Submit affidavit from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full time operation.

1.04 QUALITY ASSURANCE

A. Equipment furnished under this Section shall be supplied by a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five years.
PART 2A – PRODUCTS (P-401 and Appurtenances)

2.01 MANUFACTURERS

A. Service Pump System Package: (P401) The pump system package consists of the following components: Goulds SSV Vertical Multi-Stage Pump, Goulds Aquavar Variable Speed Controller, and Goulds Hydro-Pro Water System Tank. The Engineer knows of no known equal.

B. Utility Water Supply Pump (P402, See Part 2B)

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. Pump Schedule: P-401

<table>
<thead>
<tr>
<th>Item</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of Pumps</td>
<td>1</td>
</tr>
<tr>
<td>Pump Type</td>
<td>4-stage vertical turbine</td>
</tr>
<tr>
<td>Primary Point</td>
<td>50 GPM @ 280 ft. TDH (full-speed curve)</td>
</tr>
<tr>
<td>Maximum Capacity</td>
<td>105 GPM @ 200 ft. TDH (full-speed curve)</td>
</tr>
<tr>
<td>Minimum Capacity</td>
<td>20 GPM @ 295 ft. TDH. (full-speed curve)</td>
</tr>
<tr>
<td>Maximum NPSH Required @ Maximum Capacity</td>
<td>14 ft.</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td>3450RPM</td>
</tr>
<tr>
<td>Motor Horsepower</td>
<td>7.5 HP</td>
</tr>
<tr>
<td>Manufacturer/Model</td>
<td>Goulds Model SSV</td>
</tr>
<tr>
<td>Suction Flange</td>
<td>2.0-inch</td>
</tr>
<tr>
<td>Discharge Flange</td>
<td>2.0-inch</td>
</tr>
<tr>
<td>Minimum Guaranteed Efficiency @ Primary Point</td>
<td>60 %</td>
</tr>
<tr>
<td>Gauge Range:</td>
<td></td>
</tr>
<tr>
<td>Suction</td>
<td>0 – 10 psi</td>
</tr>
<tr>
<td>Discharge</td>
<td>0 – 100 psi</td>
</tr>
</tbody>
</table>

B. Pumps shall operate without excessive noise or vibration over the full operating range indicated in the Pump Schedule.

2.03 EQUIPMENT

A. Provide pump/controller/hydropneumatic tank package including vertical turbine pump including bowl assembly, discharge flanges, electric motor, variable speed controller, hydropneumatic tank and required appurtenances. Comply with construction features of ANSI/AWWA E101 except where indicated differently in this Specification.

B. Seismic: Entire pump and installation including motor, piping, and fasteners shall comply with the seismic requirements for the project area.
C. Pump Construction:

1. Pump End Components
   a. The pump casing shall be of deep drawn, laser welded AISI 304L stainless steel and shall be capable of withstanding maximum working pressure of 360 psi. Piping connections shall be in-line and shall be compatible with ANSI raised face flanges.
   b. Wear Rings shall be provided within each stage. Wear rings must be self centered and easily replaceable.
   c. Impeller shall be of enclosed design and constructed of AISI 316L stainless steel. Impellers shall provide internal thrust balance in each stage.
   d. Diffuser Bowel – Each stage shall have a bowl with attached diffuser and be constructed of AISI 304L stainless steel.
   e. Seal Housing shall be of concave design and shall hold the seal faces below the topmost part of the pump casing.
   f. Mechanical Seal – The pump shaft seal shall be as follows:
      
      Rotary Seal - High Temperature Carbon  
      Stationary - Silicon Carbide Graphite Filled  
      Elastomer – Viton  
      Application – Treated Domestic Wastewater

   g. Shaft Sleeve and Bearing – The pump shall have shaft sleeves made of Tungsten Carbide and ceramic bearings. The shaft height shall be set with a standard spacer.

D. Pump Motor:

1. The pump drive motor shall be NEMA standard design TC frame suitable for vertical mounting and close coupled to the pump unit. Motors shall be of standard manufacturing catalogue design and must not use special bearings as thrust handling device.
   a. The motor rating shall be as follows:

      7.5 hp  
      3450 RPM  
      3-phase  
      60 Hz  
      460 volts  
      TEFC motor enclosure  
      High Efficiency with 1.15 Service Factor

   Motors shall be suitable for operation with an adjustable frequency drive (AFD) over the specified operating range of the pump and shall comply with Section 11002.

E. Controller: The pump controller shall be a variable speed pump controller, directly coupled to the motor.

1. The controller shall have the following features:
   a. The VFD shall provide an adjustable carrier frequency with IGBT power switching, and utilize PWM technology.
   b. The drive shall provide noiseless operation of the driving motor, short circuit and ground protection, and work with controlled sinusoidal current synthesis and dynamic over current limitations.
c. The VFD shall be one complete integrated unit including the variable frequency drive, programmable pump specific control logic, and include a NEMA 4 enclosure. Additional control panels, PLC's or other external devices, shall NOT be necessary to accomplish complete pump programming and variable speed control of pump and motor. Standard variable frequency drives that do not incorporate pump control logic as the primary control software; programming and features directly applicable to centrifugal pump applications shall not be considered equal.

2. Programming: The VFD shall provide an LCD two line display with 16 characters per line and programming keypad for data entry. Unit(s) shall utilize user-friendly front panel programming in three languages that displays pump and motor language in clear text. Three colored diodes shall signal 'power on', 'pump running' and 'fault'. Program settings shall be changeable and stored in non-volatile memory. Program settings shall be retained in memory in the event of loss of power to the controller, without the use of a backup battery. System operating pressure shall be clearly displayed in PSI or feet of head for ease of use and to provide an operator friendly interface. Additional parameters, where applicable, shall be displayed in units consistent with pumping systems. Generic control systems adapted from other applications shall not be considered equal. The settings and program in whole or part may be locked out with the use of an operator selectable password.

3. Standard system hydraulic settings shall include the following functions:
   a. loss of suction
   b. lack of NPSHA
   c. pump run-out protection
   d. dead head protection
   e. constant pressure setting with variable flow capability, constant flow with variable TDH (pressure) capability, quadratic differential flow calculation, system curve compensation, multiple pump operation with alternation, pump starting point with allowable, adjustable pressure drop, minimum speed with time delay, pressure of flow sensor error, overpressure shutdown and low flow shutdown.

4. Interface: The control board unit shall contain dry relay terminals which can be connected to external devices for operation of the following:
   a. Remote start and stop
   b. Low-pressure protection switch.
   c. Pump run relay.
   d. Pump fault relay.
   e. Analog output signal (0 – 10 Vdc) actual pressure.
   f. Analog input (4 – 20mA) sensor.
   g. Secondary analog input (4 – 20mA or 0 – 10 Vdc) offset signal.
   h. Multipump interface via RS485.
   i. Two pressure settings with one transducer (field programmable).
   j. The integrated microprocessor shall provide automatic start and stop of up to four variable speed controlled pumps, and enable automatic changeover for lead and lag pump sequencing without the use of external devices or timers.
   k. A stainless steel pressure transducer shall be included. All hardware and appropriate range transducer shall be provided by the pump control manufacturer to ensure complete compatibility with controller.

5. System Protection: The VFD shall provide a programmable automatic error reset of the pump system that will provide the following:
a. Up to five restarts, with a programmable time delay between each start. The pump controller shall provide a fault history with at least five previous fault codes.

b. The pump controller shall provide for programmable automatic test run of pumps during periods of down time, based on frequency and operating hours.

c. The pump controller shall incorporate motor thermal protection and drive temperature protection as standard equipment.

d. The pump controller shall be capable of monitoring and displaying total operating hours, and total motor run hours.

e. The VFD unit shall protect the variable frequency drive and motor from: overvoltage, undervoltage, phase loss, phase imbalance, motor overcurrent, ground fault and short circuit. The variable speed pump controller shall be UL, cUL, CE listed.

6. System Installation and Integration: A complete VFD pump controller instruction, operation, and programming manual shall be provided by the authorized supplier for the VFD. The instruction manual shall include a typical system design, installation instructions, programming instructions, and troubleshooting assistance. The VFD variable speed pump control system shall include the following:

   a. variable frequency drive
   b. microprocessor based PLC
   c. pump specific control logic
   d. pump, motor and transducer.

The variable speed pump system and components, shall be provided, installed and integrated by a single source entity. Complete system integration, setup, programming and warranty will be the responsibility of the factory-authorized representative.

2.04 ACCESSORIES

A. Hydropneumatic Bladder Tank:
   1. Provide an all-steel construction bladder tank with the following specifications:
      a. 32-gallon minimum total volume.
      b. Mechanical fit air valve for field adjustment of internal tank pressure.
      c. Deep drawn steel outer shell with a working pressure rating of at least 125 psi.
      d. Steel inner shell and insert to prevent over-pressurization of the bladder.
      e. Heavy duty butyl diaphragm.
      f. Polypropylene liner.
      g. Corrosion proof stainless steel base.

B. Provide suction and discharge pressure gauges for each pump with features and accessories in accordance with Section 15050. Gauge ranges shall conform to the listing in the Pump Schedule.

2.05 FINISHES

A. Provide pumps, motors and bases with the manufacturer's standard factory-applied paint finish except as noted.
PART 2B – PRODUCTS (P-402)

2.06 MANUFACTURERS
   A. The pump shall be manufactured by Barnes, ABS, Goulds, or equal.

2.07 PERFORMANCE AND DESIGN REQUIREMENTS
   A. The effluent pump shall be capable of meeting the following pumping conditions:
      1. Primary Point: 125 gpm @ 20 feet +/- 1.0 feet
      2. Maximum Capacity: 140 gpm @ 17 feet +/- feet
      3. Minimum Shutoff Head: 25 feet

2.08 EQUIPMENT
   A. 1. Provide a 3-phase, 230/460 V, submersible effluent pump with mechanical seals, cast-iron housing, stainless steel motor shaft and fasteners, and non-clog vortex impeller for pumping treated effluent. Pump shall be able to pass a ¾-inch sphere.

PART 3 - EXECUTION

3.01 INSTALLATION
   A. Install the pump unit(s) in strict conformance with manufacturer's installation instructions. Check pump and motor alignment according to the Standards of the Hydraulic Institute after complete unit has been installed at the site.

3.02 FIELD PAINTING
   A. Apply a final color coat of paint to the pump motor and discharge head in accordance with Section 09960.

3.03 FIELD TESTING
   A. Field test each pumping system in accordance with the manufacturer’s recommendations. For further requirements on performance tests, refer to Section 11001.

3.04 FIELD SERVICE
   A. The equipment manufacturer or supplier shall supply a competent field service engineer to thoroughly check and inspect the equipment after installation, place the equipment in operation, make necessary adjustments, calibrate instruments, and conduct field tests.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Furnish, install complete, and test two (2) submersible mixers, guide rail systems and crane hoists in the oxidation ditch as shown on the drawings and specified herein. The mixing equipment shall be provided by the supplier providing the oxidation ditch rotors and appurtenances.

1.02 GEAR DRIVEN SUBMERSIBLE MIXER SYSTEM DESCRIPTION

A. Design Requirements:
   1. Number of Submersible Mixers................................................................. 2
   2. Maximum Impeller Diameter, inches......................................................... 40

B. Performance Requirements:
   1. With both mixers in operation, provide sufficient mixing energy to impart a minimum channel velocity in the oxidation ditch of 1.0 fps without the brush rotors in operation.

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit the following as a single complete initial submittal in accordance with Section 01300:
   1. Product data fully describing all items proposed for use to demonstrate that the equipment conforms to the Specifications.
   2. Motor data.
   4. Shaft and impeller design criteria (stresses and critical speed).
   5. Seismic anchorage certification and related sketch.
   6. System layouts and/or schematics.

B. Performance Testing: Submit certified non-witnessed factory performance test results and/or calculations demonstrating that the equipment meets the performance requirements. Receive favorable review of test results and/or calculations prior to shipping the equipment.

C. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

D. Affidavits: Submit affidavits from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full-time operation.

1.04 QUALITY ASSURANCE
A. Qualifications: Both low speed vertical mixers furnished under this Section shall be supplied by a single manufacturer. Manufacturers of equipment furnished under this Section shall have been regularly engaged in the design and manufacture of the equipment for at least five years. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers named herein.

1.05 DELIVERY, STORAGE AND HANDLING

A. Immediately upon delivery to job site, place materials in area protected from weather. Use non-marring slings for loading, unloading and handling units to prevent rope or cable damage to surfaces and protective wrappings.

PART 2 - PRODUCTS

2.01 GEAR DRIVEN SUBMERSIBLE MIXER

A. General: A mixer assembly consisting of an electric motor driven mixer, single mast mixer mounting system, and crane shall be provided and erected as shown on the Drawings. The mixer mounting system shall be supported by the bottom of the tank and the walkway spanning the oxidation ditch. Additional supports are not permitted.

B. Manufacturer: Lakeside/Landia; Flygt ITT, or approved equal.

C. Mixer Construction: The mixer shall be for submerged service and capable of handling raw, screened wastewater. The mixer shall be able to be raised and lowered and removed for inspection. The mixer shall be of the integral gear, close-coupled, submersible type. Only drive units suitable for continuous submergence and 24 hour per day operation shall be acceptable. Major mixer components, excluding blades and mounting system, may be either cast iron protected by a factory applied primer and epoxy finish coat or stainless steel. All other metal components, including exposed nuts and bolts, shall be stainless steel.

D. Cable Entry: Cable entry shall be sealed with a compressed nitrile o-ring to prevent leakage and shall be an integral part of the stator housing.

E. Electric Motor: The mixer shall be provided with a constant torque, 3 phase, 60 Hz, 460 volt, 1800 rpm or less, motor designed for submerged operation. Motor horsepower shall be determined by the manufacturer to meet the specified conditions. The maximum allowable horsepower shall be 10.0 Hp. An embedded thermal sensor shall be used to monitor motor over-temperature, supplemental to the external motor overload protection.

F. Gears and Shaft: The gears shall be one-stage planetary reduction type designed for infinite life. The motor shaft shall be stainless steel. All bearings shall be designed for a minimum AFBMA L-10 bearing life of 100,000 hours based at full load and operating speed.
G. Seals: Each mixer shall be provided with 4 seals separating the various parts. The outer seal in the propeller hub shall be a nitrile rubber lip seal, sealing the propeller shaft and grease chamber from the media running on a stainless steel ceramic coated, exchangeable wear brush. The 2 inner seals on the propeller shaft shall be nitrile rubber lip seals insulating the propeller shaft grease chamber from the gearbox oil chamber. The fourth seal shall be a mechanical seal containing one stationary silicone carbide ring and one rotating silicon carbide part running in the oil for cooling and lubrication.

H. The mixer shall be provided with a grease chamber in the propeller hub for the shaft sealing system with a separate oil chamber for the gearbox.

I. Propeller: The propeller shall consist of 304 stainless blades integrated with a stainless steel shaft. The propeller shall be capable of handling solids, fibrous materials, sludge, and other matter normally found in wastewater.

J. Mixer Mounting System: The mixer manufacturer shall supply a single mast mounting system constructed of schedule 40 stainless steel. The mixer manufacturer shall provide all components, fasteners, and sufficient mast length to install the mixer mounting system complete in the oxidation ditch as shown on the Drawings. The mounting shall permit the mixer to be angled for flow and energy optimization. The mixer and mast must be able to be removed for inspection and maintenance without draining the oxidation ditch. The mixer manufacturer shall provide any special tools or equipment necessary for removal and inspection of these items.

K. Mixer Crane: The mixer manufacturer shall supply a manual crane to be mounted on the walkway above the mixer, as shown on the Drawings, for removal of the mixer for inspection and maintenance. The crane, winch, cable, and fasteners shall be 316 stainless steel. The crane shall be capable of hoisting the mixer above the guardrail and rotating the crane to the adjacent walkway. The crane shall come supplied and be installed with all cable, fasteners, and appurtenances as necessary for operation.

2.02 FINISHES

A. Painting: Apply manufacturer's standard factory finish.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in strict conformance with the manufacturer's installation instructions.

3.02 FIELD PAINTING

A. Apply a final color coat in the field to the equipment in accordance with Section 09960.
3.03 FIELD TESTING

A. Prior to acceptance, the equipment shall be tested to demonstrate to the Engineer that it is operating properly. Each mixer shall be run to demonstrate its ability to operate without overloading, jamming, or excessive vibration during normal operation. For further requirements on performance tests, refer to Section 11001.

3.04 FIELD SERVICE

A. Each equipment manufacturer shall supply a competent field service engineer to thoroughly check and inspect the equipment after installation, place the equipment in operation, make necessary adjustments, calibrate instruments, and conduct field tests. The services required shall also include on-the-job training of operators including safety procedures, operating instructions, and preventive maintenance procedures. Each manufacturer shall furnish a minimum of one man-day of field services.

END OF SECTION
SECTION 11240
SODIUM HYPOCHLORITE FEED EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Provide complete, tested and operating sodium hypochlorite feed equipment as shown on the Drawings and as specified herein. The system shall be composed of two (2) new hypochlorite feed pumps and appurtenances as specified herein.

B. Related Sections:
1. Section 09960: Protective Coatings
2. Section 10400: Identifying Devices
3. Section 11001: General Equipment and Mechanical Requirements
4. Section 11002: Electric Motor Drives
5. Section 13416: Chemical Storage Tanks
6. Section 15050: Piping, Valves and Accessories
7. Section 17110: Analytical Instruments
8. Section 17140: Level Measurement

1.02 REFERENCES

A. Uniform Fire Code (UFC).
C. National Electrical Manufacturers Association (NEMA).

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit the following as a complete initial submittal in accordance with Section 01300:
1. Product data to demonstrate that equipment conforms to the specifications.
2. Motor data as required in Section 11002.
3. Pump layouts and dimensions.
4. Pump performance data.
5. Materials of construction.

B. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists for each system specified.

C. Affidavits: Furnish affidavits from the manufacturers stating that each system has been properly installed, adjusted and tested and is ready for full-time operation.

D. Material Safety Data Sheets (MSDS) for each chemical to be used during testing of each chemical feed system.
1.04 QUALITY ASSURANCE

A. All products furnished under this section shall be from a single manufacturer who has been regularly engaged in the manufacture of the pumps specified for at least five years. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by the manufacturers specifically named herein.

B. All components and equipment shall be suitable for bulk (as delivered) chemicals specified as follows in percentage by weight of solution (approximate):

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Concentration</th>
<th>Approximate Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Hypochlorite</td>
<td>12.5%</td>
<td>1.2</td>
</tr>
</tbody>
</table>

C. Comply with the Following Regulatory Standards:
   1. Uniform Fire Code, especially Article 80, Hazardous Materials with local amendments, if any.
   2. Uniform Building Code, especially Chapter 9, with local amendments, if any.

PART 2 - PRODUCTS

2.01 PERISTALTIC PUMPS

A. Peristaltic Pumps: Provide seal-less peristaltic type hose pump. Pump shall be Watson-Bredel; Autoclude; or equal.

B. Pump Schedule:

<table>
<thead>
<tr>
<th>Qty</th>
<th>Service</th>
<th>Capacity Gal/hr (Min)</th>
<th>Capacity Gal/hr (Max)</th>
<th>Discharge Pressure (psi)</th>
<th>1st Named Mfrs. Model No.</th>
<th>Speed Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sodium Hypochlorite (P-481)</td>
<td>3.0</td>
<td>15</td>
<td>15</td>
<td>504U/RL2, 220 rpm max, 1/4&quot; tubing</td>
<td>Manual</td>
</tr>
<tr>
<td>1</td>
<td>Sodium Hypochlorite (P-482)</td>
<td>0.2</td>
<td>0.9</td>
<td>12</td>
<td>504U/RL2, 55 rpm max, 1/8&quot; tubing</td>
<td>Manual</td>
</tr>
</tbody>
</table>

C. Materials of Construction: All equipment and accessories in contact with the pumped fluid shall be chemically and physically compatible.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Sodium Hypochlorite (12.5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Head</td>
<td>Epoxy coated Mazak</td>
</tr>
<tr>
<td>Rotor</td>
<td>Chrome plated Mazak</td>
</tr>
<tr>
<td>Cover</td>
<td>Polycarbonate</td>
</tr>
<tr>
<td>Tube</td>
<td>Marprene®</td>
</tr>
</tbody>
</table>

D. Accessories:
   1. Hose Failure Switch (Tube Monitor): Provide a factory-mounted conductivity leak sensor for each pump.
   2. Spare Hose: Provide one spare hose.
3. Control: Pump controller with manual speed control and remote operation of start/stop via contact.

E. Motors: Drive motors shall be 120VAC, 1 phase. Additional requirements shall be as specified in Section 11002.

2.02 CHEMICAL FEED SYSTEM ACCESSORIES

A. General: Materials of construction shall be satisfactory for continuous exposure to the hereinbefore-listed chemicals.

B. Calibration Cylinders: Provide clear PVC graduated calibration cylinders. Provide anti-splash caps for each calibration cylinder. Install calibration cylinder assemblies on suction side of all metering pumps.

C. Piping Specialties:
   1. Provide properly sized pulsation dampeners on the suction and discharge lines of each metering pump as shown on the Drawings.
   2. Provide pressure relief and backpressure valves when shown on the Drawings. Valves shall be of PVC. Valves for caustic and hypochlorite shall have flanged connections only. Valves shall be field adjustable and installed where shown on the Drawings and/or as recommended by manufacturer. Valves shall be by JESCO America Corporation; Wallace & Tiernan; or equal.

D. Rotameters shall be provided as specified in Section 15050.

E. Chemical Piping Flex Connections: Provide hoses made from the materials as shown in the table below where shown in the chemical piping systems on the Drawings. Hoses shall be not less than 6 inches long at the suction and discharge connections to the metering pumps. Hoses at tanks shall be not less than 18 inches long. Each chemical metering pump shall have a flex connection in the suction and discharge piping. Each tank shall have a flex connection in all suction piping runs shown on the Drawings.

<table>
<thead>
<tr>
<th>Chemical System</th>
<th>Flex Connection Hose Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Hypochlorite</td>
<td>PVDF, Tygon, PVC (Reinforced)</td>
</tr>
</tbody>
</table>

F. Pump Base:
   1. Provide pump bases/stands as shown on Drawings.
   2. Metering pump bases shall be concrete pads, 316 SS stands or fiberglass stands.
   3. Each base shall be suitably sized for attachment of the pumps shown. The pumps shall be positioned on the base/stand such that the suction and discharge piping connection extends past the edge of the base/stand.

2.03 SPARE PARTS

A. Furnish spare parts that are necessary for continued operation of the equipment and any special tools required for replacement of parts and adjustment of equipment. For each peristaltic pump furnish two spare hoses.

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January 2004
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PART 3 - EXECUTION

3.01 INSTALLATION

A. General: The chemical feed system equipment shall be installed in strict conformance with the manufacturer's installation instructions and with favorably reviewed shop drawings. Check out of the final installation, startup, calibration and instruction of operating personnel shall be performed by an authorized representative of the manufacturer.

3.02 FIELD PAINTING

A. Field paint in accordance with Section 09960.

3.03 IDENTIFICATION

A. Identification of the health, flammability, and reactivity of each chemical shall be affixed above each chemical feed area. See Specification Section 10400.

3.04 FIELD TESTING

A. After successfully completing leak tests of the chemical storage tanks (Section 43446), each chemical feed system shall be tested for four hours with water. Each chemical system shall be tested against a closed discharge solution line to test pressure relief valve operation. This shall be performed for each metering pump and shall be witnessed by the Engineer. Only after satisfactory testing with water and complete draining and removal of water from the chemical system, and thorough drying, which may require blowing dry air through the pipelines, may the final test with chemical be allowed to proceed. After draining the test water, hand wipe, dry and blow dry air through chemical feed pipelines to leave the chemical pipelines clean, dry and ready for conveyance of the chemical; then test each chemical feed system in all operational and alarm modes to show conformance with these Specifications. Provide sufficient chemical (approximately 55 gallons each), for the test. The chemicals used shall be favorably reviewed by the Engineer prior to the test. Each chemical metering pump shall be (chemical solution) calibrated and tested throughout its pumping range. The MSDS for each chemical shall be on hand during the testing of the chemical feed system.

B. The Contractor shall be responsible for the disposal of the test material(s).

3.05 FIELD SERVICES

A. Provide an engineer or technician from the chemical feed equipment supplier(s) to make all adjustments and monitor the testing specified in paragraph 3.04 above.

END OF SECTION
SECTION 11303
SUBMERSIBLE WASTEWATER PUMPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish complete, tested and operating, submersible sump pumps, as shown on the Drawings and as specified herein.

1.02 SUBMITTALS

A. Shop Drawings: The Contractor shall submit shop drawings for favorable review of the Pumps. Include sufficient data to show that equipment conforms to Specification requirements, including a prototype pump performance curve for each application.

B. Manuals: The Contractor shall furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

C. Affidavits: The Contractor shall furnish affidavits from the manufacturer stating that the pumps have been properly installed and tested, and each is ready for full time operation.

D. Performance Testing: Certified non-witnessed factory performance tests in accordance with Hydraulics Institute Standards are required for each pump. Obtain favorable review from the Engineer prior to shipment of the pumps.

1.03 QUALITY ASSURANCE

A. All equipment furnished under this Section shall: (1) be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least 5 years; and (2) be demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.

1.04 WARNING SIGNS

A. Each piece of driven machinery which can be started manually by any control station not within 15 feet of the machine, or which can be controlled automatically by any means, shall be identified with a warning sign inscribed:

CAUTION

THIS MACHINE IS REMOTELY CONTROLLED
AND MAY START AT ANY TIME
The word "CAUTION" shall be in yellow block letters on black panel at the top of the sign, which shall have yellow background and text in black block letters. Signs shall be fabricated from 30-gauge copper bearing steel and finish shall be high baked enamel; the finished signs shall be weather resistant. Signs shall be ten inches wide by seven inches high. Signs shall be located in prominent locations at machines and shall be fastened to surfaces previously specified for nameplates.

PART 2 - PRODUCTS

2.01 SUBMERSIBLE WASTEWATER PUMPS

A. General: Pumps P-205, P-206, shall be heavy-duty, submersible, non-clog, centrifugal, quick disconnect sump pumps. The pumps shall be capable of operating in the range of capacity specified on a continuous basis with no detrimental effects to the pump or motor.

B. Pump Schedule: The pump operating characteristics shall be as follows.

1. Pump Number: P-205 and P-206
   Pump Title: In-Plant Pump Station
   Maximum Capacity (gpm @ TDH): 700 gpm @ 17 ft
   Operating Point (gpm @ TDH): 545 gpm @ 23 ft
   Minimum Capacity (gpm @ TDH): 200 gpm @ 37 ft
   Minimum Shutoff Head: 48 feet
   Maximum Synchronous Speed: 1750 rpm
   Pump Drive Type: Constant Speed
   Nominal Motor Horsepower Size: 5 HP
   Required minimum efficiency at operating point flow rate (percent): 65%
   Basis of Design: Flygt NP impeller
   Manufacturer: Flygt ITT

C. Pump Construction:
   1. General:
      a. The pumps shall be designed to permit sump-top removal of pumping units from the wet well for inspection or service without disconnecting or disturbing the discharge piping. The pump connection shall be metal to metal or with secondary O-ring seal. The design shall permit the pumps when lowered into place to be automatically connected to the discharge piping by positively locking the volute in position to prevent any axial or lateral movement. There shall be no need for personnel to enter the wet well when pump inspection or service is required. Pump assembly, including motor, pump and cable accessories must be rated for Class 1, Division 1 hazardous environment, explosion proof, group C & D.
      b. Lifting assemblies and discharge mating flanges, shall be spark proofed, Factory Mutual Standards.
   2. Piping, Fittings, and Appurtenances: Each pump shall be furnished with quick-disconnect discharge elbow, Schedule 40 pipe rails (or stainless steel cables), upper guide rail bracket, intermediate guide rail bracket, rail-guided lifting
assembly, and stainless steel chain of sufficient strength to raise and lower pump. All guide rail components and fasteners shall be type 304 stainless steel. Guide cable system of stainless steel will be acceptable in lieu of pipe rails.

3. Pump Castings: Castings shall be of cast iron or semi-steel of uniform quality and free from blowholes, porosity, hard spots, shrinkage defects, cracks and other injurious defects. The casings shall be designed to permit replacement of wearing parts. Joints shall be properly sealed with O-rings and shall not leak under a test pressure equal to 50 percent greater than the pump discharge pressure or the total dynamic head, whichever is greater. Passageways shall permit smooth flow and shall be free from sharp turns and projections.

4. Impellers: Impellers shall be of cast iron, cast steel, or an alloy suitable for the service required. The impellers shall be smooth and free flowing and shall have sufficient clearance to permit objects in the sewage that enter the pump to pass into the discharge pipe. Each impeller shall be accurately fitted and keyed, splined, or threaded on the shaft, and locked in such a manner that lateral movement will be prevented and reverse rotation will not cause loosening.

5. Balance: All rotating parts of the equipment shall be in such balance, mechanically and hydraulically, as to operate throughout the required range without excessive end thrust, vibration or noise.

6. Shafts: Shafts shall be steel, shall be of sufficient size and strength to perform the work required, and shall be adequately provided with alignment bearings.

7. Bearings: Bearings subject to submersion shall be ball bearings manufactured from high-grade bearing alloy. Bearing shall have a minimum B-10 life of 18,000 hours.

8. Mechanical Seals: Each pump shall be equipped with either tungsten carbide or silicon carbide seals.

9. Electrical Motors: Submersible, 1800 rpm, 5 HP (P-205 and P-206), 480 Volt, 3 phase, 60 Hertz. See Section 11002 for detailed motor specifications.

10. Miscellaneous Metals: Bolts, nuts, anchors, washers, and all other types of supports necessary for the installation of the pumps and drive units shall be furnished and shall be of Type 304 stainless steel.

11. Shop Painting: Pump, motor, and accessories shall be factory applied and finish painted in accordance with the manufacturer's standard.

D. Access Frame and Cover: Access to each pump shall be furnished with a reinforced aluminum access cover and frame in accordance with Section 08307 of these specifications.

E. Pressure Gauges: Provide discharge pressure gauges for each pump with features and accessories in accordance with Section 15050.

F. Lifting Device: Provide 25-feet of 316 chain of suitable size to extract the pump.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions.
3.02 FIELD SERVICE

A. The manufacturer of the pumps shall supply a competent field service engineer to thoroughly check and inspect the pumps after installation, place the pumps in operation and make necessary adjustments, and instruct owner's personnel in proper operating and maintenance procedures before and after installation.

3.03 FIELD PAINTING

A. Pumps and appurtenances shall be touched up as required.

3.04 FIELD TESTING

A. Each pump shall be field tested to verify that they are operating properly and are able to pump the design flow rate. Field testing shall be observed by the Engineer. For further requirements on performance tests, refer to Section 11001.

END OF SECTION
SECTION 11305

SCUM PUMP
(VERTICAL CHOPPER PUMPS)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish a complete, tested and operating, vertically configured chopper pump for scum pit service, as shown on the Drawings and as specified herein.

1.02 SUBMITTALS

A. Shop Drawings: The Contractor shall submit shop drawings for favorable review of the Pumps. Include sufficient data to show that equipment conforms to Specification requirements, including a prototype pump performance curve for each application including curves at maximum and minimum speed. Submit certification that pumps and motors are suitable for adjustable speed service. Submit in a single complete initial package under the Product Review category.

B. Manuals: The Contractor shall furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

C. Affidavits: The Contractor shall furnish affidavits from the manufacturer stating that the pumps have been properly installed and tested, and each is ready for full time operation.

D. Performance Testing: Certified non-witnessed factory performance tests in accordance with Hydraulics Institute Standards are required for each pump. Obtain favorable review from the Engineer prior to shipment of the pumps.

1.03 QUALITY ASSURANCE

A. All equipment furnished under this Section shall: (1) be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least 5 years; and (2) be demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.

B. Approved Manufacturer: Pump shall be Model V3FR-062 as manufactured by Vaughan Co., Inc. or approved equal.

1.04 WARNING SIGNS

A. Each piece of driven machinery which can be started manually by any control station not within 15 feet of the machine, or which can be controlled automatically by any means, shall be identified with a warning sign inscribed:

1 Warnings signs may be included in Section 10400, if this section is included.
CAUTION

THIS MACHINE IS REMOTELY CONTROLLED
AND MAY START AT ANY TIME

The word "CAUTION" shall be in yellow block letters on black panel at the top of the sign which shall have yellow background and text in black block letters. Signs shall be fabricated from 30-gauge copper bearing steel and finish shall be high baked enamel; the finished signs shall be weather resistant. Signs shall be ten inches wide by seven inches high. Signs shall be located in prominent locations at machines and shall be fastened to surfaces previously specified for nameplates.

PART 2 - PRODUCTS

2.01 CHOPPER SCUM PUMPS

A. General: Pump shall be a vertical wet well chopper pump specifically designed to pump waste solids at heavy consistencies without plugging or dewatering of the solids. Materials shall be chopped/macerated and conditioned by the pump as an integral part of the pumping action. The pump must have demonstrated the ability to chop through and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications. The pumps shall be capable of operating in the range of capacity specified on a continuous basis with no detrimental effects to the pump or motor.

B. Pump Schedule: The pump operating characteristics shall be as follows.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Capacity (gpm @ TDH)</td>
<td>180 @ 20 ft</td>
</tr>
<tr>
<td>Operating Point (gpm @ TDH)</td>
<td>125 @ 23 ft</td>
</tr>
<tr>
<td>Minimum Capacity (gpm @ TDH)</td>
<td>85 @ 25 ft</td>
</tr>
<tr>
<td>Minimum Shutoff Head</td>
<td>28 feet ± 3 ft</td>
</tr>
<tr>
<td>Maximum Synchronous Speed</td>
<td>1750 rpm</td>
</tr>
<tr>
<td>Pump Drive Type</td>
<td>Constant Speed</td>
</tr>
<tr>
<td>Nominal Motor Horsepower Size</td>
<td>5 HP</td>
</tr>
<tr>
<td>Manufacturer and Pump Type</td>
<td>Vaughan V3FR-062 or equal</td>
</tr>
</tbody>
</table>

C. Pump Construction:

1. Casing: Shall be of semi-concentric design, with the first half of the circumference being cylindrical beginning after the pump outlet, and the remaining circumference spiraling outward to the 150 lb. flanged centerline discharge. Casing shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics.

2. Impeller: Shall be semi-open chopper type. Chopping/maceration of materials must be accomplished by the action of the curved, cupped and sharpened leading edges at the bottom of the impeller blades as they move across the cutter bar, creating a smooth efficient slicing effect. Pump out vanes must be provided across the entire diameter of the impeller on the backing plate, in order to reduce pressure in the seal area, and to draw lubricant down from the reservoir should seal leakage occur. The impeller shall be held in place with a key, shall have no axial adjustments or set screws, and shall not extend past...
the cutter bar. The impeller shall be cast steel and heat treated to a minimum 60 Rockwell C Hardness, and dynamically balanced.

3. Cutter Bar: Shall be a single cast component recessed into the pump bowl, with a funnel shaped inlet opening. As a part of the casting, segment bars shall extend inwardly, to within .015" (0.38mm) of the cutter nut. The set clearance between the cutter bar and impeller shall be adjustable to .005" to .020" (0.13mm to 0.5mm). The cutter bar shall be cast steel and heat treated to a minimum 60 Rockwell C Hardness.

4. Upper Cutter: The impeller pump-out vanes shall be specially modified to shear against an upper cutter assembly mounted into the back side of the casing, in order to eliminate any build up of rags, hair, or other stringy material in the seal area or between the impeller and the pump casing. The upper cutter shall consist of no more than 2 cutting anvils to minimize the potential for binding. The set clearance between the impeller and upper cutter shall be adjustable to .010" (0.25mm) or less. The upper cutter shall be cast steel and heat treated to a minimum 60 Rockwell C Hardness.

5. Cutter Nut: The cutter nut shall be used to affix the impeller to the shaft, and to eliminate binding or wrapping of stringy materials at the pump inlet. The cutter nut shall consist of a hex head sufficiently sized for ease of removal, and shall include an integral cast anvil which shears against the adjacent surface of the segment bars on the cutter bar. The cutter nut shall be cast steel and heat treated to a minimum 60 Rockwell C Hardness.

6. Shafting: The pump shaft and impeller shall be supported by ball bearings. Pump shafting shall be heat treated steel, adequately sized to minimize deflection during solids chopping. Pumps 4 feet (1.2 meters) and longer shall be fitted with a shaft extension to facilitate assembly and provide ease of maintenance.

7. Pump Support Column: The shaft column shall be 4" (101.6mm) O.D. SCH 40 carbon steel pipe, welded to steel flanges and machined with piloted bearing fits for concentricity of all components. All support columns tubes shall be leak tested. Distance between shaft bearings shall not exceed critical speed dimensions.

8. Bearings: Shall all be oil bath lubricated by I.S.O. Grade 46 turbine oil, with the exception of the top bearings, which shall be greased packed. The bearings shall have a minimum B-10 life rated 100,000 hours.

9. Thrust Bearings: Shaft thrust in both directions shall be taken up by either a double-row angular contact ball bearing or by two back-to-back mounted single-row angular contact ball bearings. A mechanical seal shall isolate the bearings from the pumped media.

10. Mechanical Seal: Shall be 316 stainless steel cartridge type, and fitted with silicon carbide seal faces to provide long life expectancy in the presence of grit and abrasive solids. The seal shall include a 316 stainless steel shaft sleeve, with the seal tension held integral to the cartridge assembly. Seal shall be tested for flatness within 2 Helium light bands under a Helium light source and optical flat. All seal elastomers shall be Viton. Remaining pump elastomers shall be Buna N.

11. Automatic Oil Level Monitor: Shall be located above the mounting plate and be fitted with an internal oil level switch to detect oil level and shut off the motor in event of low oil level. A sensitive relay, intrinsically safe shall be included for mounting in the motor control panel.
12. Pump Discharge Pipe: The pump assembly shall be mounted vertically on a common steel base plate with 150 LB. ANSI standard discharge flange.

13. Pump Base Plate: Shall be fabricated carbon steel, 1/2" (12mm) minimum thickness, and shall include lifting lugs.

14. Stainless Steel Nameplates: Shall be attached to the pump and drive motor giving the manufacturer's model and serial number, rated capacity, head, speed and all pertinent data.

D. Drive Motor
   1. Drive motor shall be 5 HP, 1800 RPM, 460 volts, 3 phase, 60 hertz, class 1, division 1, group D, explosion proof, 1.0 service factor. The motor shall be sized for non-overloading conditions under all conditions.

E. Options
   1. Recirculation Valve Assembly of ductile iron construction with 316 stainless steel valve disk, manually operated for recirculation or discharge. Reach rods through deck plate with handles shall be provided for operation.
   2. Recirculation Nozzle of 1018 steel including nozzle deflector that is adjustable 180 degrees horizontally and 45 degrees vertically.
   3. Explosion Proof Automatic Valve Actuator: An electrically operated valve actuator shall position the valve for pumpout or mixed operation. Unit shall be double-sealed, watertight, Class 1, Div. 1, Groups C&D, 110 volt, single-phase power, and shall be capable of producing 92 ft. lbs. of actuation torque. Actuator settings shall be performed via a non-intrusive infrared setting tool. A manual handwheel and a clutch shall be provided for manual override.
   4. Quick disconnect system: Pump shall be supplied with a quick disconnect system on the discharge piping. System shall be manufactured by Vaughan Co. Inc., Model number WW3QD. The system shall allow the pump to be removed without the need to remove any discharge flange fasteners. System shall consist of an O-ringed male receptacle with a 316 stainless steel funnel shaped female socket.

F. Surface Preparation
   1. The pump unit shall be degreased and coated with acrylic epoxy paint. Base plate and motor stool shall be powder coated with 3M Scotchcoat.

G. Pressure Gauges
   2. Provide discharge pressure gauges for each pump with features and accessories in accordance with Section 15050.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions.
3.02 FIELD SERVICE

A. The manufacturer of the pumps shall supply a competent field service engineer to thoroughly check and inspect the pumps after installation, place the pumps in operation and make necessary adjustments, and instruct owner's personnel in proper operating and maintenance procedures before and after installation.

3.03 FIELD PAINTING

A. Pumps and appurtenances shall be touched up as required.

3.04 FIELD TESTING

A. Each pump shall be field tested to verify that they are operating properly and are able to pump the design flow rate. Field testing shall be observed by the Engineer. For further requirements on performance tests, refer to Section 11001.
PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Equipment and incidentals required to provide one (1) polymer feed system as specified herein.

1.02 SYSTEM DESCRIPTION

A. Power: 120v / 1 phase/ 60 Hz/ 20 amps

B. Equipment included with the polymer system includes:
   1. Mixing Chamber
   2. Dilution water controls
   3. Neat polymer pump
   4. System Controls
   5. Spill Pallet and Ramp and 55-gallon Drum Cart.

C. The polymer system shall be a skid mounted system with interconnecting piping and wiring complete within skid limits.

D. Multi-Zone Mixing Chamber
   1. Polymer and water shall be mixed in a chamber designed to create sufficient mixing energy to activate the polymer.
      a. Design shall include a motor-driven impeller that will create high fluid sheer.
      b. Solution shall undergo a tapered mixing intensity slope as it exits the initial sheer zone and passes through a second zone, isolated by a baffle.
      c. Polymer activation efficiency shall be consistent over the dilution water range.
   2. Mixing chamber shall be transparent to allow viewing of mixing intensity. Opaque mixing chambers shall be unacceptable.
   3. Impeller shall be driven by a 1 HP maximum washdown duty motor.
      a. Motor shall be TEFC.
      b. Impeller speed shall be 3450 rpm, minimum.
      c. Motor shall be direct-coupled to impeller shaft.

E. Dilution Water Control
   1. Dilution water shall be split into two streams. Primary water flow shall supply the mixing chamber.
      a. Secondary water flow shall be used to post dilute the activated polymer stream.
      b. These two streams shall be completely blended by a static mixer prior to exiting the unit.
   2. Unit shall have an electric solenoid valve for on/off control of total dilution water flow.
3. Flow indicators and flow control valves shall be provided for each dilution water stream.
4. Dilution water and solution output connections shall include 304 stainless steel unions connected to the chassis.

F. Pump
1. Unit shall have a neat polymer metering pump.
   a. Pump shall be positive displacement, diaphragm type.
   b. Polymer pump head shall be fabricated of clear acrylic and shall have a priming port.

G. Controls
1. Unit shall be controlled through an on-off-remote circuit controlled by a three-position switch.
   a. In the remote switch position, the unit shall accept a run signal. Unit is manually controlled in the on position.
2. Unit shall accept a 4-20 mA analog signal to pace the polymer metering pump.
   a. This signal shall be processed by a pump controller that may be mounted remotely.
   b. The controller shall have an LCD readout of pumping strokes per minute (or hour), a stroke frequency touchpad pump control and a mode touchpad (internal-off-external) for pacing signal selection.
3. Unit shall detect loss of water flow, sensing that water flow has been interrupted for any reason, will place the polymer pump and mix chamber on standby and will restart it automatically when flow is restored.
4. An integral timer shall monitor loss of flow and energize contacts indicating alarm after 15 seconds of continuous loss.

H. Accessories
1. Calibration cylinder: A suitably sized calibration cylinder shall be supplied for the neat polymer feed pump. Cylinder shall be mounted to frame with PVC isolation, ball valves. Cylinder shall be calibrated in mL, and be constructed of clear PVC with slip on cap and ½ inch NPT vent connection.
2. Pressure reducing valve: A suitably sized pressure reducing valve shall be supplied for installation in the dilution water line. Pressure reducing valve shall be constructed of bronze with adjustable output pressure of 25-75 psig to reduce incoming line pressure variations. Pressure reducing valve shall be as manufactured by Watts Regulator model U5 or U5B.
3. Drumstick: A rigid drumstick suitable for mounting in the neat polymer drum bunge or vent connection shall be supplied to completely evacuate the drums contents. The drumstick shall be supplied with 2 inch NPT and ¾ inch NPT connections for connection to either port. Drumstick construction shall be PVC.
4. Drum Mixer: A bayonet mount drum mixer shall be supplied for mixing neat polymer drum contents. Mixer shall include a ½ hp, 1725 rpm TEFC motor with 28 inch long mixer shaft, (2) 4 inch long collapsible mixing blades, 8 foot power cord and on/off switch. Mounting plate shall include 2 inch bung mount and shall be constructed of mild steel with powder epoxy coating. Electrical requirements shall be 120 VAC/1 phase/60 Hz –74. Amps.
5. Spill Pallet and Ramp: Approximate dimensions: 100" x 53" (L x W) to provide at least 60 gallons of containment volume. The deck of the pallet shall be no more than 7-inches off the floor surface. The pallet shall be constructed of polyethylene. The pallet deck shall have a total bearing capacity of at least 5,000 lbs. The ramp shall securely lock into the side pallet and provide an even landing to the pallet. The pallet shall be manufactured Enpac Corporation or equal.

6. Drum Cart: The drum cart shall pick up, cradle, and transport a 55-gallon drum. The construction shall be of double-welded 1-1/4" diameter tube steel frame, coated for corrosion protection and capable of 1,000 pound capacity. Wheels shall be polyolefin roller wheels. The cart shall be designed to allow easily rotation of the drum to the draining position as shown on the Drawings. In the rotated position, the drain height shall be approximately 14". The cart should measure approximately 62" high x 24" wide (16-1/2" wide at nose). Main wheels are 10" diameter x 2-1/2" wide. Rear wheels are 6" diameter x 2" wide. The cart shall be supplied by BA-INDUSTRIAL, Bunch, OK, or equal.

I. Connections – Plumbing
   1. Dilution water inlet, 1½" FNPT
   2. Neat polymer inlet, ½" FNPT
   3. Solution discharge, 1½" FNPT

J. Connections – Electrical
   1. Standard, grounded male plug – 120 / 1/ 60, 20 amps
   2. Plug in connection – 4-20 mA signal input
   3. Terminal blocks – dry contact input for remote start
   4. Terminal blocks – dry contact alarm output
   5. Terminal blocks – dry contact run output
   6. Terminal blocks – control switch status output

K. Dimensions
   1. Frame – 36" wide x 20" deep x 40" high (92x41x102 cm)

L. Materials of Construction
   1. Structural frame – 304 stainless steel
   2. Plumbing – PVC
   3. Mixing chamber – PVC, acrylic

M. Performance
   1. Dilution water –120-1200 gph primary mixing
   2. 120-1200 gph post dilution
   3. Metering pump –0.5-10.0 gph neat polymer

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit the following as a single complete initial submittal in accordance with Section 01300:

   1. Product data fully describing all items proposed for use to demonstrate that the equipment conforms to the Specifications.
B. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

C. Affidavits: Submit affidavits from the manufacturer stating that the equipment has been properly tested and is ready for full-time operation.

PART 2 - PRODUCTS

2.01 MANUFACTURER / MODEL

A. Model M2400-d10AA by Stranco PolyBlend, equivalent product by DynaBlend.
   L4-D.

2.03 FINISHES

A. Painting: Factory applied.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the polymer feed system in accordance with the Plans and Specifications and the manufacturer's instructions.

3.02 FIELD TESTING

A. Unit shall be tested on-site to insure proper operation.

END OF SECTION
SECTION 11310A

VERTICAL NON-CLOG CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish complete, tested and operating, the equipment as shown on the Drawings and as specified herein.

B. Work Included in This Section:

C. Names of Equipment
1. RAS Pumps
2. WAS Pump

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings for the pumps and motors. Include sufficient data to show that equipment conforms to Specification requirements, including prototype performance curves, motor data, and seismic anchorage certification and description. For each pump, submit information on the moment of inertia of the rotating elements in units of pounds-feet squared including weight and radius of gyration. Shop Drawings for the pumps, motors and drive shaft assembly shall be submitted as a complete initial package for the coordinated system, including reed critical frequency calculations and pump setting and installation drawings showing connection to suction piping.

B. Factory Testing: Each pump shall be factory and field tested. Certified non-witnessed factory performance tests in accordance with Standards of the Hydraulic Institute are required for each pump, including but not limited to, determination of head-capacity curves, efficiency, power, speed and net positive suction head required. The Contractor shall provide the Engineer with these test results. Upon receipt of the Engineer's favorable review, the Contractor may have the pumps shipped to the job site. Motor tests shall be conducted as required in Section 11002.

C. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

D. Affidavits: Furnish affidavits from the manufacturers stating that the equipment has been properly installed and tested and is ready for full time operation.

1.03 QUALITY ASSURANCE

A. All equipment furnished under this Section shall be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at
least 5 years. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.

1.04 SEISMIC PROTECTION
A. Submit seismic design certifications and anchorage sketches in accordance with Section 01190 for the equipment in this Section.

1.05 WARNING SIGNS
A. Each piece of driven machinery, which can be started manually by any control station not within 15 feet of the machine, or which can be controlled automatically by any means, shall be identified with a warning sign inscribed:

CAUTION

THIS MACHINE IS REMOTELY CONTROLLED
AND MAY START AT ANY TIME

The word "CAUTION" shall be in yellow block letters on black panel at the top of the sign, which shall have yellow background and text in black block letters. Signs shall be fabricated from 30-gauge copper bearing steel and finish shall be high baked enamel; the finished signs shall be weather resistant. Signs shall be 10 inches wide by 7 inches high. Signs shall be located in prominent locations at machines and shall be fastened to surfaces previously specified for nameplates.

1.06 RESPONSIBILITY
A. The pump-motor system shall be furnished by the pump manufacturer, who shall be responsible for the coordination and performance of the pump-motor system. The responsibility shall extend to certification of field installation and meeting requirements for field installed performance, including meeting vibration limits for the vertical non-clog centrifugal pumps.

PART 2 - PRODUCTS

2.01 VERTICAL NON-CLOG CENTRIFUGAL PUMPS
A. General: Furnish and install factory-assembled electric motor and pump assembly complete with all accessories, including components and special trim items necessary for proper pump operation when pumping raw sewage. The pump manufacturer shall be responsible for the mating of the new pumps to the new piping and valves. The pump manufacturer shall coordinate with the Contractor to furnish any and all adapters, couplings and fittings to ensure the proper installation and proper functioning of the system.

B. Pump Schedule: The required pump characteristics shall be continuously declining and shall be as follows:
I. Pump Number
   Pump Title
   Shut-Off Head (Zero Flow)
   Design Operating Point
   Maximum Operating Point
   Minimum Operating Point
   Maximum Speed
   Adjustable Speed Range
   Maximum Motor Horsepower
   Minimum Pump Efficiency at Design Operating Point
   Motor Data (volts/phase/Hertz)
   Net Positive Suction Head Required (NPSHR)
   Impeller Diameter
   Minimum Size (Suction x Discharge)
   Minimum Sphere Passage

   P-500, P-501, and P-502
   RAS Pump
   0 gpm @ 26 ft
   500 @ 16.5 ft (based on full speed curve)
   665 @ 13.75 ft (based on full speed curve)
   280@ 20 ft (based on full speed curve) 865 rpm
   865-285 rpm
   5 HP
   70%
   480/3/60 (rated for AFD duty)
   Not more than 10 feet at maximum flow
   10.0 inches
   4 x 6 inches
   3 inches

II. Pump Number
   Pump Title
   Shut-Off Head (Zero Flow)
   Design Operating Point
   Maximum Operating Point
   Minimum Operating Point
   Maximum Speed
   Adjustable Speed Range
   Maximum Motor Horsepower
   Minimum Pump Efficiency at Design Operating Point
   Motor Data (volts/phase/Hertz)
   Net Positive Suction Head Required (NPSHR)
   Impeller Diameter
   Minimum Size (Suction x Discharge)
   Minimum Sphere Passage

   P-503 and P-504
   WAS Pump
   0 gpm @ 17 ft
   135 @ 14.75 ft (based on full speed curve)
   300 @ 11.0 ft (based on full speed curve)
   75 @ 16 ft (based on full speed curve)
   865 rpm
   NA
   2 HP
   60%
   480/3/60 (rated for AFD duty)
   Not more than 10 feet at maximum flow
   8.25 inches
   4 x 4 inches
   3 inches

C. Vibration: The Reed Critical Frequency of the pump-motor system shall be outside the adjustable speed range and at least 25% different from the minimum and maximum running speeds. Submit calculations by a registered Mechanical Engineer.

D. Manufacturer: Yeomans, Worthington, Cornell or approved equal.

E. General Construction: Vertical, single-stage, single suction, centrifugal, volute casing type, passing 3-inch minimum solids.

F. Impeller:
   1. Single suction, enclosed with vanes formed by accurate set cores ensuring even thickness and spacing. Finish water passages to a smooth surface. All passages shall be free from hollows, pinholes, cracks and projections, which
might incite or encourage cavitation. Balance statically and dynamically to Hydraulic Institute Standards with wearing ring attached.

2. Materials: Close-grained cast iron conforming to ASTM A48, class 30 minimum with 2 to 3% nickel added. All threaded parts necessary to secure the impeller or shaft cover shall be of AISI Type 316 stainless steel.

3. The method of attaching the impeller to the shaft shall be such as to permit easy, convenient removal, and shall be designed to withstand all stresses of the intended service. The impeller hub or shaft cover shall be designed to prevent the accumulation or catching of stringy material.

G. Casing:
1. Material: Close grained cast iron containing 2 to 3% nickel and conforming to ASTM A48, class 30 minimum.

2. Construction:
   a. Designed to permit the removal of all rotating internal parts without disturbance of the suction and discharge piping connections. The surfaces of all water passages shall be smooth and free from rust spots, core adhesions and projections. Outer surfaces shall be heavily ribbed, braced or otherwise strengthened as required. The casing shall be of the single volute type without guide vanes, and shall be of sufficient strength to support the superimposed equipment including seismic forces.

   b. Hand holes shall be provided at proper locations for cleaning and inspection. Hand holes shall be 4-7/8-inch minimum. Hand hole covers shall be of the same material as the casing, shall be bolted in place, and shall have inner contours, which exactly match the contours of the casing. Casing shall be provided with at least four places for attachment of lifting equipment.

   c. Suction elbow shall contain a flanged 6-inch minimum opening to serve as a hand hole.

   d. Discharge nozzle shall have flanges conforming to ANSI, class 125.

   e. 3/4-inch taps shall be provided for suction and discharge pressure gauges.

   f. Connections between sections of the casing shall be flanged and bolted joints of ample strength and rigidity and shall be accurately fitted and dowelled or registered to ensure accurate alignment in reassembling after dismantling.

3. The cast iron top cover shall be integral with the stuffing box and shall provide a rigid support for the bearing housing to withstand all hydraulic and mechanical loads.

4. The top cover shall be constructed of close-grained cast iron containing 2 to 3% nickel and conforming to ASTM A48, class 30 minimum. The back head shall be accurately machined to provide a self-centering fit with its respective volute casing and frame. The back head shall be drilled and tapped for seal water connections for the packing gland seal.

5. A 1-inch tapped bossed hole shall be provided at the top most point of the casing next to shaft stuffing box to vent trapped air. Tap shall be fitted with a one-inch copper tube pipe and valve. Valve shall be located outside of pump frame.
H. Stuffing Boxes:
   1. Stuffing boxes shall be of the same material as the casing and shall be so located and constructed that they can be adjusted and repacked without dismantling or disturbing any other parts of the pump including the bearings. A split lantern ring shall be provided in the center of the packing and a split bronze flushing cage or seal ring shall be provided at the inboard end of the stuffing box. Connections shall be provided to the lantern ring for both water and grease lubrication, and a connection for a fresh water seal shall be provided to the inboard flushing cage or seal ring. Boxes shall be deep enough to accommodate Teflon-impregnated packing rings to seal without excess pressure on rings in addition to the lantern and seal rings. The lantern ring, split-type gland, and follower ring shall be bronze. All bolts shall be AISI Type 304 stainless steel.
   2. Stuffing box leakage shall be collected in a pocket with bottom drain and a connection for external drain piping. The pocket and connection shall be so constructed as to prevent trapping of leakage before entering drain piping. No piping shall pass through any water passage in the pump casing.

I. Bearing Frame: Cast iron, to the same specification as the casing or ASTM A48, class 30. Large openings shall be provided adjacent to the packing gland seal to permit replacement and adjustment. Frame shall also be provided with accurately machined self-centering and self-indexing fit to ensure the proper alignment of bearings and seal housing. Frame shall be stiff enough to support motor mount without undue vibration.

J. Wearing Rings:
   1. All pumps shall be fitted with renewable wearing rings. The wearing ring shall be either the radial type with grit dam or the adjustable axial type. Wearing rings shall be of the single pair type, one ring on the suction head and one on the impeller shroud at the suction inlet.
   2. Wearing rings shall be heat treated non-galling stainless steel with a chrome content of not less than 17% for those on the casing and not less than 13% for those on the impeller.
   3. The impeller and suction head wearing rings shall be attached with epoxy material and shall be of "Loctite" variety or equal, and be of stainless steel material with a Brinell hardness of not more than 300.

K. Shafts and Sleeves:
   1. Pump shafts shall be fabricated from forged and heat treated carbon steel accurately machined and ground. Shafts shall be of ample size to transmit the maximum power required and shall be designed for adequate stiffness to operate, without distortion or vibration, throughout the range of service specified. Nowhere during the operating speed range will it approach the critical speed. Submit critical speed data.
   2. The shaft shall be protected from contact with the pumped liquid. Provide a renewable shaft sleeve, extending from where the shaft enters the impeller to where the shaft emerges from the gland. The sleeve shall be 12 to 14% chromium stainless steel with a Brinell hardness of not less than 300.
L. Bearings:
   1. Pump bearings shall be anti-friction type, grease lubricated, selected to carry all radial and thrust loads, and have a B-10 life of 100,000 hours when powered by an inverter duty motor. Pumps shall have two bearings and shall carry all pump shaft bearing loads. The entire pump thrust shall be carried at the outboard end of the bearing frame by a spherical roller thrust bearing or tapered roller bearing designed to carry radial loads as well as the unbalanced hydraulic thrust.
   2. The inboard bearing shall be of the self-aligning spherical roller or tapered roller type designed to carry all radial loads imposed upon it by the pump. The bearing assembly shall be capable of withstanding momentary up thrust.

M. Motor Shaft Coupling: Provide a shaft coupling between the motor shaft and the pump shaft. Shaft couplings shall be coordinated with pump and motor requirements by the pump manufacturer.

N. Motor: Motors shall be sized by the manufacturer to provide sufficient horsepower to overcome the maximum starting torque for the pump under load and to provide the pumping capacity at the head and speed requirements specified. Motors shall be for indoor operation unless specifically otherwise noted. Motor speed shall not exceed 1,800 rpm. Motors for P-500, P-501, and P-502 shall be inverter duty suitable for operation with an adjustable frequency drive, as specified in Section 16924, over the specified speed range. See Section 11002 for specific motor requirements.

O. Identification and Data Plates: Stainless steel, suitably attached to the pump. Data plates shall contain the manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.

P. Pump, motor and base shall receive the manufacturer's standard factory applied paint finish in accordance with Section 09960.

Q. Provide suction and discharge pressure gauges for each pump with features and accessories in accordance with Section 15050.

R. Each pump shall be furnished with a pump shaft guard. The pump shaft guard shall be designed and installed to provide access for lubrication and maintenance of pump and shaft without removal of the guard.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions.
3.02 FIELD PAINTING

A. Pumps, motors, and appurtenances shall receive a final color coat in the field in accordance with Section 09960.

3.03 FIELD TESTING

A. All pumps shall be field tested and will be witnessed by the Engineer. For further requirements on performance tests, refer to Section 11001. Before any equipment, piping systems or controls may be tested, the Contractor shall clean such by an appropriate non-damaging method to remove all debris, loose concrete, paint or other foreign matter so that all internal and external surfaces are visibly clean, continuous, and free of foreign matter. Before any equipment may be tested, it shall be made physically operable to the satisfaction of the Engineer. Prior to performing pumping tests, the following tests shall have been satisfactorily completed:

1. Piping leakage tests.
2. Valve control and operation.
3. Pump seal water systems.
4. Electrical testing of circuits, controls and conductors.

B. In addition, the Contractor shall perform vibration testing on all of the vertical non-clog centrifugal pumps covered by this Section.

1. Scope: Running conditions vibration testing shall be performed on each vertical non-clog centrifugal pump in its completed installation. Measurements of axial and radial vibration shall be made at the pump bearings and motor while operating over the range of design operation. Vibration shall not exceed the guidelines as set by the Hydraulic Institute.

2. Instrumentation: The instrumentation for measuring and recording vibration conditions shall be the following units, or equal.

<table>
<thead>
<tr>
<th>Description</th>
<th>IRD Mechanalysis</th>
<th>Bentley Nevada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration Analyzer-Dynamic Balancer</td>
<td>Model 350</td>
<td>Model TK-20</td>
</tr>
<tr>
<td>X-Y Recorder</td>
<td>Model 1080</td>
<td>Model 24173-01</td>
</tr>
<tr>
<td>Vibration Pickup</td>
<td>Model 540</td>
<td>Model 16699</td>
</tr>
</tbody>
</table>

3. The equipment shall be operated by personnel certified by the equipment manufacturer as trained and qualified for the work.

4. Documentation and Report:

a. The vibration measurements shall be incorporated in an interpretative report prepared by an independent qualified firm specializing in this type of service. The report shall compare the observed vibration spectra with the recognized industry standards for each type of equipment, NEMA for motors and the Hydraulics Institute Standards for pumps, and shall indicate whether standards are met and shall point out any deficiencies.

b. The report shall be furnished to the Engineer as a prerequisite to evaluation of installations for acceptance.
3.04 FIELD SERVICES

A. The manufacturer of each pump shall supply a competent field service Engineer to thoroughly check and inspect each pump after installation, place each pump in operation and make necessary adjustments, and instruct Owner's personnel in proper operating and maintenance procedures. Provide at least 8 hours of onsite instruction after successful completion of pump testing.

END OF SECTION
SECTION 11310B

DRY PIT SUBMERSIBLE VERTICAL NON-CLOG CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish complete, tested and operating, the equipment as shown on the Drawings and as specified herein.

B. Work Included in This Section:
   1. Submersible Vertical Non-Clog Centrifugal Pumps

1.02 SUBMITTALS

A. Shop Drawings: Submit Product Review Shop Drawings for the pumps and motors. Include sufficient data to show that equipment conforms to Specification requirements, including prototype performance curves, motor data, and seismic anchorage certification and description. For each pump, submit information on the moment of inertia of the rotating elements in units of pounds-feet squared including weight and radius of gyration. Shop Drawings for the pumps, motors and drive shaft assembly shall be submitted as a complete initial package for the coordinated system, including reed critical frequency calculations and pump setting and installation drawings showing connection to suction piping.

B. Factory Testing: Each pump shall be factory and field tested. Certified non-witnessed factory performance tests in accordance with Standards of the Hydraulic Institute are required for each pump, including but not limited to, determination of head-capacity curves, efficiency, power, speed and net positive suction head required. The Contractor shall provide the Engineer with these test results. Upon receipt of the Engineer's favorable review, the Contractor may have the pumps shipped to the job site. Motor tests shall be conducted as required in Section 11002.

C. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins and spare parts lists.

D. Affidavits: Furnish affidavits from the manufacturers stating that the equipment has been properly installed and tested and is ready for full time operation.

1.03 QUALITY ASSURANCE

A. All equipment furnished under this Section shall be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least 5 years. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.
1.04 SEISMIC PROTECTION

A. Furnish seismic anchorage certifications and descriptions.

1.05 RESPONSIBILITY

A. The pump-motor system shall be furnished by the pump manufacturer, who shall be responsible for the coordination and performance of the pump-motor system. The responsibility shall extend to certification of field installation and meeting requirements for field installed performance, including meeting vibration limits for the vertical non-clog centrifugal pumps.

PART 2 - PRODUCTS

2.01 DRY PIT SUBMERSIBLE VERTICAL NON-CLOG CENTRIFUGAL PUMPS

A. The Dry Pit Submersible Pumping Units shall be self contained, close coupled pump/motor units designed to operate at continuous full load either submerged or non-submerged without the need for any external cooling devices or water jackets. The motor shall be of the air-filled type and shall be cooled by an internal closed loop cooling system. Motor ratings shall conform to the latest applicable requirements of NEMA, IEEE, ANSI and NEC standards.

B. Furnish and install factory-assembled electric motor, pump assembly and steel pedestal base with cast iron suction elbow complete with all accessories, including components and special trim items necessary for proper pump operation when pumping raw sewage. The pump manufacturer shall be responsible for the mating of the new pumps to the new or existing piping and valves. The pump manufacturer shall coordinate with the Contractor to furnish any and all adapters, couplings and fittings to ensure the proper installation and proper functioning of the system. Contractor to install pump, motor, base and suction elbow according to drawings.

C. The required pump curve characteristics shall be continuously declining and be as follows:

1. Dry Pit Submersible Vertical Non-Clog Centrifugal Pumps – Diamond Peak Lift Station (Drawings LS1, LS2, and LS3)

| Pump Schedule |
|---------------|----------------|
| Service       | Raw Sewage     |
| Shut-Off Head | 0 gpm @ 167 ft ±2 ft |
| (Zero Flow)   |                 |
| Design        | 350 gpm @ 140 ft ±2 ft |
| Operating     | 160 gpm @ 156 ft ±2 ft |
| Point         |                 |
| Second        | 480 gpm @ 129 ft ±2 ft |
| Point         | 1,760 rpm       |
| Third         |                 |
| Operating     | Constant Speed  |
| Point         |                 |
| Speed         | 30 HP           |
| Pump Drive    |                 |
| Type          |                 |
| Maximum       |                 |
| Motor         |                 |
| Horsepower    |                 |
| Minimum       |                 |
| Pump Efficiency at |          |

Dry Pit Submersible Vertical Non-Clog Centrifugal Pumps 11310B-2

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March 2004
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D. Vibration: Reed critical frequency of the pump-motor system shall be at least 25% different from running speed. Submit calculations by a registered Mechanical Engineer.

E. Manufacturer: Yeomans, Series 9235, Model 4123C; Worthington, or equal.

F. General Construction: Vertical, single-stage, single suction, centrifugal, volute casing type, passing 3-inch minimum solids.

G. Impeller:
1. Single suction, enclosed with vanes formed by accurate set cores ensuring even thickness and spacing. Finish water passages to a smooth surface. All passages shall be free from hollows, pinholes, cracks and projections that might incite or encourage cavitation. Balance statically and dynamically to Hydraulic Institute Standards with wearing ring attached.
2. Materials: Close-grained cast iron conforming to ASTM A48, class 30 minimum with 2 to 3% nickel added. All threaded parts necessary to secure the impeller or shaft cover shall be of AISI Type 316 stainless steel.
3. The method of attaching the impeller to the shaft shall be such as to permit easy, convenient removal, and shall be designed to withstand all stresses of the intended service. The impeller hub or shaft cover shall be designed to prevent the accumulation or catching of stringy material.

H. Casing:
1. Material: Close grained cast iron containing 2 to 3% nickel and conforming to ASTM A48, class 30 minimum.
2. Construction:
   a. Designed to permit the removal of all rotating internal parts without disturbance of the suction and discharge piping connections. The surfaces of all water passages shall be smooth and free from rust spots, core adhesions and projections. Outer surfaces shall be heavily ribbed, braced or otherwise strengthened as required. The casing shall be of the single volute type without guide vanes, and shall be of sufficient strength to support the superimposed equipment including seismic forces.
   b. Hand holes shall be provided at proper locations for cleaning and inspection. Hand holes shall be 3-inch minimum. Hand hole covers shall be of the same material as the casing, shall be bolted in place, and shall have inner contours that exactly match the contours of the casing.
   c. Suction elbow shall contain a flanged opening to serve as a hand hole.
   d. Discharge nozzle shall have flanges conforming to ANSI, class 125.
e. 1/4-inch taps shall be provided for suction and discharge pressure gauges.

f. Connections between sections of the casing shall be flanged and bolted joints of ample strength and rigidity and shall be accurately fitted and dowelled or registered to ensure accurate alignment in reassembling after dismantling.

I. Wearing Rings:
1. All pumps shall be fitted with renewable wearing rings. The wearing ring shall be either the radial type with grit dam or the adjustable axial type. Wearing rings shall be of the single pair type, one ring on the suction head and one on the impeller shroud at the suction inlet.
2. Wearing rings shall be heat treated non-galling stainless steel with a chrome content of not less than 17% for those on the casing and not less than 13% for those on the impeller.
3. The impeller and suction head wearing rings shall be attached with counter sunk machine head stainless steel set screws.

J. Shafts and Seals:
1. Two independent, tandem mounted, mechanical seals shall be provided in the heat transfer fluid reservoir to isolate and protect the air-filled motor from the pumped media. The reservoir shall act as a barrier to trap moisture and provide sufficient time for a planned shutdown in the event of an outer seal failure. The inner mechanical seal shall be constructed with a solid block carbon rotating seal face and a solid block silicon carbide stationary seal face. The outer mechanical seal shall be constructed with a solid block silicon carbide rotating seal face and a solid block silicon carbide stationary seal face. All other metal seal components of both inner and outer seals shall be AISI 316 stainless steel. All elastomers of both inner and outer seals shall be of Viton® material.
2. The outer mechanical seal shall be located in a recessed housing outside the main flow path of the pump to avoid damage. Mechanical seals that employ sprayed or laminated seal faces shall neither be considered equal, nor shall they be acceptable.
3. Mechanical seals shall be readily and commercially available from third party sources other than the pump and motor manufacturer, their agents, dealers and/or distributors.

K. Bearings:
1. Bearings shall be specifically selected to carry all radial and axial loads imposed by the pump and motor.
2. Bearings shall be rated to provide a minimum L_{10} Bearing Life of 50,000 hours at any design operating point within plus or minus 40% of best efficiency flow point (BEP) of the pump performance curve. Bearing selection shall limit the bearing temperature rise to a maximum of 60° C under full load operation.
3. All bearings shall be permanently lubricated with a premium moisture resistant grease containing rust inhibitors and shall be suitable for operation over a temperature range of -25° C to +120° C. The bearings

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**Dry Pit Submersible Vertical Non-Clog Centrifugal Pumps**

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shall not require any additional or periodic lubrication. All bearings shall be commercially available from third party sources other than the pump/motor manufacturer.

L. Motors

1. Motors shall comply with Specification Section 11002 and be sized by the manufacturer to provide sufficient horsepower to overcome the maximum starting torque for the pump under load and to provide the pumping capacity at the head and speed requirements specified. Motor speed shall not exceed 1,800 rpm.

2. The nameplate ratings of the motor shall be based on 40° C ambient temperature environment and have a 1.15 service factor. The pump motors shall be designed to withstand 150 feet of static pressure. All motors shall be furnished and certified per IEEE 117 with Class F rated insulation materials or better.
   a. The dry pit submersible motors shall successfully operate under power supply variations per NEMA MG1-14.30. Motors shall be NEMA Design B with torque and starting current in accordance with NEMA MG-12.
   b. The dry pit submersible motors shall be of an air-filled design and shall be suitable for continuous operation. The motors shall have a minimum 1.15 Service Factor of 40° C ambient temperature.
   c. Stators shall be solid copper wound and shall be press fitted into the stator housing for true positive alignment and efficient heat transfer. The motor insulation system shall be Class F minimum, utilizing materials and insulation systems evaluated and certified with IEEE 117 classification tests. The entire wound stator assemble shall receive a minimum of two (2) coats of insulating varnish utilizing a dip and back process.
   d. Three (3) normally-closed, automatic-reset, thermostats connected in series shall be embedded in adjoining phases of the stator windings. The thermostats shall be connected to safely shut down the motor upon opening.

3. Moisture Detection System: A dual (2) probe moisture sensing system shall be provided to detect the entrance of moisture and provide an alarm. The moisture detection system shall be designed to detect the entrance of moisture in both the heat transfer fluid reservoir and the air-filled motor stator housing. The use of single probe or float switch type sensor system shall not be acceptable. The moisture sensing probe leads shall terminate in a sensing device located in the control panel, which shall provide an alarm in the event of moisture intrusion. The sensing device, if not specifically ordered form the pump manufacturer, shall be approved by the pump/motor manufacturer.

4. Cap/Cable Assembly: The power and control cable entry system shall be designed to provide a positive, leak-free seal to prevent liquid from entering the air filled motor housing. The design shall incorporate provisions which prevent moisture from wicking through the cable assembly in the event the cable jacket has been punctured. All cable shall be type SEOW-A and U.L. Listed for the intended submersible service.
The power and control cable entry into the lead connection chamber shall be epoxy encapsulated for positive moisture sealing. All conductor leads shall terminate at a terminal board that is permanently cast into the epoxy sealed cable entry area. The motor and control leads shall be easily connected and serviced on the motor side of the terminal board. A Buna-N cable grommet or a strain relief fitting shall be provided in addition to the epoxy sealed leads. Compression type grommet fittings employed as the primary sealing system shall neither be considered equal or shall they be acceptable. Separate power and control cables shall be provided to prevent false sensor warnings.

M. Identification and Data Plates: Stainless steel, suitably attached to the pump. Data plates shall contain the manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.

N. Pump and motor shall receive the manufacturer's standard factory applied paint finish in accordance with Section 09960.

O. Provide suction and discharge pressure gauges for each pump with features and accessories in accordance with Section 15050.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions.

3.02 FIELD PAINTING

A. Pumps, motors, and appurtenances shall receive a final color coat in the field in accordance with Section 09960.

3.03 FIELD TESTING

A. All pumps shall be field tested and will be witnessed by the Engineer. For further requirements on performance tests, refer to Section 11001. Before any equipment, piping systems or controls may be tested, the Contractor shall clean such by an appropriate non-damaging method to remove all debris, loose concrete, paint or other foreign matter so that all internal and external surfaces are visibly clean, continuous, and free of foreign matter. Before any equipment may be tested, it shall be made physically operable to the satisfaction of the Engineer. Prior to performing pumping tests, the following tests shall have been satisfactorily completed:

1. Piping leakage tests.
2. Valve control and operation.
3. Electrical testing of circuits, controls and conductors.
B. In addition, the Contractor shall perform vibration testing on all of the dry pit submersible vertical non-clog centrifugal pumps covered by this Section.

1. Scope: Running conditions vibration testing shall be performed on each vertical non-clog centrifugal pump in its completed installation. Measurements of axial and radial vibration shall be made at the pump bearings and motor while operating over the range of design operation. Vibration shall not exceed the guidelines as set by the Hydraulic Institute.

2. Instrumentation: The instrumentation for measuring and recording vibration conditions shall be the following units, or equal.

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<tr>
<th>Description</th>
<th>IRD Mechanalysis</th>
<th>Bentley Nevada</th>
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<td>Vibration Analyzer-Dynamic Balancer</td>
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<td>Model TK-20</td>
</tr>
<tr>
<td>X-Y Recorder</td>
<td>Model 1080</td>
<td>Model 173-01</td>
</tr>
<tr>
<td>Vibration Pickup</td>
<td>Model 540</td>
<td>Model 16699</td>
</tr>
</tbody>
</table>

3. The equipment shall be operated by personnel certified by the equipment manufacturer as trained and qualified for the work.

4. Documentation and Report:
   a. The vibration measurements shall be incorporated in an interpretative report prepared by an independent qualified firm specializing in this type of service. The report shall compare the observed vibration spectra with the recognized industry standards for each type of equipment, NEMA for motors and the Hydraulics Institute Standards for pumps, and shall indicate whether standards are met and shall point out any deficiencies.
   b. The report shall be furnished to the Engineer as a prerequisite to evaluation of installations for acceptance.

3.04 FIELD SERVICES

A. The manufacturer of each pump shall supply a competent field service Engineer to thoroughly check and inspect each pump after installation, place each pump in operation and make necessary adjustments, and instruct Owner's personnel in proper operating and maintenance procedures. Provide at least one day of onsite instruction after successful completion of pump testing.

3.05 SPARE PARTS

A. Furnish one seal rebuild kit complete with seal faces, gaskets and motor bearing.

END OF SECTION
SECTION 11319

ROTARY LOBE CENTRIFUGE FEED PUMP

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Furnish a complete, tested and operating rotary lobe pump as shown on the Drawings and as specified herein.

B. Related Sections:
   1. Section 09960: Protective Coatings
   2. Section 11001: General Equipment and Mechanical Requirements
   3. Section 11002: Electric Motor Drives
   4. Section 15050: Piping, Valves and Accessories
   5. Section 16925: Adjustable Frequency Drives (AFD)

1.02 REFERENCES

A. American Iron and Steel Institute (AISI).
B. American National Standard Institute (ANSI).
C. American Society for Testing and Materials (ASTM):
D. Anti-Friction Bearing Manufacturers Association (AFBMA).
E. Hydraulic Institute.

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit the following as a single complete initial submittal in accordance with Section 01300:
   1. Product data to demonstrate that the equipment conforms to the Specifications.
   2. Motor data.
   3. Seismic anchorage certification and related sketch.
   4. Pump layouts and dimensions.
   5. Pump performance curve.

B. Performance Testing: Submit certified non-witnessed factory performance test results. Receive favorable review of test results prior to shipping the equipment.

C. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

D. Affidavits: Submit affidavit from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full time operation.
1.04 QUALITY ASSURANCE

A. Equipment furnished under this Section shall be supplied by a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five years. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers named herein.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Pump: Borger PL Series, Vogelsang VX136 Series, or equal.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. Pump Schedule: P-703

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pump Service</td>
<td>Feeding of aerobically digested sludge to a centrifuge</td>
</tr>
<tr>
<td>2. Number of Pumps</td>
<td>1</td>
</tr>
<tr>
<td>3. Design Operating Point</td>
<td>65 GPM @ 48 ft. TDH</td>
</tr>
<tr>
<td>4. Max. Operating Point @ 75% rpm</td>
<td>125 GPM @ 57 ft. TDH Note (a)</td>
</tr>
<tr>
<td>5. Min. Operating Pt @ reduced rpm</td>
<td>35 GPM @ 46 ft. TDH</td>
</tr>
<tr>
<td>6. Min. Volumetric Displacement</td>
<td>47 gal/100 rev</td>
</tr>
<tr>
<td>7. Type of Drive</td>
<td>Belt drive</td>
</tr>
<tr>
<td>8. Drive Horsepower</td>
<td>7.5 HP</td>
</tr>
<tr>
<td>9. Net Positive Suction Head (NPSH) at Maximum Flow</td>
<td>Not more than 32 ft.</td>
</tr>
<tr>
<td>11. Maximum Motor Speed</td>
<td>1,800 rpm</td>
</tr>
<tr>
<td>12. Suction Gauge Range</td>
<td>0 to 20 psi</td>
</tr>
<tr>
<td>13. Discharge Gauge Range</td>
<td>0 to 50 psi</td>
</tr>
</tbody>
</table>

Note (a) – Pump must be capable of meeting Maximum Operating Point at 75% of maximum speed under new or rebuilt conditions.

2.03 EQUIPMENT

A. Pump Construction:

1. General: Provide overhead-mounted pumping unit, complete with motor and belt drive. Equip pumps with 6-inch (suction) and 4-inch (discharge), 125-pound ANSI flanges with orientation as shown on the Drawings.

2. Bearing and Timing Gear: The timing gear shall be in a separately sealed chamber that is oil-filled and independently sealed from the pump casing. The timing gears shall be straight cut steel timing gears attached to the shaft with replaceable hardened keys, running in a separate oil chamber, and requiring no external timing changes. The intermediate chamber, between the timing gears and the pump casing shall be fitted with a seal monitoring probe or oil canister to indicate seal failure.
3. Casing: Shall be of grey cast iron material, in conformance with ASTM Designation A48, 230-260 brinell hardness, with a minimum of 700 brinell radial housing segments and or radial wearplates. A quick release cover fitted with four nuts shall have an axial wearplate with a minimum brinell hardness of 750, that is reversible based on wear, and allow access to the internal parts without disturbing the suction or discharge piping. The quick release cover shall be flush with no recesses, and shall be sealed by a Buna-N o-ring. All wearing wet-end parts shall be changeable through the front cover without disassemble of any pipes/coupling or the motor.

4. Shaft Seals: Shall be front loading maintenance/adjustment-free, Split Silicon Carbide cartridge style mechanical type shaft seals accessible through quick release openings and replaceable as a complete cartridge unit. Mechanical seals shall be lubricated by oil, and require no external water flush.

5. Rotors: The rotors shall be screw-configured, non-pulsating, tri or four-lobed rotors, non-wetted cast-iron core vulcanized with abrasion resistant, Buna-N material. Rotors shall be positioned to the shaft by replaceable hardened keys ways, and secured to the shaft by internal / external expansion bolt sealed with o-rings.

6. Non-wetted Shafts: Shall be manufactured of carbon steel ASTM A470 fitted with replaceable stainless steel sleeves where passing through the seal area. The shaft shall be a minimum of 60 mm in diameter where the bearings, mechanical seals, and rotors contact the shaft to decrease the potential of torsional shaft fatigue. The use of step down shafts will not be acceptable. The conveying product shall not come into contact with the carrying shafts of the pump to ensure that the shafts do not become corroded and to ensure easy, trouble-free exchange of the rotors.

7. Bearings: Provide radial ball bearings which shall safely carry all radial loads. Bearing life shall be minimum 100,000 hours based on B10 of AFBMA Standards. Bearings shall use an oil bath for lubrication.

8. Base: Mount the pump and motor on a fabricated, twist-free base made of galvanized steel constructed to support the full weight of pump and motor.

9. Drive Arrangement: Overhead piggyback type

10. Pump shall be able to pass a 1.5-inch solid sphere.


12. Motor:
   a. Furnish drive motor complying with pump performance and operating parameters in Section 11002 and specified herein.
   b. Type: Horizontal, TEFC, squirrel cage, induction motors as specified in Section 11002, and suitable for 3-phase, 460 volt service. Motor shall have a service factor of 1.15 and Class F insulation and be suitable for inverter duty.
   c. Motor rpm shall not exceed 1,800.
   d. Nameplate motor horsepower shall not be exceeded at any flow up to the maximum operating point in the pump schedule.
   e. Motors shall have special insulation for damp locations.
   f. Motors shall be suitable for operation with an adjustable frequency drive (AFD) over the specified operating range of the pump. The AFD shall conform to the requirements of Section 16925.
   g. Motor shall be non-overloading at all points on the curve.
   h. Provide over-temperature sensor with the motor.
2.04 ACCESSORIES

A. The Pump Supplier shall supply the following accessories:
   1. Suction pressure gauge.
   2. High-pressure sensor / pressure gauge assembly for installation in the discharge pipe to protect the pump from overpressure. The instrumentation assembly shall utilize an isolator to separate the process fluid from the pressure sensing instrumentation. The process fluid pressure shall be transmitted by liquid silicone oil sealed between a stainless steel housing and a flexible Eastover element of Buna-N. The pressure shall be monitored by a no indicating pressure switch. The pressure gauge shall have a 4" face with a case from stainless steel with a reading from 0 - 100 psi.
   3. Thermal Dry Run Protection with sensor in the pump chamber to indicate an overheating condition. The system will use a sensor probe and a local display panel. The panel shall be UL and VDE approved and allow the operator to set the limits for normal operation. The panel will provide a 1 SPDT Relay 8A, 250 V/AC output. The sensor shall be a 2-wire unit using 316 SS for the tubing material. The sensor connection shall be of PTFE isolation wire. The unit shall be a model XT110C supplied by Boerger or approved equal.
   4. Clear plastic Oil Reservoir that indicates the reservoir capacity positioned so that it can be easily read.

2.05 FINISHES

A. Painting: Apply manufacturer's standard factory paint finish.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the pump unit(s) in strict conformance with manufacturer's installation instructions. Check pump and motor alignment according to the Standards of the Hydraulic Institute after complete unit has been installed at the site.

3.02 FIELD PAINTING

A. Apply a final color coat of paint to the pump units(s) in accordance with Section 09960.

3.03 FIELD TESTING

A. The equipment manufacturer shall supply a competent field service engineer to thoroughly check and inspect the equipment after installation, place the equipment in operation, make necessary adjustments, calibrate instruments, and conduct field tests.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. Requirements specified in Section 11001 form a part of this Section. Furnish complete, tested and operating, the equipment as shown on the Drawings and as specified herein.

B. Work Included: Furnish and install a vortex-type grit chamber and a grit separator with controls, pumps, motors, conveyors, and all appurtenances. The grit chamber equipment and the grit separator shall be of the same manufacturer to assure compatibility of design and operation.

C. Equipment Identification: The Vortex Grit Removal System (Grit Chamber) and the Grit Separator are identified in the Specifications and Drawings as follows:

<table>
<thead>
<tr>
<th>Equipment Name</th>
<th>Tag Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grit Fluidizer</td>
<td>ME-201</td>
</tr>
<tr>
<td>Grit Separator</td>
<td>ME-202</td>
</tr>
<tr>
<td>Grit Pump</td>
<td>P-203</td>
</tr>
<tr>
<td>Primer System</td>
<td>P-204</td>
</tr>
</tbody>
</table>

PART 2 - PRODUCTS

2.01 VORTEX GRIT CHAMBER AND GRIT SEPARATOR

A. General: Furnish and install a vortex-type grit removal system and grit separator as shown on the Drawings. The vortex degritter shall be capable of providing effective grit removal at the flow rates shown on the table below:

<table>
<thead>
<tr>
<th>Flow Rate</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADF</td>
<td>1.2 mgd</td>
</tr>
<tr>
<td>Peak Instantaneous</td>
<td>3.0 mgd</td>
</tr>
</tbody>
</table>

B. The grit chamber and separator shall be furnished and fabricated by one manufacturer to ensure compatibility of design and operation.

C. Vortex Grit Chamber: The vortex grit chamber system consists of fluidizer gear motor and propeller shaft, a turbo grit pump, a vacuum priming system and controls. This equipment is mounted in a cast-in-place concrete structure designed to extract grit from the lighter organic particles. Grit is trapped in the lower hopper section of the grit chamber and pumped to the Grit Separator on a periodic basis. The system shall be automatically controlled by a control panel provided by the manufacturer of the grit chamber system.
D. Grit Separator: The grit separator separates any residual organic matter associated with grit discharged from the vortex grit chamber using a Grit Concentrator and a lamellar plate separator. The screw conveyor shall be constructed of stainless steel with an inlet hopper to receive the mixture of water and grit. The hopper shall be equipped with an energy dissipation zone to prevent turbulence in the remaining portion of the hopper. The hopper shall have parallel plates located in the settling zone to improve retention of the fine grit. An overflow weir trough shall be provided to return the water to the system. The conveyor shall be freestanding with support legs to hold the conveyor at an angle of approximately 22°. The discharge shall be 8" diameter, plain-end steel pipe. The drive assembly shall be located at the discharge end.

2.02 CONSTRUCTION:

A. General
1. No moving parts subject to wear or stoppage shall be below the water surface.
2. To minimize the possibility of clogging, all internal openings in the piping to the grit pumping device as well as the grit pumping device shall be large enough to pass a 4" sphere.
3. No bends or elbows will be allowed in the piping on the suction side of the grit pump.
4. All drives, lubrication and bearings shall be readily accessible from walkways above the operating water level.
5. To minimize the possibility of organic capture, the floor of the grit separation chamber shall be flat and there shall be no greater than a 3" opening for grit to pass through to the storage hopper. Sloping floors in the upper chamber will not be allowed due to reduced grit removal efficiency and extra construction costs.
6. An influent baffle or equivalent and inlet coanda ramp shall be provided to enhance the coanda effect and direct the grit downward to the bottom of the separation chamber as well as enhance chamber flow patterns.

B. Removal Efficiencies: The grit removal device shall be capable of removing the following at the specified hydraulic peak flow rate, and no decrease in efficiency will be allowed at flows less than this design rate.
1. 95% of the grit greater than 50 mesh in size,
2. 85% of the grit greater than 70 but less than 50 mesh in size, and
3. 65% of the grit greater than 100 but less than 70 mesh in size.

The above performance shall have been proven in full scale field testing of at least 35 installations utilizing certified grit removal efficiency test procedures as performed by qualified, factory payroll personnel who have at least one year experience performing the test.

C. Conditions of Operation
1. The grit removal unit shall have less than 1/4" head loss and shall be capable of removing grit from raw waste or process water and depositing the grit in a storage hopper.
2. The grit chamber shall operate on the vortex principle.
3. To maximize grit removal efficiency, the grit chamber hydraulics shall incorporate a toroidal flow path enhanced by a slow vortex. Grit chambers
incorporating the gravity principle will not be acceptable due to the turbulence in the flow, which prevents gravity settling from being effective and due to the extra area needed for settling fine grit. Aerated grit chambers, including those incorporating conventional settling criteria, are also specifically unacceptable.

4. To ensure the efficient transport of the grit and simultaneous lifting and discharge of the organic material, the bottom of the upper chamber covering the storage hopper shall be constructed of structural grade steel plate, free from rotation, and shall be flat.

5. The grit moving across the bottom of the chamber shall be hydraulically scoured as the propeller blades, moving within 6" of the grit, pass over the moving grit and cause hydraulic currents to lift up the organics. The grit scouring intensity shall be adjustable. Propellers running with a center line greater than 8" from the bottom of the chamber will not be acceptable. The grit shall pass from the removal chamber through an opening in the transition plate and drop into a grit storage hopper.

6. The flow in the removal chamber shall travel between the inlet and the outlet a minimum 270°, providing maximum travel of the liquid for effective grit removal.

7. The influent flume, transporting the liquid waste to the grit chamber, shall be of the size and shape shown on the contract drawings to assure that grit does not settle in the inlet flume and to provide for proper operation of the grit chamber.

D. Mechanical Drive: The grit removal unit shall have an axial flow propeller connected by a drive tube through reduction gearing and have the following features:

1. A 3 phase, 60 cycle, 460 volt, totally enclosed helical gear motor.

2. The minimum rated horsepower of the motor shall be ¾ BHP.

3. The drive tube shall be driven by a large, totally enclosed combination spur gear and turntable bearing. The maximum output speed of the drive shall be 25 RPM. Pinions and gears shall be high quality steel, machined and hardened for high strength and long wear.

4. Propeller blades shall be tapered, with generously rounded leading edge to reduce energy consumption and prevent foreign material from fouling the propeller.

5. A pinion mounted on the output shaft of the helical gear motor shall drive a large spur tooth bull gear enclosed in a heavy cast iron case. The spur gear pinion shall be cut from heat treated steel. The bull gear shall rotate with a minimum 20" diameter turntable bearing for durability and stability. The pinion and bull gear shall have a service factor of 5.0 or greater at standard operating speeds.

6. All bearings of the drive unit, including the motor, shall have a minimum B-10 bearing life of 50,000 hours, except for the 21" diameter turntable bearing supporting the propeller assembly which shall have a minimum B-10 life of 20 years.

7. The bull gearbox shall be specifically designed for this service. It shall have an opening for the 10-3/4" diameter torque tube driving the propeller. The gearbox shall be sealed and the bottom opening shall have an air bell around the torque tube to prevent water from entering the gearbox in case of flooding. The top of the gearbox shall have a bolted flanged connection for the grit discharge pipe.

8. The drive motor shall have normal starting torque and low starting current. The motor shall not be overloaded beyond the nameplate rating under any normal conditions encountered.
E. Grit Fluidizer: The system shall be equipped with Grit Fluidizer vanes with the following features:

1. The vanes shall be located within 6" of the elevation of the pump suction inlet.
2. The vanes shall be bolted to the propeller drive tube in a helical fashion so as to gently pump the grit upward and keep the grit fluidized at the inlet of the grit pump.
3. The Fluidizer vanes shall be fabricated of heavy steel plate and coated with 6-8 mils of epoxy coating.
4. The Fluidizer vanes shall be bolted to the drive tube to facilitate easy removal of the drive tube.

F. Grit Pump: The Grit Pump shall be a 4" vertical, close-coupled, vacuum primed type with the following features:

1. Include a curved, 5-vane flow inducer completely out of the flow path between the pump inlet and discharge connection, so that the grit pumped is not required to pass through the impeller.
2. All internal clearances shall provide for the passage of a 4" spherical solid to preclude clogging of the pump and suction line.
3. The pump shall be designed to be in-line mounted directly to a flange on top of the straight 4" suction line. The suction line shall be vertical, passing up through the Grit Chamber, drive, to prevent accumulated grit from flowing into the suction pipe during idle periods and clogging the suction line.
4. The pump shall be vertical, for easy removal of the motor and impeller, to facilitate maintenance of the suction line by providing a straight path to any potential blockage.
5. The pump shall be of Ni-Hard construction, with Ni-Hard impeller, and especially designed for the use of mechanical seals and vacuum priming. Self-priming type pumps are specifically not acceptable.
6. In order to minimize seal wear caused by lineal movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearance within the bearing.
7. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of 1-7/8". The dimension from the lower bearing to the top of the impeller hub shall not exceed 6".
8. The bottom bearing of the motor shall be locked in place and designed to handle all thrust loads and the necessary radial load. The upper bearing shall be free to move up and down and thus carry only radial load. This movement allows for thermal expansion of the shaft.
9. The shaft shall be solid stainless steel through the mechanical seal to eliminate corrosion and abrasive rust particles. Removable shaft sleeves will not be acceptable if the shaft under the sleeve does not meet the specified 1-7/8" minimum diameter. Carbon steel shafts are not acceptable.
10. The impeller shall produce a turbine-like flow pattern within the casing, generating flow. To prevent grit from entering the seal area, all impellers less than full diameter shall be trimmed with the back shroud remaining full diameter so that a minimum clearance from shroud to casing is maintained. Both the end of the shaft and the bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.
11. The pump shall be specifically designed for vacuum priming service and have been in this service for a period of at least 10 years. The pump shall have an adapter providing a large water reservoir above the impeller to provide for positive exclusion of air from the impeller. The seal shall be inside this area to assure lubrication and grit shall be excluded from this area by a full size impeller shroud. Pumps, which do not use hollow priming adapters for positive lubrication of the seal, will not be acceptable.

12. The pump shall be arranged so that the complete rotating element can easily be removed from the casing without disconnecting the electrical wiring or disassembling the motor, impeller, backhead or seal.

13. The pump shall be sealed against leakage by a single mechanical seal, constructed so as to be automatically drained and automatically primed each time the pump is drained and primed. Water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime; in order to allow the pump and the seal to be drained, thereby preventing freezing and breakage of the seal during power outages in sub-freezing temperatures.

14. The seal shall be of carbon and ceramic materials with the mating surface lapped to a flatness tolerance of one light band. The rotating ceramic shall be held in mating position with the stationary carbon by a stainless steel spring.

15. The Grit Pump shall be capable of delivering the required head and flow rate required for proper operation of the downstream device. SELECTION OF THE PROPER GRIT PUMP WILL BE THE RESPONSIBILITY OF THE MANUFACTURER OF THE GRIT CHAMBER EQUIPMENT.

16. The pump motor shall be vertical, solid shaft, TEFC NEMA P-base, squirrel-cage induction type, suitable for 3 phase, 60 cycle, 460-volt current. It shall have Class F insulation, but the motor shall have Class B temperature limits. The motor shall have normal starting torque and low starting current, as specified for NEMA Design B characteristics. It shall have a 1.15 service factor.

17. The motor-pump shaft shall be centered, in relation to the motor base, within .005". The shaft run-out shall be limited to .003".

18. A bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housings shall be provided with fittings for lubrication as well as purging old lubricant.

19. The motor shall be fitted with heavy lifting eyes or lugs, each capable of supporting the entire weight of the pump and motor.

G. Vacuum Priming System: The vacuum priming system shall be located adjacent to the Grit Pump in a weatherproof enclosure mounted on the drive unit for the grit chamber and shall have the following features:

1. It shall be complete with vacuum pump, vacuum control solenoid valve, prime level sensing probe, heater, and a float operated check valve installed in the system ahead of the vacuum pump to prevent liquid from entering the vacuum pump.

2. The float-operated check valve shall have a transparent body for visual inspection of the liquid level and shall be automatically drained when the vacuum pump shuts off.

3. The vacuum pump shall have corrosion resistant internal components.

4. The vacuum pump shall be capable of priming the grit pump and grit removal piping in not less than 60 seconds under rated static lift conditions.
5. The priming system shall automatically provide positive lubrication of the mechanical seal each time the grit pump is primed.
6. To prevent excessive stoppage due to grit accumulation, no passageway in the priming system through which grit must pass shall be smaller than the equivalent of a 2-1/2" opening.
7. Priming from high-pressure (gauge) connections will not be acceptable.

H. Electrical Controls: the electrical control equipment shall be mounted in a NEMA type 4 steel enclosure with removable access cover and dead-front operation and shall have the following features:
1. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.
2. Magnetic across-the-line starters with overload coils for each phase shall be provided for the grit pump motor and drive motor for the propeller drive unit.
3. Each single-phase auxiliary motor shall be equipped with an over-current protection device, in addition to the branch circuit breaker, or shall be impedance protected.
4. All switches shall be labeled and a coded wiring diagram shall be provided.
5. An On-Off selector switch shall be provided to operate the propeller drive motor starter.
6. To control the operation of the grit pump, a manual momentary-off-automatic selector switch shall be provided. In the automatic position, control shall be by a time clock with manual selector switch to override the timer and initiate the pumping cycle. A 24-hour, 96-position time clock shall be provided. The 24-hour timer contacts shall operate a 0-30-minute pump timer (and a 0-30-minute priming timer.) All timers shall be provided within the control cabinet enclosure.
7. A pneumatically controlled discharge pinch valve shall be furnished for installation in the vertical discharge piping run, and the controls shall be located in the vacuum priming control panel. The controls shall include an oil-less air compressor and solenoid valve. The operation of the discharge pinch valve shall be tied into the cycle timer and electrode, so as to be fully automatic.
8. Prime Failure Alarm: A "prime failure" alarm shall be initiated if pump does not prime before time set on the priming timer. Interlocks shall be provided to prevent the grit pump from operating if the pump is not primed. All necessary capacitors, relays, diodes, etc., shall be provided as required. In order to ensure continuity of operation, the Manufacturer of the grit chamber equipment shall provide these controls, and the full-opening pneumatically controlled pinch valve for installation on the grit discharge line as shown on the drawings.
9. Control Transformer: A properly sized insulating type control transformer shall be provided by the controls Manufacturer to supply power for controls and auxiliary devices necessary to semi-automatic operation. The control transformer shall have 208/230/460 volt AC primary, 120 volt AC secondary, Class F insulation; with temperature rise not to exceed 115° C above a 40° C ambient.

I. Grit Concentrator: A 6-inch, 250 GPM second stage Grit Concentrator shall be provided as shown on the Drawings for secondary treatment of organics and secondary grit dewatering. The Grit Concentrator shall operate on the constant rate vortex principle. The operation of the grit concentrator shall be such that a small
volume of water and the grit will discharge at the bottom of the concentrator for final
dewatering and ultimate disposal of the grit. The grit concentrator shall incorporate
the following features:
1. As a minimum, 93 percent of the water pumped to the Grit Concentrator and
95 percent of the residual organic material shall flow out the top and be
returned to the drain. The unit shall be capable of intermittent operation with
minimal variation in removal efficiency. There shall be less than 5% (by weight)
putrescible material in the recovered grit from the underflow.
2. The Grit Concentrator shall be constructed of Ni-hard, with a minimum
thickness of 1/2" and 1-1/4" in high wear areas. Inlet and outlet connections
shall be as shown on the drawings. The Grit Concentrator shall be provided by
the Manufacturer of the Grit Chamber, for installation by the contractor. The
operating range shall be compatible with the total grit removal system as
described herein.

J. Grit Screw Conveyor with Parallel Plate Separator: The Grit Screw Conveyor shall
be constructed of steel with an inlet hopper to receive the mixture of water and grit
and shall incorporate the following features:
1. The hopper shall be equipped with an energy dissipation zone to prevent
turbulence in the remaining portion of the hopper.
2. The hopper shall have parallel plates located in the settling zone to improve
retention of the fine grit. An overflow weir trough shall be provided to return
the water to the system.
3. The conveyor shall be freestanding with support legs to hold the conveyor at
an angle of approximately 22°.
4. The discharge shall be 8" diameter, plain-end steel pipe.
5. The drive assembly shall be located at the discharge end.
6. The Grit Screw Conveyor shall have an open, 3/16" steel U-trough. The screw
shall be 9" in diameter. The conveyor shall be 15' in length, with overall
dimensions as shown on the drawing. The hopper shall have a 4" full-length
outlet weir trough to minimize the overflow rate and carry-over of the fine grit.
The projected separator plate settling area shall be a minimum of 15 sq. ft.
The conveyor screw shall run on anti-friction bearings at the outlet end, and a
bronce bushing at the inlet end. The inlet end shaft bushing shall be capable of
being greased. The inlet end shall have two 2" drains. Clearance between the
legs and the discharge outlet shall be as shown on the drawing. The drive to
the conveyor shall be a belt driven, shaft mounted helical gear reducer. The
motor shall be 1 HP, TEFC, 3-phase, 60 Hertz, 230/460 volt. The screw speed
shall be 9 RPM. The drive shall be mounted on a plate at the discharge end
and the plate shall be bolted to the flanges on the trough.
7. An expanded aluminum flattened mesh cover shall be provided over the
hopper and trough openings. The 30" x 60" opening over the hopper shall not
be covered.

K. Corrosion Protection:
1. All structural steel surfaces shall be factory blasted with steel grit to remove
rust, mill scale, weld slag, etc. All weld spatter and surface roughness shall be
removed by grinding. Surface preparation shall comply with SSPC-SP6
specifications. Immediately following cleaning, a single 3-mil dry film thickness
of red oxide primer shall be factory applied prior to shipment.
2. Stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated. Carbon steel surfaces, not otherwise protected, shall be coated with a suitable non-hardening rust preventative compound. Auxiliary components, such as the grit pump, gear motor, etc., shall be furnished with the original Manufacturer's coating.

3. Final touch-up and finish coating of the primed surfaces shall be the responsibility of the purchasing contractor, and shall be accomplished in the field. Finish coating shall be a high-solids epoxy, applied in one coat to a dry film thickness of 6 mils. The purchasing contractor shall be responsible for ensuring that the finish coating is compatible with the above specified primer.

L. Grit Storage Container: Provide a 50-gallon, heavy duty, polyethylene grit storage container. The grit storage container shall have handles on either side capable of handling container loads to 250 lbs.

2.03 MANUFACTURER

A. All equipment furnished under this Section shall be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment.

B. Acceptable manufacturers are Smith and Loveless, Lakeside, and Westec.

2.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings for favorable review of the grit handling equipment. Include sufficient data to show that equipment conforms to Specification requirements. The degritters and classifiers shall be submitted in a single submittal.

B. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare part lists.

C. Affidavits: Furnish affidavits from the manufacturer stating that the grit cyclone and grit washer have been properly installed and tested and are ready for full time operation.

2.05 SEISMIC PROTECTION

A. Submit seismic design certifications and anchorage sketches in accordance with the Division 1 requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions.
3.02 FIELD PAINTING

A. The cyclone degritter, the exterior of the classifier and the classifier motor received protective coats applied in accordance with the requirements of Section 09800, Protective Coatings.

3.03 TESTING

A. The cyclone degritter and classifier shall be operating to demonstrate to the Engineer that they are functioning properly. See Section 11001 further details.

END OF SECTION
SECTION 11330
SCREENING EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish, install and place into satisfactory operating condition a perforated basket-type fine screen for removing floating, particulate, or fibrous material as shown on the Drawings. The fine screen shall include a concentric conveyor/dewatering screw, screen basket, transport tube, spray washer, press zone assembly, discharge section, drive system, pivot stand, controls, and appurtenances. The unit shall be complete with electrical control panel and motor starter.

1.02 REFERENCES

A. American Institute of Steel Construction (AISC)
B. American Society of Testing and Materials (ASTM)
C. American Welding Society (AWS)
D. Steel Structures Painting Council (SSPC).

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Number of Screens .............................................................. 1
   2. Peak Design Flow, mgd ......................................................... 4.5
   3. Maximum Downstream Liquid Depth, inches ............................ 6.0
   4. Maximum Allowable Headloss, inches ................................ 16.0
   5. Orifice Opening Diameter, inches ......................................... 1/4
   6. Screening Channel Width, inches ......................................... 24
   7. Wash Water Pressure, psig .................................................. 60
   8. Main Control Panel Enclosure Type ..................................... NEMA 4X

1.04 SUBMITTALS

A. Shop Drawings and Product Data: Submit the following as a single complete initial package in accordance with Section 01300:
   1. Product data fully describing all items proposed for use to demonstrate that the equipment conforms to the specifications.
   3. Seismic anchorage certification and related sketch.
   4. System layout and schematic.
   5. Data from three (3) separate tests proving compliance of the screen with the "Paint Filter Test" as described in EPA Publication SW-486 Method 9095.
   6. Hydraulic performance curves showing the relationship of headloss versus the full range of downstream liquid depths for the peak design flow, 50% of the peak...
design flow, and 25% of the peak design flow. Curves based upon other manufacturer's data will not be acceptable for this project.

7. Vendor data shall be furnished to confirm the torque and thrust rating of the drive.

8. Control panel information.

B. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts list.

C. Affidavits: Submit affidavits from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full-time operation.

1.05 QUALITY ASSURANCE

A. Qualifications: Equipment furnished under this Section shall be supplied by a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five years. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers named herein.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Immediately upon delivery to the job site, place materials in an area protected from weather. Use non-marring slings for loading, unloading, and handling units to prevent rope or cable damage to surfaces and protective wrappings.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Model HLS by Hycor, Lakeside Model MS, or equal.

2.02 EQUIPMENT

A. Screen

1. The screen shall be designed and built to withstand static hydraulic forces exerted by the liquid to the screen. All structural and functional parts shall be sized to prevent deflections or vibrations, which may impair the screening, conveying, and pressing operations. All submerged components and all components of the screen in contact with the screened solids shall be of stainless steel construction, except that the screw conveyor can be made of corrosion-resistant and abrasion-resistant carbon steel.

2. The screen basket shall be of a semi-cylindrical shape and installed in the housing in-line to the direction of liquid flow.

3. The screen basket shall use perforated plate.

4. Stainless steel seal plates or rubber side seals shall be provided with a profile conforming to the channel to prevent flow from bypassing the screen.

5. The upper end of the screenings basket shall have a stainless steel mating flange suitable for bolting to the screenings conveyor transport tube.
B. Screenings Conveyor and Screenings Dewatering Press

1. The screen shall be cleaned by a shaftless screw conveyor, at least throughout the screen basket area, with flights designed to operate and to convey screened material. The shaftless screw conveyor flights for cleaning the screen shall be fabricated with ½-inch minimum corrosion-resistant and abrasion-resistant carbon steel or stainless steel plate. Carbon steel screw conveyor designs, which are not corrosion-resistant and abrasion-resistant, will not be acceptable for this project.

2. Attached to the shaftless screw conveyor flights the full length of the perforated screen shall be a stainless steel backed brush composed of water-resistant bristles. The brush shall be attached to the shaftless screw conveyor with stainless steel holder clips and stainless steel fasteners.

3. As material is conveyed into the enclosed transport tube there shall be a transition section from the screen to the screenings transport tube. The transport tube shall be stainless steel.

4. The compaction zone shall be an integral part of the screenings screw conveyor and transport tube design. The compaction zone shall be designed to return water released from the screened material back to the wastewater channel via a flexible reinforced rubber hose. Drain design shall allow for removal and cleaning of the drain hose should it ever become plugged without removing the drive, discharge head or screw conveyor. Compaction zone housing shall be furnished with appropriate access to the screw conveyor should the compaction zone ever become plugged. Designs, which require removal of the drive assembly, discharge head or screw conveyor to gain access to the compaction zone will not be acceptable.

5. A reverse flight spiral with a serrated cutter shall be provided to cut off the compacted material plug to drop into the receiving receptacle.

6. The screen shall be provided with a pivoting support bracket allowing rotation of the unit out of the channel for maintenance purposes.

C. Drive

1. The spiral drive system shall consist of a single-speed motor direct connected to the gear reducer.

2. The gear reducer shall be bolted to the upper end of the transport tube shaft.

3. The gear reducer shall be driven by a 1,800 rpm, 3-phase, 60 Hertz, 230/460 volt, continuous-duty, totally-enclosed, fan-cooled motor with leads to a large conduit box for outdoor operation.

D. Spray Wash Systems

1. Spray wash systems shall be furnished with a control solenoid valve, ball valve, stainless steel piping and fittings, flexible reinforced PVC hose, ball valve, and stainless steel nozzles. Piping, fittings and valves shall be 3/4-inch diameter minimum. A Y-strainer shall be provided for the incoming plant water supply.

2. The screenings spray wash system shall be located in the upper section of the transport tube to break up and return organic materials to the flow stream. The screenings spray wash system and screenings screw conveyor shall be designed to prevent washing screenings down the center of the screw conveyor.

3. The solenoid valves shall be normally operated via the control panel, but allow for manual operation.
4. Solenoid valves shall be 3/4-inch minimum, brass body, 2-way, and designed for 120 VAC operation with a NEMA 4X rating. Solenoid valves shall be normally closed and rated for up to 100 psig.
5. Ball valves shall be in accordance with Section 15050.
6. Y-strainer shall be 3/4-inch diameter bronze body with stainless steel internals.
7. Conduit and fittings shall be included between the solenoid valves and junction boxes.
8. ALL HYDRAULIC CONDUITS ASSOCIATED WITH THE SPRAY WASH SYSTEM SHALL BE HEAT TRACED AND FREEZE PROOF TO -30F (See Section 2.04).

2.03 CONTROL SYSTEM

A. All controls necessary for the fully automatic operation of the screen shall be provided.

B. The electrical control system shall provide for automatic control of the screen via a high liquid level using an ultrasonic liquid level control system in connection with an adjustable timer to provide a variable time between cleaning operations.

C. The local-mounted control panel shall include the following items:
   1. Disconnect switch with door handle
   2. Control transformer
   3. Reversing starter (if screw conveyor is not shaftless through the transport tube)
   4. Programmable controller or relays and timers to monitor equipment and perform logic functions
   5. Elapsed time meter
   6. Overload protection in addition to motor thermal overload
   7. Transient voltage surge suppressor
   8. Ultrasonic liquid level sensor controller
   9. Power on pilot light
   10. Screen running pilot light
   11. Fault and fault reset push button light
   12. Screen stand-by pilot light
   13. Emergency stop pushbutton
   14. Screen hand-off-auto switch with discrete output to monitor switch position
   15. Spray wash system hand-off-auto switch
   16. Screen forward-off-reverse switch (only included with reversing starter)
   17. 600 VAC terminal block
   18. NEMA 4X enclosure
   19. Dry contacts for run and fault outputs for remote monitoring.

2.04 OUTDOOR WEATHER PROTECTION

A. The screenings transport tube shall be furnished with a heat tracing system for outdoor weather protection, which shall enclose the screenings transport tube, compaction and dewatering zone and spray wash piping, ball valves, and solenoid valves. Provide 15 feet of heat tracing and insulation material for aboveground connecting water piping. Connecting water piping to be provided by the Contractor.

B. The outdoor weather protection system shall include self regulating heat tracing, adjustable thermostat, closed-cell foam, insulation and a protective jacket. The
protective jacket shall either be properly coated or of suitable materials to prevent breakdown from UV radiation.

C. The heat tracing system shall be suitable for operation down to a minimum temperature of -25 deg C (-13 deg F) and shall be powered from the main control panel.

D. The protective jacket shall extend from the discharge chute over the compaction and dewatering zone and down to the main basket support flange. The protective jacket shall be connected with stainless steel nuts, bolts and washers. The insulation shall be completely encapsulated within the jacket to prevent water intrusion and damage.

2.05 ANCHOR BOLTS

A. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Bolts, washers and hex nuts shall be 304 stainless steel unless noted otherwise. Anchor bolts shall be expansion-type stainless steel.

B. Anchor bolts shall be set by the Contractor. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

2.06 SHOP SURFACE PREPARATION AND PAINTING

A. Painting: Apply manufacturer’s standard factory paint finish.

B. Clean all stainless steel surfaces and provide glass bead blast or chemically treat all external non-wetted stainless steel to a uniform finish.

2.07 SOURCE QUALITY CONTROL

A. All welding in the factory shall use shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide for a cross section equal to or greater than the parent metal. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of the joint.

B. Field welding of stainless steel will not be permitted.

C. Bolts, nuts and washers shall be AISI 304 stainless steel furnished in accordance with ASTM A193.

D. All surfaces that are specified to be machined shall be designed and fabricated to provide a runout of not more than 0.005 inches and a concentricity to within 0.005 inches.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in strict conformance to the manufacturer’s installation instructions.
3.02 FIELD PREPARATION AND PAINTING

A. Apply a final color coat in the field in accordance with Section 09960.

3.03 FIELD TESTING

A. Prior to final acceptance of the screen, three (3) tests shall be conducted according to the EPA Paint Filter Test as described in method 9095 of EPA Publication SW-486.

B. Should the system fail to produce screenings capable of passing the "EPA Paint Filter Test", the manufacturer shall at its own expense make all necessary modifications to the equipment until such tests can be passed.

3.04 OPERATOR TRAINING

A. The manufacturer shall supply a competent field service engineer to thoroughly check and inspect the equipment after installation, place the equipment in operation, make necessary adjustments, calibrate instruments, and conduct field tests. The services required shall also include on-the-job training of operators including safety procedures, operating instructions, and preventive maintenance procedures. Furnish a minimum of one man-day of field services.

END OF SECTION
SECTION 11364
DECANTER CENTRIFUGE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work Included in This Section:
   1. Decanter Centrifuge and appurtenances as shown on the Drawings and specified herein.

B. Related Sections
   1. Section 11320 – Rotary Lobe Pumps
   2. Section 11305 – Polymer Feed System
   3. Section 14550 – Shaftless Screw Conveyor

1.02 SUMMARY

A. The Contractor shall furnish, install and place into operation a centrifuge, controls, instrumentation, and appurtenances as specified herein and shown on the Drawings. The centrifuge is intended to dewater aerobically digested municipal sludge. Appurtenant equipment including the centrifuge feed pump, the polymer feed system and the shaftless screw conveyor are covered in separate specification sections and are not intended to be provided by the centrifuge supplier. Provisions to incorporate these equipment pieces shall be included in the centrifuge control panel.

B. The centrifuge system specified in this section shall be provided by a single supplier to ensure coordination and compatibility of equipment.

C. All equipment specified herein, shall be fabricated, assembled, and placed in proper operating condition in full conformity with drawings and specifications, engineering data, and instructions and recommendations of the equipment manufacturer. The centrifuge units shall be the product of a manufacturer regularly engaged in the design and manufacture of centrifuges and shall be specifically designed for the intended conditions of service. Appurtenant equipment shall be new and shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Individual parts shall be manufactured to standard sizes and gauges. Components of the centrifuge shall be designed for the stresses which may occur during fabrication, shipping, assembling, or maintenance. Materials shall be suitable for service conditions and as described herein.

D. The unit shall be completely tested in the assembling facility. The equipment shall be shipped in a minimum number of components, and they will typically be comprised of the centrifuge skid assembly with drive and backdrive, control panel and other parts.

1.03 DEFINITIONS

FINAL
January 2004
037012.10
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11364 - 1
Decanter Centrifuge
A. Solids Capture: The percent of the feed solids that remain in the dewatered end product on a weight basis.

For purposes of this specification, "% Capture" is defined as:

\[
\% \text{ Capture} = \left(\frac{C}{F}\right) \left[\frac{(F-E)(C-E)}{100}\right]
\]

Where:
- \(C\) = Dewatered Cake Total Solids (TS) (mg/kg)
- \(F\) = Feed TS (mg/kg), excluding any dilution from polymer solution flow
- \(E\) = Centrate TS (mg/kg), excluding any dilution from polymer solution

B. Polymer Consumption
1. To be based on 100% active polymer.

C. G-Volume: G-Volume is the product of centripetal acceleration and decanter volume. This value is used to quantify the potential performance of the centrifuge. G-Volume (G-Vol) is defined as follows:

\[
G\text{-Vol} = G \times \pi \times L_{(cyl)} \times \frac{1}{4} (D^2 - d^2)
\]

where:
- \(G\) = G Force = \(D \times \omega^2 \times \frac{1}{2} x (2 \times g)\)

where:
- \(D\) = Bowl Diameter
- \(\omega\) = angular velocity
- \(g\) = acceleration due to gravity

and:
- \(L_{(cyl)}\) = length of the cylinder section (does not include beach section)
- \(D\) = bowl diameter
- \(d\) = discharge diameter

1.04 SYSTEM DESCRIPTION

A. Design Criteria

The centrifuge shall be designed to extract water from the biosolids specified herein after conditioning of the biosolids with a polymer solution. The process of dewatering shall produce a finished biosolids product based on the following feed characteristics and operating parameters:

- Type of Sludge: Aerobically Digested Secondary Sludge
- Source of Sludge: Domestic Wastewater
- Solids Concentration (% TSS): 1.0 % to 2.0%
- Average Dry Solids Loading (lbs/hour): 500
- Min. Temperature of Feed Solids (°F): 60
- Volatile Solids (% by weight): 40 to 70
- Operating Cycle (hrs/day), (days/week): 7, 3 (21 hours/week)
- pH: 6.0 to 8.0
- Particle Size Not to Exceed (inches): 0.25
B. Performance Requirements

1. The centrifuge shall meet the performance criteria specified below for the entire range of feed characteristics specified in Paragraph 1.03.A. above:

   Number of Centrifuges.................................1
   Minimum Flow Rate (gpm)............................65
   Minimum Solids Loading (dry lbs/hr)...........625
   Minimum Dewatered Sludge Solids (%TS).....see item B.4 below
   Minimum Solids Capture (% TSS)...............95
   Maximum Polymer Consumption
     (lbs active polymer/dry ton of sludge).....28

2. The centrifuge shall be sized to dewater feed flow rates in the design operating range specified above, plus any additional flow due to polymer addition to the feed.

3. The G-Volume value shall be 88,000 gallons or greater as calculated in the formula presented in Section 1.02 C above.

4. The Minimum Dewatered Sludge Cake concentration shall be based on the table below:

   Minimum Dewatered Sludge Cake Concentration

<table>
<thead>
<tr>
<th>Minimum Ash Content of Digested Sludge (%)</th>
<th>Maximum Polymer Consumption (lb/DT)</th>
<th>Minimum Dewatered Solids (%)</th>
<th>Solids Capture Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>28</td>
<td>18%</td>
<td>95</td>
</tr>
<tr>
<td>30</td>
<td>24</td>
<td>20%</td>
<td>95</td>
</tr>
<tr>
<td>35</td>
<td>24</td>
<td>22%</td>
<td>95</td>
</tr>
</tbody>
</table>

1.05 SUBMITTALS

A. Complete fabrication, assembly, foundation, and installation drawings, together with power drive assembly and instrumentation shall be submitted for review. The following information shall also be included in the submittal:

1. Detailed drawings and descriptions of all items of equipment, including centrifuge control panels. Information showing all dimensions, parts, constructed details, materials of construction, connection sizes, required overhead and disassembly clearances, and capacity and location of lifting eyes shall be included.

2. Maximum bowl speed and corresponding G-force.

3. G-Volume calculation (per Section 1.02 C).

4. Information on the control panel

5. Complete backdrive system operating description.

6. Complete motor data sheets including the following information:
   a. Manufacturer's name.
   b. Manufacturer's type and frame designation.
   c. Horsepower output.
   d. Time rating.
   e. Maximum ambient temperature rating.
   f. Insulation system designation.
g. rpm at full load.

h. Voltage, number of phases, frequency, and full load amperes.

i. Code letter for locked rotor kVA.

j. Service factor at 40°C ambient.

k. NEMA design letter.

l. Enclosure type.

m. Lubrication requirements, including type and frequency.

n. KW input power and power factor at 75% and 100% of rated horsepower output.

o. Guaranteed minimum efficiency and nominal efficiency per Section 11002.

p. Speed torque curves.

7. Complete system schematic (elementary) wiring diagrams, including, but not limited to, the following:
   a. Complete system interconnection diagrams between power supply, control panel, main drive motor, backdrive motor, AFDs, and all related components or controls external to the system, including wire numbers and terminal board point identification. Diagrams shall be in accordance with NEMA ICS 1-101.
   b. One-line diagram of 460-volt system, including component ratings.

8. Calculated AFBMA L-10 bearing life and type of lubrication recommended for all equipment.

9. Information on field and installation requirements, including:
   a. Mounting and access requirements.
   b. Foundation plan with recommended anchor bolt locations and sizes.
   c. Total number of components to be handled.
   d. Weight of each component and each complete assembly.
   e. Overall dimensions of each component and each complete assembly.
   f. Clear indication of heaviest and largest (bulkiest) components for handling and lifting.
   g. Clear indication of the locations for mechanical and electrical connections on the equipment.
   h. General installation manual with Supplier’s installation instructions.
   i. Clear delineation on installation drawings of those items being furnished by the Supplier and those to be furnished by the Installation Contractor.

10. A detailed description of the instrumentation and control system proposed, including a list of all centrifuge functions monitored, controlled and alarmed.

11. Panel control and power wiring diagrams, including all connections to external devices.

12. Electric motor control schematics.

13. Variable frequency drive details showing conformance to IEEE-519 Standards as well as NEMA ICS 1, 2, 3, 3.1, 4, and 6.

14. List of spare parts to be furnished.


16. Seismic design and calculations as specified in Section 01190.

17. Control and instrumentation drawings as described in Section 17100.

18. Provide and submit, in accordance with Section 00700. 8.6, mechanical and structural drawings stamped and sealed by an engineer licensed in the state of Nevada showing all modifications to the existing design necessary to install the equivalent centrifuge and appurtenances. The basis of design for this project is the Andritz model D4L. Installation of a different centrifuge may require...
structural, mechanical, or electrical changes. The revised drawings must be approved by the project engineer of record prior to final acceptance of the reconfigured design. All engineering costs incurred as a result of the re-design shall be the Contractor's responsibility.

B. Field Testing Plan: Provide a detailed plan for conducting the specified Field Services and Field Testing. As a minimum, the plan shall include: procedures that will be used during the Field Testing; an indication of necessary coordination with the Engineer and the Installation Contractor; and a schedule for performing each component of the Field Services, the Functional Test, and the Performance Testing (see Section 3.03 A and B).

C. Four (4) Owners Manuals: Provide operation and maintenance manuals and parts list for all equipment furnished under this contract. Include instructions for delivery, storage, assembly, installation, lubrication, adjusting, startup, operation and maintenance.

1. For all equipment include:
   a. Startup instructions  
   b. Normal operation instructions.  
   c. Alternate specified operating modes.  
   d. Emergency shutdown instructions.  
   e. Normal shutdown instructions.  
   f. Long-term shutdown instructions.  
   g. Troubleshooting instructions.  
   h. Lubrication instructions.  
   i. Maintenance and reinstallation instructions.  
   j. Parts identification.  
   k. List of spare parts recommended to have on hand.  
   l. Operator safety instructions.  

2. For all Electrical Equipment, provide the following additional information:
   a. Equipment ratings.  
   b. Calibration curves and rating tables if appropriate.  

D. Suppliers' Affidavits: Each equipment manufacturer, or his authorized representative, shall submit affidavits in conformance to the following:

1. Acceptable affidavits shall be submitted prior to completion of the work. The first set of affidavits shall be submitted after the Functional Test, and the second set of affidavits shall be submitted after the Performance Testing.

2. The first set of affidavits shall contain the following specific wording:  
   "The [Name of Equipment] has been properly installed, adjusted, lubricated, and is ready for full time operation and for Performance Testing. The installation has been inspected and has been found to be in conformance with our (the Supplier's) standards and requirements."

3. The second set of affidavits shall contain the following specific wording:
   "The [Name of Equipment] has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full time operation in conformance with the specified performance criteria. The installation has been inspected and has been found to be in conformance with our (the Supplier's) standards and requirements."

4. No amplification, dilution, or modification of the specific wording will be permitted.
1.06 QUALITY ASSURANCE

A. The Centrifuge Supplier must be prequalified by the Engineer/Owner for the particular model of centrifuge proposed in order to furnish the centrifuge equipment for this project.

1. The following Centrifuge Suppliers have been pre-qualified for this project: Andritz-Ruthner, Inc.; Alfa Laval Separation Inc., Centrisys Corporation. Qualification of any other centrifuge manufacturer and model will be based on the technical specifications, as determined by the sole discretion of the Design Consultant, Kennedy/Jenks Consultants following award of the bid.

2. The naming of these pre-qualified manufacturers does not in any way indicate or constitute a guarantee that the named equipment will meet the requirements in these technical specifications. The Centrifuge Supplier shall be responsible for meeting all of the specified requirements, including the performance requirements.

B. The Centrifuge Supplier shall have a minimum of ten (10) years experience in the manufacture and installation of solid bowl decanter centrifuges.

C. The Centrifuge Supplier shall have centrifuges of the same or larger inside bowl diameter as the specified minimum installed and in operation at a minimum of ten (10) other facilities within the United States. The Centrifuge Supplier shall be able to demonstrate the ability to meet performance requirements with the same model of centrifuge as the proposed unit.

1.07 SEISMIC DESIGN REQUIREMENTS

A. Provide vertical support, lateral bracing, anchorage, and adequate space for seismic movement in accordance with Section 01190.

1.08 DELIVERY, STORAGE AND HANDLING

A. Ship items as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components.

B. Spare parts.

1. Pack in containers bearing labels clearly designating contents and pieces of equipment for which the part is intended. Each part shall be identified with a tag bearing its part number and a part description.

2. Deliver at same time as the centrifuge equipment.

3. Centrifuge Supplier shall furnish as a minimum the following spare parts and tools. The tools supplied shall be capable of assembling and disassembling the centrifuge.

   a. 1 set of universal tools, spanners, hex keys, pliers, screwdrivers, etc.
   b. 1 set of bearing pullers for the various bearings on the centrifuge.
   c. 1 gear box lifting sling.
   d. 1 bowl lifting yoke.
   e. 1 conveyor lifter.
   f. 1 set of lubricants necessary for the operation of the centrifuge. Supply shall cover 2 years operation.
g. 1 set each of main bearings, conveyor bearings, and thrust bearings.
h. 1 set of other tools as required for assembly and disassembly of centrifuge.

1.09 WARRANTY

A. The Centrifuge Supplier shall warrant against any defects in material or workmanship of the centrifuge equipment for a period of twelve (12) months following successful completion of startup and Performance Testing of the centrifuge equipment or for a period of twenty-four (24) months following delivery of the centrifuge equipment, whichever occurs first. If the unit is stored for more than 60 days, the machine must be rotated at least monthly and the lubricants checked and replaced, if necessary, prior to startup.

B. The Centrifuge Supplier shall repair or replace any parts of the centrifuge system that are found to be defective in workmanship or materials during the warranty period, provided said equipment is operated in accordance with the Supplier’s written operating instructions, and provided that the Engineer notifies the Supplier in writing within fourteen (14) calendar days after such defect becomes apparent.

C. If the Centrifuge Supplier provides a statically cast bowl, the Centrifuge Supplier shall provide a ten (10) year written replacement warranty against bowl distortion requiring servicing or rebalancing of the bowl. The warranty must be submitted with other submittal items required in Section 01300.

1.10 SERVICE

A. The Centrifuge Supplier shall provide a scroll conveyor loaner program for times during which the Engineer’s scroll is removed for maintenance repair or overhaul.

B. The Centrifuge Supplier shall maintain a facility with a complete spare parts inventory in the contiguous United States. Spare parts shall be delivered within forty-eight (48) hours of demand.

C. The Centrifuge Supplier shall maintain service centers, a balancing and major repairs facility, and a control system service center in the contiguous United States.

PART 2 – PRODUCTS

2.01 GENERAL

A. The centrifuge shall be a high speed, solid bowl, horizontal, continuous feed, scroll type unit. The centrifuge unit shall be designed specifically for dewatering and shall be designed to operate in a counter-current configuration. The centrifuge unit shall also be designed and built to operate on 8-hour run cycles with full clean-up in between operation cycles.

B. The centrifuge scroll shall be equipped with a disc, or annular ring, at the end just before the solids leave the pond in the bowl. The disc shall be designed to allow only the bottom (driest) layer of solids to exit the cylindrical section of the bowl.

C. All wetted metal parts shall be of 316L or 316 stainless steel, unless otherwise specified.
D. Miscellaneous hardware, including bolts, nuts, washers, fasteners, and fastener clips, shall be ASTM A320, 316L or 316 stainless steel.

E. The centrifuge shall be dynamically balanced prior to shipment and shall be designed such that operating noise levels will not exceed 88 dBA at a 3-foot distance from the centrifuge, as measured with all inlet and outlet openings closed, and running without any process liquids. Note: Operating noise level will be verified in the field, with inlet and outlet openings connected to process piping, and running without any process liquids.

F. The bowl, scroll and gearbox shall be balanced independently at full operational speeds so that rebalancing of the bowl, scroll, or gearbox will not be necessary after scroll is removed for maintenance.

G. Supply the centrifuge unit with lifting eyes. Motors shall have lifting eyes of their own.

H. Furnish the centrifuge unit with a stainless steel nameplate fastened to the centrifuge in a readily readable position. This nameplate shall contain the manufacturer’s name, equipment rating, capacity, size, model, serial number, and speed. All information shall be in English.

I. Furnish each piece of rotating equipment with an arrow indicating the forward direction of rotation.

2.02 BOWL

A. The bowl shall either be centrifugally cast from 316L stainless steel or duplex 317 stainless steel, or be statically cast from 316L stainless steel. The bowl shall be manufactured to withstand all centrifugal forces encountered throughout the design operating speed range with adequate safety factors. The bowl shall be inspected for cracks, shrinkage, porosity, or other defects, by means of a liquid dye penetrant test. As an alternative to liquid dye penetrant testing, the bowl may be x-ray tested for defects. Bowl inspection reports from both tests shall be supplied to the Engineer.

B. The bowl shall be lined with replaceable welded longitudinal stainless steel ribs. Ribs or grooves shall prevent circumferential slippage of the sediment solids, thereby facilitating conveyance of solids by the scroll to the discharge ports.

C. The pond depth in the centrifuge bowl shall be adjustable through the use of weirs at the large diameter feed end of the bowl where liquid is discharged.

D. Cake solids shall be discharged from the small diameter end of the bowl.

2.03 SCROLL CONVEYOR

A. The centrifuge shall include a Type 316L or 316 stainless steel horizontal conical-cylindrical scroll conveyor. The scroll shall utilize a differential speed with that of the bowl to convey solids from the cylindrical section to the conical section and out of the bowl with a minimum disturbance to the pool.
B. Automatic control for the scroll shall be based on torque. Adjustment of the scroll speed shall be made through the backdrive adjustable frequency control or through the use of a hydraulic drive scroll.

C. Scroll conveyor shall be designed such that the feed is evenly discharged 360 degrees into the bowl via a conical feed distributor for dissipation of energy and minimum disturbance to the pool. Scroll conveyor shall be a ribbon screw scroll, equipped with helical flighting and flow equalization windows to allow axial flow of process liquid along the scroll shaft for minimum disturbance to the pool and maximum settling of fine particles.

D. The scroll conveyor shall be provided with polymer feed ports, such that polymer can be dosed directly into the centrifuge bowl, or a special connector shall be provided to dose polymer at the inlet of the centrifuge, as close to the conveyor hub as possible.

E. The scroll conveyor edge and face of the flights shall be protected against abrasion with field replaceable sintered tungsten carbide tile assemblies from the feed zone to the solids discharge of the scroll conveyor. Each tile assembly shall be affixed to the conveyor flight by a welding attachment procedure. Each tile assembly shall be weight-corrected and shall consist of a sintered tungsten carbide tile attached to a stainless steel backup plate or holder. Each tile assembly shall be individually replaceable. The unsupported overhang length of each tile, as measured from the scroll flight edge to the tile edge, shall be a uniform length and be within the range of 0.2 inches minimum to 0.5 inches maximum. The tungsten carbide must pass the ASTM G-65 dry sand abrasion test with a volume loss of no more than 3 cubic mm.

F. The centrifuge scroll conveyor shall be removable with minimal or no displacement of the main drive or backdrive allowing for ease of inspection. If a slight displacement of a drive motor is necessary, the motor shall remain mounted and displacement shall be a one-person job.

2.04 BEARINGS

A. Two main bearings shall support the rotating assembly. Bearings shall be cylindrical roller type or ball type bearings with grease lubrication. Bearings shall be housed in one-piece pillow blocks, sealed from process contamination and from flush water seepage of clean-in-place operation, and equipped with external high-speed grease lubrication points.

B. Scroll and thrust bearings shall be anti-friction type bearings with grease lubrication.

C. Bearings shall have an AFBMA L-10 life of 100,000 hours minimum.

2.05 GEAR BOX

A. The centrifuge shall be equipped with either (1) a planetary gear reducer or (2) a cyclo gear, or (3) a single-stage radial piston hydraulic motor. Cyclo gear shall be manufactured by Sumitomo or equal. The hydraulic drive shall be manufactured by ViscoTherm.
B. The gear box shall be rated for at least 1.2 times the maximum torque to which the gear box may be subjected.

C. Gears shall be oil lubricated. Lubricating oil shall be self-contained and shall be high performance gear oil.

D. The gear box shall be independently balanced from the centrifuge and shall be interchangeable.

E. Each gear unit shall be protected from damage due to high torque overload.

2.06 BASE

A. The centrifuge shall be supported on a painted reinforced carbon steel base mounted on vibration isolators. The vibration isolators shall be provided to isolate the centrifuge frame from the building structure, as recommended by the Centrifuge Supplier for the service required. Isolators shall be specifically sized by the Centrifuge Supplier depending on bowl speed and service conditions. Centrifuge Supplier shall furnish vibration isolators. Centrifuge Supplier shall indicate required size of anchorage to match vibration isolators.

B. The vibration shall be a maximum of 2 mils displacement (6.5 mm/s RMS), as measured on the centrifuge pillow blocks at maximum operating speeds under field conditions and running with no process fluids. The centrifuge shall be equipped with on-line vibration monitoring and vibration indication shall be provided as a continuous 4-20 mA signal. In addition, an accelerometer type switch shall be used to sense vibration and automatically shut down the machine at a vibration of a predetermined displacement.

2.07 BOWL COVER

A. The bowl cover shall be of one-piece construction and fabricated of stainless steel or fiberglass.

B. If bowl cover is fiberglass, the centrifuge shall also be equipped with internal stainless steel guards: one over the centrate port and one over the solids discharge port.

2.08 ANCHORAGE

A. Equipment anchorage to the supporting structure will be 316L stainless steel. The Installation Contractor will provide the equipment anchorage, as specified by the Centrifuge Supplier. The Installation Contractor will provide the proper anchorage as required by the Centrifuge Supplier to match the vibration isolators.

2.09 DRIVE SYSTEM

A. General

1. The drive system shall consist of electric motors and a belt drive system. The belt drive system shall consist of multiple belts as required to provide full load capacity and also to withstand the full starting torque of the system. The drive system shall use one AC motor for the main drive and a separate AC motor or
hydraulic drive system for the backdrive for differential adjustment. The main drive will control the bowl, while the backdrive will control the scroll. The electrical motors for the main drive and backdrive shall each be controlled by an adjustable frequency drive (AFD) and shall be specifically designed for use with AFDs. If a hydraulic drive system is used to maintain the scrolling speed of the machine, the scroll speed shall be controlled torque.

2. The converter section of each AFD shall be a clean power controller providing sinusoidal current to the inverter section with minimal harmonics to the incoming power source. Products of the following manufacturers are acceptable, subject to conformance with the specifications:
   a. Cutler-Hammer/Westinghouse Clean Power Accutrol 700 Series;
   b. Halmar Robicon Group Clean Power Drives; ABB
   c. Or, equal.

3. Motors rated 100 horsepower or less and rated 600V or less shall be listed in UL Recognized Component Directory.

4. Provide ground lug inside the terminal box.

5. Provide lifting eye on each motor weighing more than 50 pounds.

6. Motors shall have inverter duty complying with NEMA MG-1 Part 31.40.4.2.

7. Provide stainless steel nameplate for each motor, attached to the motor by stainless steel screws or drive pins. Nameplates shall indicate clearly the information required by NEMA MG1, Part 10 and MG1-12.55.

8. Provide premium efficiency motors. Premium efficiency motors shall have nominal efficiencies at full load not less than those listed in Table 1 at the end of this specification. Guaranteed minimum efficiencies shall correspond to nominal values as tabulated in NEMA MG-1, Table 12-6. Efficiencies shall be determined by using the IEEE 112, Test Method B, using segregated loss determination.

9. The maximum permissible motor loading for motors with service factor 1.15 or greater: 100% of nameplate horsepower.

10. Provide motors with locked rotor kVA values less than or equal to those corresponding to the following:

<table>
<thead>
<tr>
<th>Horsepower</th>
<th>Code Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤5</td>
<td>M</td>
</tr>
<tr>
<td>7-½ -10</td>
<td>H</td>
</tr>
<tr>
<td>≥15</td>
<td>G</td>
</tr>
</tbody>
</table>

B. Main Drive Motor

1. Design, construction, testing and performance of the drive motor shall conform to the requirements of the latest revisions of NEMA Publication MG-1 and requirements specified herein. Motor nameplate horsepower rating shall be equal to, or greater than, the maximum brake horsepower of the drive system at its maximum hydraulic flow rate.

2. Motor shall be a maximum 50 horsepower squirrel cage induction motor, 1,800 RPM, TEFC, continuous duty, with a Class F insulation system limited to a B temperature rise, 1.15 service factor, NEMA design B, standard long shaft for V-belt drive, and terminal box rotatable in 90 degree increments. Motor shall have copper windings and be of high thermal capacity design for operation on 460/3/60 power. Fluid couplings starting systems are not acceptable.
3. Motor shall be provided with thermal protection using a bi-metal thermal switch or a resistance temperature detector (RTD). A dry contact for indication of thermal shutdown (high high temperature) of the motor shall be provided.

4. Motor at ambient temperature shall be capable of making 2 complete starts in succession with coasting to reset between starts. Motor shall be capable of at least 1 restart within 1 hour after any shutdown. Motor shall not take longer than 5 minutes (each start) to accelerate to full rated revolutions per minute at 90 percent nameplate voltage. Motor shall be rated by the motor manufacturer as having a noise level not exceeding 85 decibels (sound pressure) when measured at 3 feet from the motor in any direction. Motor bearings shall be grease lubricated, ball or roller anti-friction type of standard manufacture. Bearings shall be conservatively designed to withstand all stresses of the service specified. Motor bearings shall have a minimum B-10 rating of 40,000 hours of operation.

5. The main drive shall be designed so that in-rush starting current does not exceed the continuous full load current rating of the main drive motor.

C. Backdrive Motor
1. Each centrifuge shall be equipped with a backdrive system to allow the adjustment of the differential speed between the centrifuge bowl and conveyor during operation.

2. The AFD-controlled backdrive AC motor or the hydraulic backdrive motor shall be a maximum of 15 HP and shall be 1800 RPM, TEFC, continuous duty, with a Class F insulation system limited to a B temperature rise, 1.15 service factor, and high efficiency design. Design, construction, testing and performance of the drive motor shall conform to the requirements of the latest revisions of NEMA Publication MG-1 and requirements specified herein. Motor shall have copper windings and be of high thermal capacity design for operation on 460/3/60 power.

3. Motor shall be provided with thermal protection using a bi-metal thermal switch or a resistance temperature detector (RTD). A dry contact for indication of thermal shutdown (high high temperature) of the motor shall be provided.

4. Motor shall be rated by the motor manufacturer as having a noise level not exceeding 85 decibels (sound pressure) when measured at 3 feet from the motor in any direction. Motor bearings shall be grease lubricated, ball or roller anti-friction type of standard manufacture. Bearings shall be conservatively designed to withstand all stresses of the service specified. Motor bearings shall have a minimum B-10 rating of 40,000 hours of operation.

5. The backdrive shall be designed so that in-rush starting current does not exceed the continuous full load current rating of the main drive motor.

6. For ease of maintenance, the backdrive system shall be designed so that the motor need not be disturbed in the removal of the rotating assembly.

7. The backdrive AFD system shall be provided with a dynamic braking system.

8. Backdrive systems utilizing eddy current brakes or direct current drives are not acceptable.

2.10 CLEAN-IN-PLACE

A. An automatic sequence for CLEAN-IN-PLACE system shall be provided to ensure the centrifuge bowl is clean after operating and before starting again.
1. The system shall be controlled by manual START-STOP selections on the centrifuge local control panel.

2. The system shall rotate the scroll in a reverse direction and shall include provisions for alternating scroll rotation direction at timed intervals.

B. The bearings shall not require regreasing after a CLEAN-IN-PLACE sequence has been performed.

2.11 ABRASION PROTECTION

A. In addition to the sintered tungsten carbide tiles required on the scroll conveyor, the following shall be considered a minimum degree of hard surfacing required:

1. Feed Compartment Walls: The feed zone or distributor shall be protected with flame-sprayed tungsten carbide. The feed zone is in the conveyor hub and is the first area in contact with the feed sludge after it leaves the feed tube and before entering the bowl.

2. Scroll Feed Ports: The scroll feed ports shall be protected by field replaceable tungsten carbide inserts.

3. Solids Discharge Ports: The solids discharge ports shall be protected by field replaceable tungsten carbide inserts.

4. Solids Discharge Casing: The solids discharge casing shall either be protected with a field replaceable tungsten carbide liner or be a field replaceable stainless steel unit.

2.12 PROTECTION AGAINST ELECTROLYSIS

A. Where dissimilar metals are used in conjunction with each other, provide suitable insulation between adjacent surfaces so as to eliminate direct contact and any resultant electrolysis. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings or bushings.

2.13 INSTRUMENTATION AND CONTROLS

A. General

1. All elements of the instrumentation and control system shall be tested to demonstrate that the total system satisfies all of the requirements of this specification.

2. Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and service. All components, assemblies, and wiring shall conform to the requirements of Division 16.

B. Control Panel

1. The centrifuge shall be supplied with a NEMA 4X stainless steel control panel housing controls, starters, and drives. The panels shall be free standing or wall mounted and suitable for operation of the system components as described herein.

2. The panel shall be completely assembled, prewired, and tested by the centrifuge manufacturer for proper control of the dewatering centrifuge system. Five spare terminal connections shall be provided.
C. Programmable Logic Controller (PLC)
   1. A microprocessor based programmable logic controller shall be used to control the centrifuge process. The PLC shall be Allen Bradley or equal to match those provided by Section 17330. The controller shall have battery backup in case of power failure to preserve settings and programs. EEPROM shall be used to store the master program.

D. Operator Interface Terminal (OIT)
   1. The OIT shall be a microprocessor based computer with color LCD display. The following parameter shall be monitored from the system:
      a. Indications
         1) Bowl RPM
         2) Backdrive RPM
         3) Differential RPM
         4) Backdrive Torque
         5) Centrifuge Drive Motor Amps
         6) Sludge Flow Rate
         7) Local/Remote Control Status
         8) Auto/Manual Control Status
      b. Control Signals
         1) Centrifuge Start/Stop Selections
         2) Centrifuge Run/Start/Off Indications
         3) Clean in Place Start/Stop Selections
         4) Clean in Place Run/Start/Off Indications
         5) Sludge Feed Pump Start/Stop Selections
         6) Sludge Feed Pump Run/Start/Off Indications
         7) Polymer Feed and Control
         8) Dewatered Sludge Conveyance System Start/Stop Selections
         9) Dewatered Sludge Conveyance System Run/Start/Off Indications
      c. Shut Down Alarms
         1) Shutdown
         2) Dewatering Sludge Feed Pump Valve Open/Close Selections
         3) Excessive Vibration System
         4) Excessive Main Drive Motor Temperature
         5) Backdrive Malfunction
         6) Excessive Scroll Drive Torque (stop feed and sludge feed pump)
   2. Centrifuge operation may be controlled manually or automatically. When operating in an automatic or "auto-torque" mode control is through a PID loop controller. When operating in the "auto-torque" mode relative speed is adjusted automatically to maintain constant torque, measured at the conveyor during optimization of separation.
   3. Control of the dewatering centrifuge system shall have provisions for automatic shutdown in case of abnormal conditions including but not limited to high vibration, and excessive torque.
   4. As a minimum, the dewatering centrifuge control panel shall include provisions for local and automatic START/STOP operation of each individual system component supplied under this section. In addition, provide a local status indicating light for each individual system component supplied under this section; provide local speed indication and provisions for local speed and torque control.
for the centrifuge drive system; and response for not less than the conditions identified herein.

5. An automatic sequence for CLEAN-IN-PLACE system shall be provided to ensure the centrifuge bowl is clean after operating and before starting again.
   a. The system shall be controlled by manual START-STOP selections on the centrifuge local control panel.
   b. The system shall rotate the conveyor in a reverse direction and shall include provisions for conveyor rotation in both directions at timed intervals.

C. Alarms
   1. In the event that a fault condition occurs, the sounding of an alarm horn will take place, the machine will shut down and an alarm fault message will be displayed on the operator interface unit to facilitate trouble shooting. An Alarm Acknowledge push-button, mounted on the front panel, will flash when a fault condition occurs. When pressed, the horn will be silenced and the flashing will turn solid. When the alarm fault is corrected and reset, the solid light shall be turned off.
   2. The following faults shall be provided as alert conditions:
      a. Feed Pump Fault
      b. Cake Conveyor Fault
      c. Torque Alert
   3. The following faults shall be provided as alarm and shutdown conditions:
      a. Main Motor Overheated
      b. Main Drive Malfunction
      c. Excessive Vibration
      d. Backdrive Motor Overheated
      e. Backdrive Malfunction
      f. Centrifuge Cover Open
      g. Torque Alarm
      h. Low Differential Speed
      i. Centrifuge Bow Overspeed
      Faults listed in items d and e above shall also cause immediate shutdown of the backdrive motor.
   4. Shutdown will be accomplished as described in the shutdown section above.
   5. Auxiliary Contact: Provide a dry "Common Alarm" contact for remote indication.
   6. Provide dry contacts for start of centrifuge pump, polymer equipment and conveyor.
   7. Provide 4-20 mA signal for regulating sludge feed rate and polymer feed rate.

2.14 PAINTING

A. Factory Painting: On motors, drives, starters, control panels, and other similar self-contained or enclosed components, apply a factory protective paint system as specified herein for the centrifuge, unless otherwise noted. Paint or otherwise protect surfaces that are inaccessible after assembly by a method which provides protection for the life of the equipment.

B. Shop Priming: Except where field sandblasting is required, apply one or more shop coats of metal primer on surfaces to be finish painted at the site, of sufficient thickness to protect surfaces until finished. Primer shall be compatible with finish coat.

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C. The paint system that is applied to the centrifuge shall be compatible with a top coat of aliphatic urethane (3-5 mils), Carboline System 33 or equal. The top coat will be applied by the Installation Contractor, with top coat color to be selected by Engineer.

2.15 POLYMER VENTURI MIXER

A. Provide a sludge/polymer mixer for mixing and flocculation of feed sludge conditioned with polymer. Sludge mixer shall be of the variable orifice venture type. Static mixers with stationary baffles will not be acceptable.

B. The mixer shall include an inline four port UHMW polyethylene polymer injection ring, flow splitting manifold, tubing and fittings between the injection ring and the manifold. The polymer injection ring shall inject polymer at a minimum of four points located 90 degrees apart around the circumference of the ring. The inside of the ring shall not be less than the inside diameter of the sludge feed piping. Each polymer injection port shall be a ½-inch NPT threaded connection with each of the four ports located on the flow splitting manifold.

C. The venture mixer shall be constructed of 316 stainless steel and provided with a check valve type of flapper with and external adjustable stop nut and counterweight. The mixer shall be equipped with ANSI compatible flanges at each end and a removable side plate for inspection and cleaning.

PART 3 – EXECUTION

3.01 FACTORY TESTS

A. Conduct factory tests on all motors in conformance with NEMA MG1-12.51. All tests shall be in accordance with IEEE Standard 112.

3.02 INSTALLATION

A. Install the pump unit(s) in strict conformance with manufacturer's installation instructions and the Contract Documents.

3.03 FIELD SERVICES

A. Centrifuge Supplier's Representation for Startup and Testing
   1. A technical representative of the Centrifuge Supplier shall be present at the jobsite for a minimum of eight (8) workdays consisting of two trips (a workday is an eight (8) hour period on site) for the services listed below, which are exclusive of the Performance Testing. The Centrifuge Supplier's technical representative shall allow additional time, as may be necessary, to complete the required Performance Testing. The following services shall be provided with allocation of workdays as established by the Engineer with the following distribution as a guide:
      a. First Trip – Four (4) workdays for coordination with the Installation Contractor, onsite inspection, Functional Test, certification of installation, and for pre-startup classroom and onsite equipment instruction and maintenance training.
b. Second Trip – Four (4) workdays for startup and for post-startup classroom and onsite equipment instruction, troubleshooting, and other follow-up services.

B. Workdays shall be eight (8) hour days, Monday through Friday, with dates determined by the Engineer.

3.04 FIELD TESTING

A. General
1. Field testing shall include both a Functional Test and Performance Testing, as specified. The main purposes of the Functional Test are to confirm that the centrifuge equipment is installed in accordance with the Centrifuge Supplier's standards and requirements and is ready for operation. The main purpose of the Performance Testing is to verify that the centrifuge performance meets the specified and guaranteed performance criteria.
2. The Performance Testing shall be completed within the period specified.
3. Field testing, sampling, and analyses shall be conducted during regular workdays, which are eight (8) hour days, Monday through Friday.

B. Functional Test
1. A Functional Test shall be performed for the centrifuge installed. Prior to system startup, centrifuge system components, including instrumentation and controls, shall be inspected for proper alignment, proper connection, and satisfactory operating condition. The Centrifuge Supplier's representative shall inspect the installation, check for lubrication and minor adjustments, and provide certification that the system components have been installed correctly and are ready for operation.
2. Completion of the Functional Test to the Engineer's and Design Consultant's satisfaction and provision of the specified affidavit by the Centrifuge Supplier are prerequisite to beginning the Performance Testing.

C. Performance Testing
1. During the Performance Testing, the centrifuge shall be operated by the Centrifuge Supplier in the automatic, torque-control mode.
2. The polymer used during the Performance Testing will be specified by the centrifuge supplier and supplied by the contractor.
3. The Owner will provide feed sludge, water, electrical power, centrate disposal, and biosolids cake disposal necessary to conduct the Performance Testing.
4. Data collected during the Performance Testing shall include, as a minimum: feed (sludge) flow rate, feed solids concentration, centrate solids concentration, cake (dewatered biosolids) solids concentration, polymer concentration, polymer dosage flow rate, bowl speed, scroll speed, G-force, amperage draw by the main drive, amperage draw by the back drive, and torque.
5. Performance Testing shall consist of Performance Curve Generation and Performance Demonstration Runs. The Performance Curve Generation shall be completed prior to conducting the Performance Demonstration Runs.
6. During the Performance Curve Generation work, sufficient tests shall be conducted to allow the development of the following performance curves:
   a. Feed Flow Rate versus Cake Solids: This performance curve shall show how the dewatered biosolids concentration varies with flow rate by plotting...
the feed flow rate (on the x-axis) and cake solids concentration (on the y-axis). A family of curves shall be developed for given polymer dosages. Each curve shall be generated by plotting at least five (5) test points. At least one curve shall be generated for the specified maximum polymer dosage rate, and at least one curve each shall be generated for polymer dosages above and below the specified maximum. The feed flow rate range for the curves shall at least cover the specified design operating range.

b. Feed Flow Rate versus Capture Rate: This performance curve shall show how capture varies with flow rate by plotting the feed flow rate (on the x-axis) and percent capture (on the y-axis). A family of curves shall be developed for given polymer dosages. Each curve shall be generated by plotting at least five (5) test points. At least one curve shall be generated for the specified maximum polymer dosage rate, and at least one curve each shall be generated for polymer dosages above and below the specified maximum. The feed flow rate range for the curves shall at least cover the specified design operating range and the minimum swallowing capacity.

7. A Performance Demonstration Run shall consist of a continuous eight (8) hour test run period, during which the feed flow rate and polymer dosing flow rate are held steady and no adjustments are made to the centrifuge equipment other than those made automatically by the control system to maintain the pre-set torque.

8. A Performance Demonstration Run will be considered to be successful if all of the results of the analyses of samples from that test run indicate that all of the specified performance criteria have been met during that test run. If the feed characteristics for a particular set of samples are found to be outside of the specified range, the results of the analyses of that set of samples will not be included.

9. Performance Testing Protocol:
   a. Flow Rate Measurements:
      i. The feed (sludge) flow rate will be determined based on the percentage of speed of the feed pump and the factory-tested feed pump performance curve. The Engineer may provide an inline flowmeter on the discharge side of the feed pump, but if so provided, this flowmeter will only be used for additional verification of the feed flow rate. The feed flow rate will be considered to be steady if it is within +/- 5% of the target flow rate.
      ii. The polymer dosing flow rate will be determined based on the polymer pump speed (or stroking rate) and, if applicable, the pump’s stroke length. A calibration tube will be included with the polymer system to confirm the dosing flow rate of the polymer pump. A calibration of the polymer system will be performed at least once for each polymer dosage flow rate selected for testing. The polymer dosing flow rate will be considered to be steady if it is within +/- 3% of the target dosing rate.
   b. Sample Locations:
      i. Feed (sludge) will be sampled by “drawing off” a sample through a sample tap on the feed line just after the discharge of the feed pump.
ii. Cake will be sampled from the centrifuge discharge chute, before the cake has been discharged into the cake conveyor.

iii. Centrate will be sampled by “drawing off” a sample through a sample tap on the centrate return line just after discharge from the centrifuge.

c. Sample Volumes:
   i. Feed samples will be a minimum of five hundred (500) cubic centimeters each.
   ii. Cake samples will be a minimum of five hundred (500) cubic centimeters each.
   iii. Centrate samples will be a minimum of one thousand (1000) cubic centimeters each.

d. Sampling Responsibility and Frequency:
   i. The feed, cake, and centrate sampling will be conducted by the Engineer.
   ii. Feed, cake, and centrate will be sampled as requested by the Centrifuge Supplier's representative during the Performance Curve Generation.
   iii. During the Performance Demonstration Runs, feed, cake, and centrate will be sampled every thirty (30) minutes but not sooner than 20-minutes following an adjustment to the centrifuge or polymer system. Every two (2) samples will combined prior to analysis to produce a representative sample for the hour and produce a total of eight (8) samples to be analyzed for each Performance Demonstration Run.
   iv. Each set of samples (feed, cake, and centrate samples) will be taken at approximately the same time, within a total time span of ten (10) minutes.

e. Analysis:
   i. Feed samples will be analyzed for Total Solids (% TS), Volatile Solids (% VS), pH, and Temperature.
   ii. Cake samples will be analyzed for Total Solids (% TS).
   iii. Centrate samples will be analyzed for Total Solids (mg/L).
   iv. Total Solids and Volatile Solids for feed and cake samples will be reported to the nearest one half of one percent (0.5%). Suspended Solids for the centrate samples will be reported to the nearest fifty (50) mg/L. These reported values shall be the basis for comparison to the specified performance criteria.

10. The Contractor will provide sampling and analyses, as described in the above Performance Testing Protocol, for up to forty (40) sets of samples during the Performance Curve Generation work. In addition, the Contractor will provide sampling and analyses, as described in the above Protocol, for five (5) complete Performance Demonstration Runs. Analyses conducted by the Contractor will be performed in accordance with standard analytical procedures in the Engineer's laboratory.

11. At the Centrifuge Supplier's option, an independent commercial laboratory that is acceptable to the Engineer may conduct all sampling and analyses. If the Centrifuge Supplier elects this option, then all costs associated with the sampling and analyses will be at the Centrifuge Supplier's expense. The Engineer may elect to perform its own sampling and analyses for comparison with the results from the independent commercial laboratory.
12. Any sampling or analyses requested or required in excess of that indicated as being provided by the Contractor in Paragraph 3.04.C.10 will be at the Centrifuge Supplier's expense. At the Centrifuge Supplier's option, the additional sampling and analyses may either be conducted by the Engineer, to be reimbursed to the Engineer, or by an independent commercial laboratory that is satisfactory to the Engineer. If an independent commercial laboratory is selected, the Engineer may elect to perform its own sampling and analyses for comparison with the results.

13. If, in the Engineer's opinion, any results from an independent commercial laboratory are potentially erroneous or unrepresentative of the samples, the Engineer may require additional sampling and analyses. Such additional sampling and analyses will be at the Engineer's expense. The results from such additional sampling and analyses must confirm the initial results from the independent commercial laboratory to be considered acceptable to the Engineer.

14. To fully satisfy the Performance Testing requirements and demonstrate that the centrifuge performance meets the specified and guaranteed performance criteria, at least one (1) successful Performance Demonstration Run must be completed at the design flow rate (Section 1.04 Paragraph B).

15. If, after two (2) Performance Demonstration Runs at the design flow rate, in the opinion of the Design Consultant, the Performance Testing results do not meet the requirements specified herein, the Design Consultant will notify the Engineer and Centrifuge Supplier of non-acceptable performance.

16. In the case of non-acceptable performance, the Centrifuge Supplier shall then have a maximum of sixty (60) calendar days in which to perform at its sole expense, any supplemental testing, equipment adjustment changes or additions, and to perform a re-test of the non-acceptable system. Damages for delays shall be applicable during this period of non-acceptable performance. If, after re-testing, the equipment again fails to meet the requirements specified herein, the Owner shall have the option of rejecting the installed equipment. If the Owner elects this option, the Centrifuge Supplier shall replace the rejected equipment with a different centrifuge, either in kind or in capacity and test again until the performance criteria are met.

D. Report:

1. The Centrifuge Supplier shall prepare and submit to the Engineer a written report documenting the Field Testing procedures, the Performance Curves generated, and the Performance Demonstration Run results.

END OF SECTION
SECTION 11375
OXIDATION DITCH EQUIPMENT
(BRUSH ROTOR AERATORS and EFFLUENT WEIRS)

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish, install and place into satisfactory operating condition brush rotor aerator assemblies with shafts, bearings, and drives; splash plates; baffles; covers; effluent weirs; and appurtenances as shown on the Drawings and described herein. Mixing Equipment for the oxidation ditch is covered under Specification Section 11220. A single supplier to maintain sole-system responsibility for the equipment and process requirements shall supply the Oxidation Ditch Equipment (including Mixing Equipment).

1.02 REFERENCES

A. American Institute of Steel Construction (AISC)
B. American Society of Testing and Materials (ASTM)
C. American Gear Manufacturers Associates (AGMA)
D. American Society of Civil Engineers (ASCE)
E. American Welding Society (AWS)
F. Steel Structures Painting Council (SSPC).

1.03 SYSTEM DESCRIPTION

A. Design requirements:
1. Number of Brush Rotor Aerators ................................................................. 3
2. Rotor Length, feet ............................................................................. 26
3. Minimum Number of Blade Star Assemblies per Rotor .................................. 52
4. Minimum Drive End Bearing Diameter, inches .................................. 4-7/16
5. Minimum Tail Shaft Bearing Diameter, inches .................................. 3-15/16
6. Motor Size, horsepower ........................................................................ 60
7. Biochemical Oxygen Demand (Design), lb/day ..................................... 1,763
8. Nitrification Oxygen Demand (Design), lb/day .................................... 350
9. Minimum Dissolved Oxygen Concentration (one rotor out of service), mg/l 1.50
10. Number of Effluent Weir Assemblies .................................................. 1
11. Weir Length, feet .................................................................................. 19
A. Shop Drawings and Product Data: Submit the following as a single complete initial package in accordance with Section 1300:

1. Product data fully describing all items proposed for use to demonstrate that the equipment conforms to the specifications.
2. Motor data.
3. Seismic anchorage certification and related sketch.
4. System layouts and schematics.
5. A certified oxygen transfer and horsepower report demonstrating that the units are capable of providing the required oxygen demand and meeting the stated oxygen transfer and power criteria below based on full-scale performance tests in a closed loop reactor configuration. Tests conducted in a small tank and not in a full-scale closed loop reactor configuration will not be acceptable. Oxygen transfer tests shall have been conducted by a recognized independent laboratory or accredited university personnel in strict conformance with "Measurement of Oxygen Transfer Rate in Cleanwater" procedures established by ASCE. Test report shall be certified by a registered Professional Engineer from the independent laboratory or accredited university who was in direct responsible charge of the tests.

<table>
<thead>
<tr>
<th>Speed (rpm)</th>
<th>Immersion (in)</th>
<th>O₂ Transfer (lb/hr-ft)</th>
<th>Power (bhp/hr-ft)</th>
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<tr>
<td>50</td>
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6. Demonstration that rotor covers do not impair oxygen transfer efficiency or velocity.
7. Details of the shaft seal arrangement.
8. A rotor blade strength test report. Rotor blade strength tests shall have been conducted by an independent materials testing laboratory and certified by a Registered Professional Engineer who was in direct responsible charge of the strength testing. Minimum testing requirements shall be as follows:
   a. Rotor blade strength tests shall be performed on at least six (6) blades mounted in the actual operating configuration for the material type provided for this project.
   b. Each blade tested shall be an integral part of a complete ring mounted on a full size torque tube section held in a test stand.
   c. Each blade shall be loaded perpendicularly at the tip in the same direction as that for actual operation.
   d. A load of 120 lb shall be applied to each blade at a point 20-1/4 inches from the center of the torque tube. Load shall be measured with a calibrated scale or dynamometer.
   e. Tip deflection for each blade shall be measured. The average tip deflection of the blades shall be less than 0.65 inches. In no case shall the blades be permanently deformed.
The Engineer reserves the right to require field verification tests of the strength of the rotor blades to be performed by the Contractor at no additional charge to the Owner. Failure of the blades to pass the strength test requirements shall be cause for rejection of the rotor aeration equipment at which time the Contractor shall be responsible replacing the equipment at no additional cost to the Owner.

B. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

C. Affidavits: Submit affidavits from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full-time operation.

1.05 PERFORMANCE

A. With two rotors in service at design year average conditions, each rotor aerator shall be able to transfer 163.5 lb O_2/hr at standard conditions of zero D.O., 20° C and 760 mm pressure while drawing not more than 49.2 bhp/hr.

B. With any one rotor in service at design year average conditions, a single rotor aerator operating at an immersion of 15 inches and speed of 72 rev/min shall be able to transfer a maximum of 171 lb O_2/hr at standard conditions of zero D.O., 20° C and 760 mm pressure.

1.06 QUALITY ASSURANCE

A. Qualifications: Equipment furnished under this Section shall be supplied by a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five years. Demonstrate to the satisfaction of the Engineer that the quality is equal to the equipment made by those manufacturers named herein.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Immediately upon delivery to the job site, place materials in an area protected from weather. Use non-marring slings for loading, unloading, and handling units to prevent rope or cable damage to surfaces and protective wrappings.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Rotor assembly as described herein and shown on the Drawings by Lakeside Equipment Corporation, Mammoth Rotor by US Filter/Zimpro, or approved equal.

2.02 TORQUE TUBE

A. Each rotor assembly shall include a minimum 14-inch diameter steel torque tube with a minimum 3/8-inch wall thickness and shall have flanged ends.

B. The torque tube material shall be ASTM-A53, Grade B steel or better.
2.03 BLADES

A. Each blade shall be a minimum of 3 inches wide.

B. Each blade shall have a long and short leg with two (2) holes minimum in each leg to bolt to the adjacent blade. Each blade assembly star shall be held in place on the torque tube by compression between the assembled blades and the torque tube.

C. Blades shall be mounted so that adjacent legs provide the greatest structural strength in the direction of rotation and positioned to minimize pulsation impacts of the blades entering the liquid. Blades shall be removable by unbolting from adjacent blades.

D. Blades shall be minimum of 10 gauge, Type 304 stainless steel.

E. Coils used for fabricating rotor blades shall have rolled edges.

F. Welding blades to torque tube, bracing between blades, using less than two (2) bolts per blade or bolting blade directly to the torque tube will not be acceptable. Fiberglass or composite plastic materials, which may be subject to ultraviolet light degradation or which may break under cold winter conditions, will not be acceptable.

2.04 STUB SHAFTS

A. Rotor assembly shall be supported at both ends by a flanged stub shaft which is indexed to the rotor assembly to allow for possible field replacement.

B. Steel stub shafts shall be fabricated of not less than ASTM-A36 steel. Where stub shaft flanges are machined and pressed onto the shafts, they shall be ASTM-A536 cast ductile iron. A one piece A-536 cast ductile iron shaft with flanges is also acceptable.

C. Welding the shaft to the flange or the use of taper lock bushings, which may be subject to misalignment, will not be acceptable.

D. The rotor assembly shall have steel end plates bolted on both ends.

2.05 BEARINGS

A. Each rotor assembly shall be furnished with and supported by a bearing assembly on each end of the rotor length. Bearings shall have a minimum of an AFBMA L-10 theoretical design life of 500,000 hours when powered by an inverter duty motor.

B. Split type pillow block bearings shall be used for both the drive and outboard ends and shall be securely mounted on a plate grouted on the firm concrete base of the service area. These bearings shall take reasonable misalignment and shall be fitted with a locking collar on each side of the bearing to assure double locking of the bearing inner race to the rotor shaft.

C. Bearing seals shall be of the face riding rubbing type and shall be fitted to the rotating element to prevent seal damage and moisture intrusion in the event of misalignment.
D. The locking collars shall be located in front of the bearing seals acting as a slinger to prevent moisture from any contact with the lip of the seal.

E. Lubrication fittings with 1/4-inch copper grease lines to the bearings shall be conveniently located so that lubrication and inspection in a dry service area is assured.

F. For accurate leveling and alignment, bearings shall be mounted on bearing mounting plates for setting on a minimum of four (4) anchor bolts.

G. Bearings with the seals pressed into the housing in which they are fixed with respect to shaft movement will not be acceptable.

2.06 SPLASH PLATES

A. Fabricated aluminum frames shall be mounted in the vertical concrete parapet walls at both ends of the rotor assembly to which aluminum splash plates are bolted. Splash plates shall be split horizontally above the shaft opening to allow operator access to the shaft seals. Splash plates attached directly to the concrete parapet walls using adhesive anchor bolts are also acceptable.

B. The openings in the wall formed by the splash plates shall be a minimum of 3 feet wide for removal of the flanged rotor shafts.

C. Where the shafts pass through the splash plates, a seal arrangement shall be provided to protect the outboard bearing, inboard bearing and drive unit from rotor splashing and spray. The seal design shall include as a minimum seal plates, seal gaskets, and a replaceable slinger with stainless steel seal cover on the torque tube side of the splash plates.

2.07 GEAR REDUCER

A. A shaft-mounted, double-reduction reducer in a cast iron housing with alloy steel high hardness helical gearing, positive splash-type lubrication and double lip oil seals, shall be keyed to the inboard rotor stub shaft.

B. The rotor stub shaft shall be supported by the inboard pillow block bearing and extended through the reducer hollow bore and centered and held firmly in place by a tapered bushing arrangement. Use of set screws and collar to lock gear reducer to shaft will not be acceptable.

C. Shaft mounted reducer shall have not less than a Class II rating based on motor horsepower.

D. Reducer shall be held in position by a torque arm and torque arm bracket. Torque arm bracket shall be fastened with cast-in-place anchors. Expansion anchors will not be acceptable.

E. A visual oil level gauge and oil filler tube for the reducer shall be mounted on the reducer.
F. The drive assembly shall be protected from rotor splash by the parapet wall and splash plate.

G. Base-mounted gear reducers which support the rotor loads on the gear reducer output shaft bearings and which are not belt driven will not be acceptable.

2.08 BELTS AND SHEAVES

A. Power transmission from the motor to the reducer shall be by means of a set of V-belts and sheaves. Belts and sheaves shall be designed with a minimum 1.5 service factor based on motor horsepower.

B. Sheaves shall be two section units for both drive and driven sheaves and shall consist of a tapered split shaft bushing with three tapped holes to which the sheave is attached by three cap screws. Changing sheaves shall not require a wheel puller.

C. Belts and sheaves shall be provided for each rotor assembly to meet the design conditions required in paragraph 1.05.

D. Belts and sheaves shall be covered with a fabricated steel belt guard with expanded metal front panel in accordance with OSHA standards.

2.09 MOTOR

A. Each unit shall be driven by a 60 hp, 1,750 rpm, 3 phase, 60 Hertz, 230/460 volt, horizontal, ball bearing, continuous duty, constant speed, Design B, normal starting torque, totally enclosed fan cooled, foot-mounted motor with leads to large conduit box for outdoor operation.

B. Motor shall be mounted on plate with threaded studs to provide adjustment of belt slack.

C. A thermostat shall be applied directly to the motor windings to monitor over-temperature, supplemental to the external motor overload protection.

D. Motor shall be inverter duty rated and comply with Section 11002.

2.10 ROTOR IMMERSION GAUGE

A. Rotor manufacturer shall furnish for each Oxidation Ditch a clear anodized aluminum or passivated stainless steel rotor immersion gauge with a minimum of a 14-inch scale complete with mounting bracket.

2.11 VELOCITY CONTROL BAFFLE

A. The Contractor shall furnish and install a velocity control baffle for each of the rotor aerators.

B. Each unit shall consist of a steel baffle assembly with a nominal length the same as the rotor and shall be arranged for wall mounting.
C. The baffle shall consist of a minimum 1/4-inch steel plate with minimum 1/4-inch steel reinforcing member welded continuously to its reverse side. Baffles consisting of steel tubes welded together with continuous welds are also acceptable. Ends of reinforcing members and structural tubes shall be sealed with a cap plate to prevent exposure of interior surfaces to the elements. Steel wall brackets shall be provided complete with embedded anchor bolts and machine bolts, nuts, and washers. Expansion type anchors will not be acceptable.

D. At minimum, the baffle shall be adjustable to 15, 30, 45, and 60 degrees from horizontal.

2.12 Rotor Cover

A. The Contractor shall furnish and install a hinged fiberglass cover for each of the brush rotor aerators.

B. Covers shall be of such a design as to prevent impairment of oxygen transfer, mixing, induced velocity by the rotor and prevent deviation from the manufacturer's power consumption characteristic curves. The cover shall extend far enough beyond the rotor and baffle to trap mist and splash within the cover.

C. Covers shall have sufficient minimum width to ensure proper clearance around the rotor aerator.

D. Covers, which are fixed or do not allow operator access to the rotor without removing the entire cover will not be acceptable. Covers with small observation hatches only will not be acceptable.

E. Each cover shall consist of a number of hinged fiberglass panel sections, mounted between arch supports with a fiberglass end cap at either end and fabricated steel support members. The steel support members shall be mounted on steel brackets anchored to the concrete walls. The arch supports shall form a drain between the cover sections. The cover design shall allow individual cover sections to be lifted for rotor inspection without disturbing the other sections.

F. Each panel section shall be of split construction with a hinged front portion connected to a fixed rear portion by a stainless steel hinge. Each panel section shall include a lifting handle and a quick release locking arrangement to hold the cover in place or to facilitate lifting the section for rotor inspection. Portable inspection rods shall be provided to support the cover sections in the raised position. The rods shall have safety chains to keep them from falling into the water.

G. Cover sections, arch supports and end caps shall be molded fiberglass reinforced polyester laminate, with the exterior surface gel coated for ultraviolet radiation protection. Cover supplier shall certify with approval specifications that fiberglass shall have a glass content of not less than 30%, a tensile strength of not less than 22,000 psi, a flexural strength of not less than 25,000 psi and Barcol hardness of not less than 40. Finished fiberglass must withstand a temperature of 200°F without blistering, pinholes, warping, or other defects.
H. The cover and support structure shall be designed to support a live load of 40 lb per square foot and a wind load of 30 pounds per square foot.

I. All fasteners to assemble cover components shall be stainless steel. Fasteners to mount the cover to structural supports shall also be stainless steel.

2.13 EFFLUENT WEIR ASSEMBLY

A. The CONTRACTOR shall furnish, install and place into satisfactory operating condition hinged weir assemblies and appurtenances as shown on the drawings and described herein.

B. The rotating plate weir shall be 1/4-inch fabricated ASTM A-36 steel plate welded to an 8-in minimum diameter pipe with steel stub shafts, support plates, and lever arm.

C. Horizontal and vertical neoprene seals complete with steel backing plates shall be provided at each weir section to seal the weir at concrete wall and support plates.

D. Each rotating plate weir shall be supported by a grease lubricated flange bearing mounted on a steel support plate.

E. A fabricated steel floor stand complete with a minimum 18-inch diameter fabricated steel handwheel, stainless steel operating stem, bronze operating nut and steel operating pipe shall be furnished for operation of the weir plate.

F. Handwheel shall not require greater than a 40 pound rim pull to operate the hinged weir assembly.

2.14 ANCHOR BOLTS

A. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Bolts, washers and hex nuts shall be 304 stainless steel unless noted otherwise. Anchor bolts shall be L-type embedded. Expansion-type anchors will not be acceptable.

B. Anchor bolts shall be set by the Contractor. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

2.15 FINISHES

A. Prior to assembly, the rotor torque tube shall be solvent-cleaned per SSPC-SP1 followed by near-white blast cleaning per SSPC-SP10. Torque tube shall be given two (2) coats of Tnemec 66 Hi-Build Epoxoline Paint.

B. Electric motors, speed reducers, and other self-contained or enclosed components shall have the original manufacturer's standard enamel finish.
C. Apply rust preventative compound to all machined, polished, and nonferrous surfaces which are not to be painted.

D. All fabricated carbon steel or cast iron components for submerged service shall be solvent-cleaned per SSPC-SP1 followed by a near-white blast cleaning per SSPC-SP10 and given a 3 mil dry film thickness coat of Tnemec 66 Epoxoline Primer.

E. All fabricated carbon steel or cast iron components for non-submerged service shall be solvent-cleaned per SSPC-SP1 followed by a commercial blast cleaning per SSPC-SP6 and given a 3 mil dry film thickness coat of Tnemec 66 Epoxoline Primer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in strict conformance to the manufacturer's installation instructions.

3.02 FIELD PREPARATION AND PAINTING

A. Finish field preparation and painting shall be performed as specified in Section 09960.

B. The Contractor shall touch-up all shipping damage to the paint as soon as the equipment arrives on the job site.

C. Prior to assembly all stainless steel bolts and nut threads shall be coated with a non-seizing compound by the Contractor.

3.03 FIELD TESTING

A. Field test all equipment. For further requirements on performance tests, refer to Section 11001.

3.04 FIELD SERVICE

A. The equipment manufacturer shall supply a competent field service engineer to thoroughly check and inspect the equipment after installation, place the equipment in operation, make necessary adjustments, calibrate instruments, and conduct field tests. The services required shall also include on-the-job training of operators including safety procedures, operating instructions, and preventive maintenance procedures. Furnish a minimum of two man-days of field services.

END OF SECTION
SECTION 11620
LABORATORY EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provide laboratory bypass fume hood and laboratory glassware washer, installation and connection to all utilities and exhaust duct work.

B. Related work specified elsewhere:
   1. Divisions 15 and 16: Rough in for mechanical, plumbing, and electrical

1.02 SUBMITTALS

A. Submit the following for Product Review.

B. Submit data fully describing the fume hoods including all features and components.

1.03 QUALITY ASSURANCE

A. Comply with all applicable local, state, and federal regulations.

B. ASHRE Handbook Chapter 30.

C. American Conference of Governmental Industrial Hygienists "Industrial Ventilation" pages 5-22, 5-23 and 4-11.

D. National Fire Protection Association Standard No. 45 especially Chapter 6 and Appendix A, B, and C.

PART 2 - PRODUCTS

2.01 BYPASS FUME HOODS

A. Kewaunee Hoodaire Supreme, St. Charles, Labconco, or equal.

B. Fume hoods shall be rated for Class A applications and have the following characteristics.
   1. A directional air foil vane across the bottom of the hood face opening to direct air across the bottom of the hood from front to back.
   2. A sight tight louvered bypass grill at the top of the hood face to allow air to enter in a smooth, uniform, unbroken pattern when the sash is closed.
   3. An automatic air bypass feature to allow room air to enter the hood near the top when the sash is 75% to 100% closed. The bypass shall limit the maximum velocity of air flowing into the hood when the sash is in the closed position to 2 to 3 times the velocity when the sash is fully open.
   4. A vertical sliding counter balanced safety glass sash. When in the raised position; the sash shall close off the air bypass. When the sash is in the raised
5. Deflector Vane: Provide a deflector vane air foil across the full width of the hood opening 1 inch above the hood bottom. The deflector vane shall be 6 inches deep and extend 3 inches in front of the base cabinet supporting the hood. When in the completely closed position, there shall be an opening of 1 inch between the bottom deflector air foil vane and the edge of the work top and the air bypass shall be fully open.

6. A rear baffle with a fixed open center exhaust slot and adjustable upper and lower exhaust slots designed to maximum the safe removal of heavier-than-air and lighter-than-air gases and fumes. The rear baffle shall also have the top section bent forward so that a portion of the exhaust air is drawn from the center of the hood (measured from front to back).

7. Face velocity range shall be 125-150 feet per minute (FPM) minimum. Exhaust Air Volume shall be at least 150 cubic feet per minute per square foot of maximum sash opening.

8. Provide 4-inch-wide beveled or air foil shaped jambs to create a smooth air flow at the sides of the sash opening.

9. Fume Hood Working Surface: The working surface shall be a watertight one piece molded form, recessed a minimum of 3/8-inch to retain spillage, with a cutout for a cup drain.

10. Finishes:
    a. Fume Hood Working Surface and Lining Surfaces: Modified epoxy resin with selected airing resins and inert fillers to produce a thermosetting material. Kewaunee Kemresin; St. Charles; or equal.

C. Fume Hood Accessories:

A. Equip each hood with a vapor proof light and switch, a two-plug grounded electrical receptacle, and a cup sink. Also provide gas and air outlets as shown on the Drawings.

B. Provide an airflow indicator complying with NFPA No. 45, paragraph 6-9.7 for each hood.

C. Provide a label on each fume hood, exhaust duct work, exhaust fan and exhaust discharge indicating class of hood and intended use. Provide an additional sign on each hood for recording inspection information per NFPA No. 45, paragraph 6.13.2.

D. The hood exhaust connection shall be coordinated to interface with the exhaust duct specified in Section 15800.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install on top of base cabinet where shown. Securely anchor to base cabinet and back wall. Connect to all utilities and exhaust duct work. Coordinate with work under Division 15 and Division 16.

B. Hood Performance Tests:
1. Perform "Face Velocity Test," "Exhaust Capacity Test," and "Dry Ice Test" on hood in accordance with ASHRE Handbook Chapter 30 and ASHRE 110 and method of testing performance of Laboratory Fume Hoods. Make necessary adjustments in exhaust fan speed exhaust duct air velocity and Room Air supply register face velocity and face air distribution pattern required to achieve satisfactory hood performance.

2. Test hoods in accordance with NFPA No. 45, paragraph 6-14.1. Make necessary corrections and retest until required perform is achieved.

C. Glass Washer Performance Tests

1. Test the glass washer in accordance with the manufacturer's specifications. All utilities, piping and fixtures for future installation are to be included as shown in the documents.

END OF SECTION
DIVISION 12
FURNISHINGS

12346 Wood Laboratory Casework
PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Modular and custom casework, laboratory casework, and molded epoxy resin laboratory tops, and related accessories. Include factory prefinishing and field installation by factory trained and supervised installers.

B. Related Sections: Section 06200: Finish Carpentry.

1.02 SUBMITTALS

A. Submit the following for Product Review in accordance with Section 01300.

B. Submit shop drawings prepared specifically for this project. Drawings to show every item of casework in plan and in elevation at scale: 1/4-inch equals 1-foot, or larger. Show all cut outs for electrical, mechanical and plumbing fixtures and accessories. Show all dimensions. Furnish templates for proper location of accessories furnished and installed by other trades. Show location of backing required for attachment of cabinets.

C. Submit casework manufacturer's Product Data and standard details clearly showing the following:
   1. Top construction, as specified.
   2. Drawer construction.
   3. Corner and leg construction.
   5. Door construction.
   6. Finish.
   7. Hardware.
   8. Accessories, as specified.

1.03 QUALITY ASSURANCE

A. Standards:
   1. Provide products of a single manufacturer regularly engaged in fabricating casework.
   2. Conform to the standard specifications of the following manufacturers.
      a. Kewaunee, Kewaunee Scientific Equipment Corporation, Wood Furniture Division, Adrian Michigan;
      b. Hamilton, Hamilton Industries, Division of American Hospital Supply Corporation, Two Rivers, Wisconsin;
      c. Or equal.
   3. Installation shall be accomplished under the direct supervision of the manufacturer.
1.04 SEISMIC DESIGN REQUIREMENTS

A. All equipment in this Section is classified as essential for seismic protection in accordance with Division 1.

1.05 DELIVERY, STORAGE AND HANDLING

A. Protect casework prior, during and after installation to assure equipment's acceptability at the time of completion.

B. Deliver materials in labeled, unbroken packages and crates as factory sealed. Store materials as recommended by the manufacturer. Take care in handling laboratory equipment to prevent damage.

C. Building must be enclosed and heating/air conditioning system in operation for at least five days prior to delivering casework.

PART 2 - PRODUCTS

2.01 CASEWORK MATERIALS

A. Lumber to be kiln dried at manufacturer's plant to moisture content of 5 to 6%. Exposed exterior cabinet wood to be Northern Hard Maple. Drawer sides and backs solid oak, clear and sound, unselected for color.

B. Plywood: Thickness as specified, consisting of cross and face plies glued with water resistant resin glue.

C. Particle Board: Formed of selected wood granules, compressed into sheets of the specified thickness having an average density of 45 pounds per cubic foot, held and bound with urea-formaldehyde resin glue.

D. Composition Board: Composed of wood fibers and resin binder formed under heat and pressure, in thickness specified.

E. Welded Fiber: Sheets of wood fibers, pressed in heated hydraulic presses and bound with a lignin binder.

F. Tempered Welded Fiber: Same as welded fiber, but impregnated with a tempering liquid polymerized by baking.

G. Glass: 1/4-inch-thick sheet glass without imperfections and with unmarred surfaces. Provide safety glass where required by UBC Chapter 54 or by Section 08800.

H. Glue: Type II water resistant, with gluing done in clamps and jigs.
2.02 CASEWORK FABRICATION

A. General:
1. Doors and drawer fronts, lipped, square edged.
2. Cupboard bottoms flush with top edge of bottom front rail.
3. Cupboard sides flush with edge of face frame.
4. Mortise and tenoned, or doweled glued and screwed construction throughout.
5. Each unit to be rigid and self-supporting for use interchangeably in an assembly or for single use.

B. Cabinets and cases to be of the size and configuration shown on the drawings and constructed as follows:
1. Ends: 3/4-inch veneered or plywood core panel with 1/4-inch x 3/4-inch solid hardwood edge banding. Interior of sides bored for shelf support clips or dadoed for metal adjustable shelf standards.
2. Front Top Rail: 1-1/2-inch x 2-1/2-inch minimum size, L-shaped from two pieces 3/4-inch hardwood, grooved and glued together, mortised, tenoned, glued and screwed to cabinet end, exposed portion maple.
3. Back Top Rail Hardwood: 3/4-inch x 3-7/8-inch with groove for cabinet back, mortised, tenoned, glued and pinned to cabinet ends.
4. Front Bottom Rails: 1-1/2-inch x 3/4, hardwood toe space rail 3/4-inch x 3-1/2-inch; both rabbeded and glued to cabinet ends. Toe space 4 inches high x 2-1/2 inches deep, toe rail of solid hardwood.
5. Cupboard Bottoms: 3/4-inch particleboard panel, veneered in open cabinets, mortised into cabinet ends, and set flush into front rail with mortised, tenoned and glued joint.
6. Cupboard Backs: 3/16-inch welded fiber, veneered in open cabinets, full width, nonstructural and removable from cupboard interior for access to service lines.
7. Horizontal frames of hardwood below all drawers, blind mortised, tenoned, glued and screwed into vertical divisions and ends. 1/8-inch welded fiber security panels in frames when keyed different locks are specified.
8. Ends and back rails grooved for "Z" irons, holes for screws in front top rail for installation of working surface.
9. Shelves: 3/4-inch, 5-ply fir plywood with front and back edge hardwood banded, adjustable 2-inch centers. Plastic supports are not acceptable. Provide two-degree rearward slope of shelves and raised rail on the front edge of shelves to prevent forward migration of contents by vibration or during an earthquake.
10. All drawers shall have guides. Drawers less than 30 inches wide shall be equipped with two hardwood machined side guides; drawers 30 or more inches in width shall also be furnished with two oil finished hardwood bottom guides.
11. Drawer Back and Sides: 1/2-inch hardwood assembled with glue and drive pins. Bottoms shall be 3/16-inch-thick welded fiber, grooved 1/4-inch into sides, back and front. An interior groove for divider clip installation shall be provided on all four sides. Working parts of drawer stop shall be corrosion resistant, stainless steel or plastic.
12. Slides for file drawers shall be side mounted, cold rolled steel, full extension, 100 lb. capacity per pair, combination nylon rollers and steel ball bearings, Grant No. 329; Knape and Vogt 1700; or equal.

C. Cases, wall, upper and tall storage constructed as follows:
   1. Ends: 3/4-inch veneered particleboard core panel with 1/4-inch by 3/4-inch solid hardwood edge banding.
   2. Top Rails: 3/4-inch x 1-1/2-inch solid maple. Bottom rails, upper and wall case: 3/4-inch x 1-1/2-inch solid maple. Bottom rails tall storage case: 3/4-inch x 5-1/8-inch. All rails mortised, tenoned and glued into ends. Bottoms and tops, 3/4-inch veneered particleboard core panel, grooved into ends. All case bottoms shall be of flush interior design.
   3. Backs: 1/4-inch, 3-ply veneered welded fiber panel on all units, recessed 7/8-inch and set into top, bottom and ends.

D. Doors shall be swinging, solid or glazed as shown:
   1. Swinging doors to 48 inches high, two 2-1/2-inch hinges. Doors over 48 inches, three 2-1/2-inch hinges. Left swinging door with astragal, overlapped by right door.
   2. All Solid Doors: 3/4-inch-thick, veneered lumber core, veneer banded four edges with select maple.
   3. Framed Glass Doors: 3/4-inch, solid maple frames. Doors 48 inches to 84 inches high, have intermediate rail. All joints mortised, tenoned and keyed. Glass retaining molding vinyl extrusion. Glass replaceable without tools.

E. Hardware:
   1. Swinging Door Catches: Nylon button or roller type. Magnetic catches or catches permitting rebound opening, not acceptable.
   2. Hinges: Institutional type, 2-1/2-inch stainless steel, hardened, attached with no 10 FHSMS.
   3. Elbow Catch: Spring type with strike.
   4. Shelf Supports Required for All Adjustable Shelves: 13 gauge angle, 1/2-inch wide, with 1/4-inch diameter x 3/8-inch long pin, bright zinc plated and all edges rounded.
   5. Base Molding: 4 inches high, black rubber or vinyl, inside corners mitered, outside corners wrapped.
   6. Leg Shoes: Black rubber or vinyl with provision for floor clip.
   7. Pulls: Stainless steel, loop design, with two through bolts, 4-1/4 inches on centers.

F. Wood Finish:
   1. Chemically resistant varnish furnished and applied by the furniture manufacturer. Finish shall be resistant to acids, alkalis, salts, and solvents in accordance with the manufacturer's test procedure using 50 different chemicals (reagents).
   2. Apply finish in the shop under proper room temperature and dry under controlled conditions. Sand and wipe clean between varnish coats.
      a. All Exterior Exposed Surfaces: One coat of stain and three coats of varnish.
b. Interior Finish for All Cases Where Exposed to View: same as for exteriors.

c. Interior Finish for Cases Where Not Exposed to View: one coat of stain and two coats of varnish.

d. Finish for All Interior Surfaces of Drawers: One coat of stain and two coats of varnish.

2.03 WORK SURFACES

A. Molded Epoxy Resin, "Kemresin" by Kewaunee Scientific Equipment Corporation; "Corrocast 20L122" by American Hamilton, or equal.

1. Material shall be resistant to acids, alkalis, salts and solvents in accordance with the manufacturer's test procedure using 50 different chemicals (reagents).

2. Tops shall be 1-1/4 inches thick. All joints shall be made with highly chemical and corrosion resistant cement having the same properties as the base material. Drip grooves shall be provided on the underside of all exposed edges of tops installed on units or assemblies containing sinks.

3. Tops shall have the following minimum physical characteristics:
   a. Flexural Strength (ASTM Method D790-66): 4,000 lbs/in².
   b. Compressive Strength (ASTM Method D695-63T): 14,000 lbs/in².
   d. Water Absorption, % by weight and ASTM Method D2127, % in 24 hours - 0.02.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate all work under this Section with all other trades whose work adjoins, combines or aligns with same. Take such field measurements as may be required. Report any major discrepancy between drawings and field dimensions, and secure directions before proceeding.

B. Verify that all blocking and backing are properly located before wall finishes are in place.

C. Inspect all surfaces to receive casework and report all defects before proceeding.

3.02 INSTALLATION

A. Set casework in place, scribe plumb, square and level and secure to structure in position indicated with all required fastenings, clip angles, bases, anchors, nailing, blocking, shimming and other fittings.

B. Provide all closures, fillers and scribe strips required to provide a neat and finished installation. All such exposed items shall match casework.

C. Furnish all miscellaneous metal supports, clips, anchors, fasteners and bracings required for installation.
1. Anchor wall cabinets with a row of fasteners near the top and a row near the bottom of cabinets. Use 1/4-inch-diameter wood screws spaced 16 inches on centers maximum, into solid backing.

2. Anchor base cabinets to wall with a row of fasteners near the top of cabinets spaced 16 inches on centers into solid backing. Anchor to floor with a row of drilled expansion bolts into concrete floor, spaced 16 inches on centers maximum.

3. Anchor island (free standing) base cabinets with drilled expansion anchor bolts all around the perimeter of cabinets spaced 16 inches on centers maximum.

D. Adjust all doors, drawers and other moving parts to operate freely without binding or sticking, adjacent items level, vertical lines plumb and aligned, clearance uniform.

E. Field fit composition worktops, splashes and utility curbs to job conditions after cabinets are in place. Attach to cabinets with concealed fasteners from inside of cabinets.

END OF SECTION
DIVISION 13
SPECIAL CONSTRUCTION

13125  Prefabricated Fiberglass Buildings
SECTION 13125
PRE-FABRICATED FIBERGLASS BUILDINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes a complete pre-engineered fiberglass building and includes the following:
   1. Prefabricated, prefinished fiberglass building, including structural framing, and connection bolts.
   2. Bracing as required to provide lateral rigidity in both principal directions.
   3. Factory finished roof and wall panels, thermal insulation, building accessories, roof jacks, flashing, fasteners, closures and sealants.
   4. Door, frame, and hardware.
   5. Light fixtures.
   6. Exhaust fan and air intake louver.

B. Related Sections:
   1. Section 03300: Concrete
   2. Section 07900: Sealants
   3. Section 08110: Hollow Metal Work

1.02 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data: Fully describe manufacturer's product.

C. Shop Drawings: Custom prepared drawings fully describing the proposed product including plans, sections, elevations and sufficient details for assembly and installation.

D. Certification that the Building is Pre-Approved by the Nevada Department of Business and Industry Manufactured Housing Division.

1.03 QUALITY ASSURANCE


B. The building shall be Pre-Approved by the Nevada Department of Business and Industry Manufactured Housing Division.

1.04 DESIGN LOAD CRITERIA

A. UBC Chapter 16 and also:
   1. Roof snow load: 30 psf
   2. Basic wind speed: 85 mph. Exposure: C
3. Seismic:
   a) Seismic Zone: 3
   b) Site coefficient: 1.0
   c) Occupancy category: F2
4. Deflection of roof members not exceeding: Span/180 for total specified loading.
5. Wall: Provide additional strength to resist out-of-plane seismic and wind loading.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, handle and erect prefabricated components, sheets, panels, and other manufactured items in a manner that will not cause scratching, damage or deformation of exposed or concealed items or surfaces. Stack site stored materials and components on platforms or pallets and cover with tarpaulins or other suitable weathertight covering. Inspect all panels upon arrival at jobsite. Remove moisture, if any, and restack and protect materials and components until used.

PART 2 - PRODUCTS

2.01 BUILDING SYSTEMS

A. Manufacturer: Bevco Engineering Company, Inc.; or equal.

2.02 DESIGN

A. The building shall be completely assembled ready to install, and capable of housing equipment as shown on the Drawings; Bevco House Model ECS810, or equal. Supply with all components factory mounted and wired.

B. Building shall meet the requirements of and be pre-approved by the Nevada Department of Business and Industry, Manufactured Housing Division.

C. The building shall be a molded fiberglass reinforced polyester (FRP) construction with minimum wall, door, and roof thickness of 1-inch. The house shall have a minimum of insulation to maintain a rating of "R" 7.0. All materials are to be ultraviolet resistant and the finished building when installed. The 3'-0" wide x 6'-6" high door shall have corrosion-resistant hardware, and shall be provided with a 17" x 17" shatterproof window. The building shall be 8' W x 10' L x 7' high at the peak, and shall be shipped factory assembled and wired. Included shall be removable lifting eyes and sufficient gasket and mounting flanges for direct setting on concrete slab.

D. The building shall have the following components factory mounted and wired in non-conductive, non-corrosive electrical conduit boxes and fittings.
   1. Electrical fixtures: The following fixtures shall be provided: PVC light fixtures(s) with covered bulb. Exterior mounted weatherproof automatic-manual selector switch to operate the fan and lights either manually or automatically when the door is opened. A 2-pole 120/60/1, fused safety switch
of sufficient size to handle the electrical accessories. Duplex receptacle(s) in PVC weatherproof enclosure.

2. Exhaust fan and intake louvers: An exhaust fan shall be provided with gravity type louvers capable of providing complete air change every minute. Intake air shall come in through screened motorized intake louver of sufficient size to allow the specified air change.

3. Building heater and thermostat: A heater and adjustable thermostat with sealed contacts of sufficient size shall be provided.

E. Color as selected from manufacturer's standard range.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

3.02 FLASHING, CLOSURES AND TRIM

A. Install flashing and/or trim at the rake, corners and framed openings, where shown and where necessary to provide weathertightness and a finished appearance.

3.03 DOOR AND FRAME

A. Install frame so that outswinging door can swing a full 180 degrees. Apply sealant in joints between door frames and building trim.

B. Apply painter's finish to all components and accessories that are not factory finished.

C. Refer to Section 09900 for paint application techniques.

3.04 PENETRATIONS

A. Provide conical roof jacks for pipe and conduit penetrations.

B. Seal all joints with polyurethane sealant.

3.05 ADJUSTMENTS AND TOUCH-UP

A. Factory Finished Items: Exercise care in handling factory finished panels, sheets and accessories. Touch up scratches and small blemishes with compatible paint system. Replace items that have been dented, creased, or bent with new identical items.

END OF SECTION
DIVISION 14
CONVEYING SYSTEMS

14550 Shaftless Screw Conveyor System
SECTION 14550
SHAFTLESS SCREW CONVEYOR SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide all labor, material and equipment necessary to furnish and install one (1) shaftless screw conveyor system as shown on the drawings, and as specified herein.

B. The Conveyor System shall consist of, but not be limited to, flighting, trough, rough liner, trough ends, bearings, seals, inlet and discharge ports, reversing conveyor drives, supporting steel, discharge slide gates, electrically actuated gate operators, and appurtenances together with any other items required for a complete conveying system.

C. Related Work Specified Elsewhere
   1. The provisions of this section are a direct extension of Section 11001, GENERAL EQUIPMENT AND MECHANICAL REQUIREMENTS, and shall apply equally to this section.
   2. Motors: Section 11002, ELECTRIC MOTORS DRIVES
   3. All appurtenances including electrical controls, other than specified herein, wiring of motor or controls and field painting are as specified under other sections of these Specifications.
   4. Refer to the following Specification sections for coordination of work:
      a. Centrifuge Decanter: Section 11364

1.02 QUALITY ASSURANCE

A. It is the intention of the Specifications to cover minimum acceptable quality equipment for a complete installation.

B. All equipment furnished under this section shall: (1) be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least 10 years; and (2) be demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufactures specifically named herein.

C. The conveyor shall be designed in accordance with CEMA guidelines and shall be furnished by Spirac, Inc, Custom Conveyor, or Parkson Corporation.

1.03 SUBMITTALS

A. Shop Drawings: Submit Product Review shop drawings for the conveyor system in accordance with Section 01300 SUBMITTALS. Include sufficient data to show that equipment conforms to Specification requirements, including motor data and seismic anchorage certification and description. All equipment and appurtenances in this section shall be submitted in a complete initial submittal.
B. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists in accordance with Section 01300 of these Specifications.

C. Affidavits: Furnish affidavits from the manufacturers stating that the equipment has been properly installed and tested and is ready for full time operation.

1.04 GUARANTEE AND WARRANTY

A. The equipment shall be unconditionally guaranteed to meet or exceed the design criteria detailed in PART 2 of this Specification section.

B. See Section 11001 of these Specifications and the General Conditions for other requirements.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

A. Design criteria for the (2) conveyor sections are presented below:

<table>
<thead>
<tr>
<th>Conveyor #</th>
<th>#1</th>
<th>#2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Conveyed</td>
<td>Sludge</td>
<td>Sludge</td>
</tr>
<tr>
<td>Maximum Solids Content (%)</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Minimum Solids Content (%)</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Design Capacity, ft³/hr</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Approximate length, Ft.</td>
<td>31</td>
<td>16</td>
</tr>
<tr>
<td>Degrees Incline, approx.</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Max. screw speed, rpm</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Max. filling factor @ design load</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Minimum flight outside screw diameter</td>
<td>215mm (8.46&quot;)</td>
<td>same</td>
</tr>
<tr>
<td>Minimum trough width</td>
<td>260mm (10.24&quot;)</td>
<td>same</td>
</tr>
<tr>
<td>Minimum trough thickness</td>
<td>3mm (11ga.)</td>
<td>same</td>
</tr>
<tr>
<td>Minimum lid thickness</td>
<td>3mm (11ga.)</td>
<td>same</td>
</tr>
<tr>
<td>Maximum lid length - Feet</td>
<td>1500mm (60&quot;)</td>
<td>same</td>
</tr>
<tr>
<td>Minimum UHMW-PE liner thickness</td>
<td>12mm (1/2&quot;)</td>
<td>same</td>
</tr>
<tr>
<td>Maximum UHMW-PE liner section length</td>
<td>1m (3.3')</td>
<td>same</td>
</tr>
<tr>
<td>No. Discharges:</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Type of Discharge</td>
<td>free</td>
<td>1 electrically actuated gates, 2 free discharge gates</td>
</tr>
<tr>
<td>Discharge Type:</td>
<td>vertical</td>
<td>vertical</td>
</tr>
<tr>
<td>Minimum Drive Horsepower:</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Location of drives</td>
<td>pulling/reversing</td>
<td>reversing</td>
</tr>
<tr>
<td>Minimum reducer size SEW Base (or equal)</td>
<td>FA87</td>
<td>FA77</td>
</tr>
</tbody>
</table>
Materials. Materials used in the fabrication of the equipment under this section shall conform to the requirements below:

<table>
<thead>
<tr>
<th>Chutes, Troughs, End Plates, Covers, Hoppers, &amp; Supports</th>
<th>Chutes, Troughs, End Plates, Covers, Hoppers, &amp; Supports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports</td>
<td>Supports</td>
</tr>
<tr>
<td>Galvanized structural steel</td>
<td>Galvanized structural steel</td>
</tr>
<tr>
<td>Spiral Flighting</td>
<td>Spiral Flighting</td>
</tr>
<tr>
<td>Special Chrome-Alloy Steel w/minimum 225 Brinnel Harneess</td>
<td>Special Chrome-Alloy Steel w/minimum 225 Brinnel Harneess</td>
</tr>
<tr>
<td>Wear Liner</td>
<td>Wear Liner</td>
</tr>
<tr>
<td>UHMW Polyethylene Duraflo SPX</td>
<td>UHMW Polyethylene Duraflo SPX</td>
</tr>
<tr>
<td>Hardware</td>
<td>Hardware</td>
</tr>
<tr>
<td>18 - 8 stainless steel (304)</td>
<td>18 - 8 stainless steel (304)</td>
</tr>
</tbody>
</table>

2.02 SCREW CONVEYOR

A. General: The conveyor shall be designed to handle partially dewatered sewage sludge for discharge to the sludge container.

B. Screw conveyors shall be a reversing, shaftless screw, U-trough design.

C. The conveyors shall be capable of conveying sludge from the centrifuge to the discharge points in a clean efficient manner.

D. Flighting:
   1. The screw conveyor is to incorporate a full pitch shaftless screw flighting designed to convey sludge without a center shaft or hanger bearings.
   2. Spirals shall be cold-forged high strength chrome-alloy steel.
   3. The spiral flights shall be designed with adequate stability to prevent distortions and jumping in the trough.
   4. A second, inner spiral, concentric with the outside spiral shall also be provided.
   5. The torsional rating of the flighting shall exceed the torque rating of the drive motor at 150% of its nameplate horsepower.
   6. The spring effect of the spiral shall not exceed 1.0 mm / 100 mm of length at maximum load conditions.
   7. Spiral flighting shall have full penetration welds at all splice connections.
   8. The spiral flights shall be coupled to the end shaft by a flanged, bolted connection. The flange shall be welded to the spiral flight forming a smooth transition. The drive shaft shall have a mating flange and shall be bolted to the spiral connection plate. Additionally, a grease lubricated, labyrinth seal shall be shaft-mounted between the back plate and the spiral coupling connection.

E. Drive:
   1. The conveyor shall be driven by a constant speed 460 volt, 3 phase, 1800 RPM, severe duty, reversing, TEFC motor with 1.15 SF and class F insulation with Design B speed/torque characteristics. The motor shall be high efficiency, 40°C ambient rated.
   2. An adapter mounted, AGMA Class II, helical gear reducer shall be provided at the conveyor trough end. The adaptor flange shall allow the leakage of any material form the conveyor trough to atmosphere rather than into the gear.
reducer/motor drive unit. Direct coupling of the reducer gear/motor drive unit will not be acceptable.

3. The drive unit shall be rigidly supported so there is no visible wobble movement detectable under any conditions.

4. The drive unit shall be capable of starting the conveyor from a dead stop with the conveyor full of partially dried and hardened material as could occur in a power outage.

5. All gears shall be AGMA Class II single or double reduction, helical gear units with high capacity roller bearings. Bearings shall be designed for the thrust loads of from the fully loaded startup conditions and shall have an AFBMA B-10 life of 30,000 hours.

6. The reducer shall be air cooled with no auxiliary cooling requirements. The gear reducer shall be sized with a torque service factor of 1.5 times the absorbed power of 1.1 times the motor nameplate, at the driven shaft speed, whichever is greater.

7. A gland packing ring consisting of two aramid fiber rings shall seal the drive shaft at its penetration through the end plate, along with a greased labyrinth sealing system in a bell housing to adapt the drive assembly to the trough end plates. The bell housing or drive adaptor housing shall be hot dipped galvanized carbon steel. Mating surfaces shall be machined following galvanization to ensure a proper fit.

F. Bearings:
1. Intermediate and end bearings shall not be required.
2. Bearings in the gear reducer shall have an AMBA B-10 life of 30,000 hours.

G. Trough and Covers:
1. The conveyor flight shall be a U-trough with formed top flanges and integral end flanges. Trough dimensions and construction shall comply with CEMA 350.
2. A flanged drain outlet shall be provided as shown on the Drawings.
3. Each trough shall be equipped with inlet and/or discharge openings as shown on the contract drawings. Any interconnecting devices, such as chutes and hoppers shall be fabricated from the same grade of material as the troughs and to a gauge to suit the applications requirements. THE CONVEYOR SUPPLIER SHALL SUPPLY THE FABRICATED CONNECTION BETWEEN THE FLEXIBLE CONNECTION TO THE CENTRIFUGE AND THE CONVEYOR TROUGH.
4. Bolted and gasketed covers shall be furnished for all portions of the trough not covered by the filling chute(s). Covers shall be manufactured in maximum five (5) foot length sections to allow for easy access and ease of liner replacement.

H. Wear Liners: The internal trough surfaces shall be lined with a 12 mm (minimum) thick layer of ultra high molecular weight polyurethane (UHMW-PE). The wear liner shall be furnished in two layers, each of a different color to provide a visible indication of wear. The liner shall be supplied in maximum 3.3 foot sections to provide ease of replacement. The liner shall be held in place with stainless steel clips. The liner material shall have the following physical properties:
<table>
<thead>
<tr>
<th>Property</th>
<th>Value/Unit</th>
<th>Testing Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>61.2 lbs/ft³</td>
<td>DIN53479</td>
</tr>
<tr>
<td>Molecular Weight</td>
<td>9.2x10⁹ g/mol</td>
<td>Margolies</td>
</tr>
<tr>
<td>Ball Indentation Harness</td>
<td>5,946 lbs/in²</td>
<td>DIN53456</td>
</tr>
<tr>
<td>Shore Hardness D</td>
<td>64</td>
<td>DIN53505</td>
</tr>
<tr>
<td>Crystalline melting Range</td>
<td>278 °F</td>
<td></td>
</tr>
<tr>
<td>Dynamic Coefficient of Friction</td>
<td>0.1 – 0.12 ratio of tension/load</td>
<td>Plastic to Steel</td>
</tr>
</tbody>
</table>

I. Supports: The screw conveyor shall be supported by structural steel members at locations shown on the drawings. Supports shall include base plates for anchoring to the floor.

J. Guards: All exposed, accessible rotating parts, as well as the drive mechanism shall be covered with an OSHA guard to prevent accidental injury. These guards are to be epoxy coated safety yellow.

K. Zero Speed Switch: The screw conveyor is to be provided with a NEMA-4, 115V., zero speed switch located at the end shaft(s). The speed switch shall be of the non-contacting magnetic-disc and sensor type with mounting bracket.

L. Conveyor Construction:
1. The screw conveyor trough, flighting, covers, trough ends and supports shall be shop prime painted. All stainless steel shall remain unfinished.
2. All welding to be in accordance with the latest AWS standards.
3. All component items shall be provided with manufacturers standard finish. Shafting and other exposed machined surfaces shall be coated with a rust inhibitive compound.
4. All nuts, bolts and washers used for assembly to be stainless steel and installed using an anti-seize compound.

2.03 DISCHARGE SLIDE GATES

A. General: Electro-Mechanically Operated Slide Gates
1. The slide gates shall be designed with a maximum vertical dimension of 4" excluding the electric motor operator. The slide gate shall be designed so that in the full, open position at least one pitch rotation of the spiral is exposed to the opening in the direction of transport and where layout permits 1.5 x spiral pitch opening. The slide gates shall have an opening at least the full width of the conveyor trough. The slide gates shall be fabricated entirely of AISI 304 (316 option) stainless steel and replaceable UHMW Polyethylene guides, all minimum 3/16" thickness.

B. Gate Actuators:
1. Provide an electric motor operated gate operators for each gate.
2. The gate actuators shall be Rotork IQ12 or Limitorque MX05 or engineer approved equal only. They shall be in a non-intrusive NEMA 4/6 Enclosure which is 'O' ring sealed with a separately sealed terminal compartment. The actuator
configuration shall be accomplished by non-intrusive interface either by infrared communications or via local control switches and an LCD indicator panel shall provide continuous position and torque information as well as valve status, alarm, and diagnostic information. The actuator calibration, setup, and communications settings shall be stored in non-volatile memory and shall be retained in the event of power loss. In addition, the battery power shall insure that local indication of valve position is provided under power failure conditions. The actuator shall include an on board data logger which allows download of historical actuator/valve performance data to PC or via irDA compatible PDA.

3. The actuator shall be warranted for a minimum of 12 months of operation from the date of start-up/commissioning. The actuator shall operate at 57 rpm.

4. The actuator shall be supported by supports designed and supplied by the conveyor manufacturer.

5. The gate actuators shall be supplied and integrated by the provider of the screw conveyor.

6. Provide a push-button station for control of the gates.

2.04 WORK COORDINATION

A. Layout and design of the screw conveyor and discharge gate shall be coordinated with layout of the centrifuge and appurtenances.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in accordance with Section 11001 and in accordance with the manufacturer's installation instructions to provide a complete installation.

3.02 ELECTRICAL CONNECTIONS AND CONTROLS

A. Wiring and conduits for electrical power, control and instrumentation will be provided by the Electrical Contractor under Division 16 - ELECTRICAL.

3.03 FIELD PAINTING

A. The Conveyor shall be unfinished stainless steel. Appurtenances shall be factory primed and receive a final field coating following installation.

3.04 FIELD TESTING

A. Conveyor and discharge gate shall be field tested according to the requirements of Section 11001, GENERAL EQUIPMENT AND MECHANICAL REQUIREMENTS.

Shaftless Screw Conveyor System 14550-6
3.05 FIELD SERVICE

A. The manufacturer or supplier shall provide a competent field service engineer for two (2) eight (8) hour working days, to thoroughly check and inspect the conveyor system after installation, place the system in operation, make necessary adjustments, and instruct plant personnel in proper operating and maintenance procedures, in accordance with Section 11001.

END OF SECTION
DIVISION 15
MECHANICAL

15050  Piping, Valves, and Accessories
15400  Plumbing
15800  Heating, Ventilating, and Air Conditioning
15875  Odor Scrubber
PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Provide all piping, including fittings, valves, supports, and accessories as shown on the Drawings, described in the Specifications and as required to completely interconnect all equipment with piping for complete and operable systems, including equipment drains.

1.02 SUBMITTALS

A. Shop Drawings:
1. Verify by excavation, inspection and measurement all installation conditions, including existing utilities and structures, for buried pipe before preparation of Shop Drawings. Submit field measurements and photos with Shop Drawings where exposed conditions are significantly different than indicated on the Drawings. See also paragraph 3.02, Existing Utilities, of Section 02301.
2. Layouts and Schematics: Submit detailed installation drawings of all piping. Schematics may be submitted for piping 4 inches and smaller. The Drawings and schematics shall include: pipe support locations and types, fittings, valves, other appurtenances.
3. Submit data to show that the following items conform to the Specification requirements:
   a. Pipe, fittings, and accessories.
   b. Fabricated pipe supports and other pipe supports as required herein.
   c. Pipe couplings and flexible pipe pieces.
   d. Valves and Accessories.
5. Submit reinforcement calculations for T.M-2P to demonstrate compliance with AWWA M11.
6. Submit procedures for welding field joints of welded steel pipe (T.M-2P and T.W-1P) and welder qualifications.
7. Submit certified test reports as required herein and by the referenced standard specifications.

B. Manuals: Furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for the following items:
1. Valves 4 inches and larger and all actuated valves
2. Strainers
3. Filters
4. Pressure regulators
5. Rotameters.

C. Affidavits: Furnish affidavits from the manufacturers for all motorized or calibrated equipment.
1.03 QUALITY ASSURANCE

A. Materials and equipment furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of the materials and equipment for a period of at least 5 years. Demonstrate to the satisfaction of the Engineer that the quality is equal to the materials and equipment made by the manufacturers specifically named herein, if an alternate manufacturer is proposed.

B. Factory Quality Control: The Contractor shall test all products as noted herein and by the reference specifications.

C. Field Quality Control:
   1. The Owner will:
      a. Inspect field welds and test the welds if it is deemed necessary.
      b. Perform bacteriological analysis for pipelines to be disinfected.
   2. The Contractor shall:
      a. Perform leakage tests.
      b. Be responsible for the costs of additional inspection and retesting by the Owner resulting from noncompliance.

1.04 APPURTENANCES

A. Furnish and install all necessary guides, inserts, anchors and assembly bolts, washers and nuts, hangers, supports, gaskets, couplings and flanges; all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the piping; devices included in or on the piping equipment; and piping accessories.

1.05 PIPE SUPPORTS

A. General:
   1. Piping 6 Inches and Larger: Pipe supports are shown on the Drawings for piping 6 inches and larger in diameter, where the piping is shown on layout drawings. Each pipe support used is designed to resist seismic loading except where the support is of the sliding type for thermal expansion. Other supports are provided to resist axial seismic loading of pipes designed for thermal expansion. Pipe supports that are considered seismic resistant are so noted on the pipe support detail sheets on the Drawings. The location and types of supports and braces are indicative and may be modified by the Contractor to suit field conditions, provided the modified support system conforms to the design criteria stated herein, and receives the favorable review of the Engineer. Where piping is shown schematically only, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated herein and using support details shown on the Drawings. Pipe supports have been designed assuming flanged joints on ductile iron pipe and steel pipe, unless otherwise indicated on the Drawings.
   2. Piping Less Than 6 Inches: Pipe supports are generally not shown for piping less than 6 inches in diameter. Where supports are not shown, it shall be the Contractor's responsibility to support all such piping in accordance with the
design criteria stated hereinafter and the support details shown on the Drawings. Piping 2-1/2 inches and larger and all piping for hazardous chemicals shall be supported with pipe supports designed to resist seismic loads. Hazardous chemical piping includes: sodium hypochlorite, sodium bisulfite, polymer, and alum. Piping smaller than 2-1/2 inches with non-hazardous contents may be supported with non-seismic resistant supports.

3. Shop Drawings: Submit layout drawings, schematics, and design calculations to demonstrate that support systems that are not as shown on the Drawings are in accordance with the design criteria.

4. Where not detailed or otherwise indicated, pipe support types and spacing shall be in accordance with the Manufacturer's Standardization Society (MSS) Standard Practice No. SP-58 and No. SP-69, except as superseded by the requirements of these Specifications. Submit Drawings of pipe supports that are not as detailed on the Drawings.

B. Pipe Support System Design:

1. Design Loads: Pipe suspension shall be such as to prevent excessive stress or excessive variation in supporting force while system is in operation. Pipe supports shall support the sum of the weight of the pipe, fittings, appurtenances, and contents. In addition, the pipe shall be anchored to resist internal pressure forces tending to separate any unrestrained joint at pressures 1-1/2 times the maximum working pressure for the applicable service.

2. Seismic Loads: Seismic loads shall conform to Section 01190.

3. Location: All piping shall be supported in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at all nonrigid joints, at hose bibs, and where otherwise shown. Where piping connects to equipment, it shall be supported by a pipe support and not by the equipment.

   a. Maximum support spacing shall conform to the following table:

<table>
<thead>
<tr>
<th>Pipe Size Inches</th>
<th>Pipe Material</th>
<th>Maximum Spacing Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; &amp; smaller</td>
<td>Iron or Steel</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Copper</td>
<td>4-1/2</td>
</tr>
<tr>
<td></td>
<td>Plastic</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Tubing</td>
<td>1-1/2</td>
</tr>
<tr>
<td>1-1/4 to 2&quot;</td>
<td>Iron or Steel</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Copper or Plastic</td>
<td>5</td>
</tr>
<tr>
<td>2-1/2 to 4&quot;</td>
<td>Iron or Steel</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Copper or Plastic</td>
<td>6</td>
</tr>
<tr>
<td>6 to 8&quot;</td>
<td>Iron or Steel</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Plastic</td>
<td>8</td>
</tr>
<tr>
<td>10&quot; &amp; larger</td>
<td>Iron or Steel</td>
<td>15</td>
</tr>
</tbody>
</table>

   b. Piping penetrations through concrete walls and slabs are considered to resist seismic loading, provided penetrations for pipes 3 inches in diameter and larger are complete with a wall flange.

   c. Branch piping is not considered to provide resistance to seismic forces.

4. Anchors: Anchors for connecting pipe supports to concrete shall be in accordance with Section 05500.
PART 2 - PRODUCTS

2.01 GENERAL

A. Pipe and valve sizes are nominal inside diameter unless otherwise noted.

B. Construct vents of materials specified for the pipe system for which they serve.

C. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping.

D. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage tests as specified hereinafter.

E. Cutoff Flanges: Provide at all pipe or sleeve penetrations where cast into wall for pipes 4 inches and greater in nominal diameter, and at all penetrations of 3-inch and smaller nominal diameter pipe in wet or potentially wet locations as indicated on the Drawings. Cutoff flange outside diameter shall be at least a standard connection flange’s outside diameter except that for pipe 30-inch-diameter and larger, nominal size, cutoff flange outside diameter may be 6 inches greater than outside pipe diameter. Cutoff flange shall be at least 1/4-inch thick and shall be continuously welded (or cast) onto the pipe. Conform to pipe penetration details shown on the Drawings.

F. All exposed fittings and valves shall be flange and all buried fittings and valves shall be restrained mechanical joint unless specifically stated otherwise.

2.02 GENERAL MATERIAL REQUIREMENTS

A. Gaskets: Unless specifically specified otherwise all gaskets shall be SBR or nitrile.

B. Bolts and Tie Rods: Unless specified otherwise herein, flange bolts and nuts, coupling bolts and nuts, tie rods and other hardware shall be as follows:
   1. Exposed: Galvanized steel, zinc electroplated or cadmium electroplated steel.
   2. Submerged: Type 316 stainless steel, minimum tensile strength: 60,000 psi.
   3. Concrete Encased: Steel.
   4. Buried: Ductile iron coated with 12 mils coal tar epoxy or steel coated with Tripac 2000 Blue fluoropolymer coating system, minimum tensile strength: 60,000 psi.
   5. Apply an anti-seize compound to the bolt threads.

C. Flexible Sealant: Flexible sealant for pipe joints, where shown on the Drawings, shall be a two-component polysulfide, non-sag; Sikaflex 412, Dualthane, or equal.

D. Fusion Epoxy Coating: AWWA C213; except application shall be by fluid bed only unless the greatest dimension of the article to be coated exceeds ten feet, in which case electrostatic spray application may be used.
2.03 PIPING MATERIALS

A. Piping Schedule: Piping systems and their corresponding piping and valve systems are listed on Drawing G0.4.

**Material**

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Acrylonitrile-Butadiene-Styrene</td>
</tr>
<tr>
<td>BS</td>
<td>Black Steel</td>
</tr>
<tr>
<td>DI</td>
<td>Ductile Iron</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl Chloride</td>
</tr>
<tr>
<td>Cu</td>
<td>Copper</td>
</tr>
<tr>
<td>SS</td>
<td>Stainless Steel</td>
</tr>
</tbody>
</table>

**Service**

<table>
<thead>
<tr>
<th>Service</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Buried</td>
</tr>
<tr>
<td>C</td>
<td>Concrete</td>
</tr>
<tr>
<td>E</td>
<td>Exposed</td>
</tr>
<tr>
<td>S</td>
<td>Submerged</td>
</tr>
</tbody>
</table>

B. Pipe Type Schedule: Pipe material, joints and fittings shall be as summarized below. A detailed specification of each pipe type follows. (The detailed specification supersedes the schedule in case of any conflicts.)

<table>
<thead>
<tr>
<th>Pipe Material</th>
<th>Service</th>
<th>Field Joints</th>
<th>Fittings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductile Iron, Cement Mortar Lined</td>
<td>ML, RS, SE, RAS, WAS, DC</td>
<td>Restrained Push-On (buried)</td>
<td>Restrained Mechanical Joint</td>
</tr>
<tr>
<td>Ductile Iron, Cement Mortar Lined</td>
<td>ML, RS, SE, RAS, WAS, DC</td>
<td>Flanged (exposed)</td>
<td>Flanged</td>
</tr>
<tr>
<td>Ductile Iron, Epoxy Lined</td>
<td>DS, SC</td>
<td>Restrained Push-on (buried)</td>
<td>Restrained Mechanical Joint</td>
</tr>
<tr>
<td>Ductile Iron, Glass Lined</td>
<td>DS, SC</td>
<td>Flanged (exposed)</td>
<td>Flanged</td>
</tr>
<tr>
<td>Black Steel, Schedule 40</td>
<td>UW (exposed)</td>
<td>Welded</td>
<td>Socket or Butt Weld</td>
</tr>
<tr>
<td>PVC, Schedule 80 (dual contained for buried service)</td>
<td>NaOCL</td>
<td>Solvent Weld</td>
<td>Solvent Weld/Barbed</td>
</tr>
<tr>
<td>ABS</td>
<td>D,VTR</td>
<td>Solvent Weld</td>
<td>Solvent Weld</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>Misc. Fittings</td>
<td>Mechanical Fitting / Welded</td>
<td></td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>SW (exposed)</td>
<td>Compression Fittings / Threaded</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>PW, UW</td>
<td>Solder / Copper</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>PW, UW, SW (buried)</td>
<td>Compression Fittings / Copper</td>
<td></td>
</tr>
</tbody>
</table>

* restrained joints and fittings not required not required for DR type pipe.

2.04. DUCTILE IRON PIPE (BURIED):

A. Pipe: Ductile iron, AWWA C151

B. Joints: Restrained Push-on joints, AWWA C111 as modified.
   1. Gaskets: SBR
   2. Joints: Provide restrained joints capable of deflection. Joints shall not separate under an internal pressure of 350 psi. Use TR-FLEX by US Pipe, equivalent product by American Cast Iron Pipe; or equal.

C. Fittings: Ductile iron restrained-push-on joints Either ductile iron restrained push-on joints or mechanical joint with restrained gland, AWWA C110 or AWWA C153. Use TR-FLEX by US Pipe push-on restrained fittings or equal or mechanical joint restraint system by Mega-Lug, Uni-Flange, or equal.

D. Lining:
   1. Standard thickness cement mortar lining for pipe and fittings, AWWA C104, except where noted otherwise in the Drawings or in the Pipe Schedule. Cement mortar linings shall be seal coated.
   2. Ceramic Epoxy lining for pipe and fittings where required in the Drawings or Pipe Schedule:
      a) Pipe and fittings shall be previously unlined. Solvent clean and completely abrasive blast all areas to receive lining.
      b) The ceramic epoxy material shall be an amine cured novolac epoxy containing at least 20% by volume of ceramic Quartz. Ceramic epoxy lining shall meet the following test requirements:
         i) Permeability rating of 0.00 when tested per Method A of ASTM E-96, Procedure A with 30-day test duration.
         ii) Salt spray (scribed panel) results equal to 0.0 undercutting after two years per ASTM B-117.
         iii) Cathodic disbondment 1.5 volts at 77°F equal to no more than 0.5 mm under cutting after 30 days per ASTM G-95.
         iv) Immersion testing using ASTM D-714:
            (1) 20% sulfuric acid – no effect after two years.
            (2) 140°F 25% sodium hydroxide – no effect after two years.
            (3) 160°F distilled water – no effect after two years.
            (4) 120°F tap water (scribed panel) 0.0 undercutting – after two years.
         v) Abrasion resistance of no more than 3 mils loss after one million cycles per European Standard EN 598, section 7.8.
      c) Lining shall be factory applied to the interior of pipe and fittings to a dry film thickness of 40 mils. Gasket areas and spigot ends shall be coated with 6 to 10 mils of ceramic epoxy joint compound, which shall also be used for field touchup of any damaged surfaces.
      d) Thickness test linings per SSPC-PA-2 using a magnetic film thickness gauge. Test interiors for pinholes with nondestructive 2,500-volt test. Correct all defects before shipment

E. Coating: Buried pipe shall receive asphalt coating per AWWA C151. Exposed pipe requiring protective coating per Section 09960 shall be shipped bare or shall be factory primed compatible with selected field paint system.
F. Protection for buried pipe: Polyethylene encasement, AWWA C105. Double wrap flanged fittings, mechanical joints, or other appurtenances with significantly different outside diameters from the pipe.

2.05 DUCTILE IRON PIPE (EXPOSED):

A. Pipe: Ductile Iron, AWWA C115 minimum thickness Class 53.

B. Flanges: Ductile iron, plain faced, AWWA C115. Submit certification that flanges comply with AWWA C115. Manufacturers are US Pipe, equivalent product by American Cast Iron Pipe, or equal.

C. Fittings:
   1. Flanged: Ductile iron, AWWA C110.

D. Lining:
   1. Standard thickness cement mortar lining for pipe and fittings, AWWA C104, except where noted otherwise in the Drawings or in the Pipe Schedule. Cement mortar linings shall be seal coated.
   2. Ceramic Epoxy lining for pipe and fittings where required in the Drawings or Pipe Schedule shall be the same as for BURIED Ductile Iron Pipe (2.04, Part D, No. 2):

E. Coating: Buried pipe shall receive asphalt coating per AWWA C151. Exposed pipe requiring protective coating per Section 09960 shall be shipped bare or shall be factory primed compatible with selected field paint system.

F. Gaskets: Full face, 1/8-inch-thick SBR.

G. Flange Bolts: AWWA C115, Appendix A, unless stainless steel is required in Paragraph 2.02.

H. Pipe Taps:
   1. Unless noted otherwise on the Drawings, direct threaded taps shall not be used. Pipe branch line connections shall be made using service saddles for tapping, by using reducing flanges on tees, or by tapping blind flanges on tees. For direct threaded taps, where indicated on the Drawings, ductile iron wall thickness must be in excess of the minimum shown in Tables A.1 and A.2 of AWWA C151 for four full threads.
   2. Service Saddles:
      a. Materials: Fusion plastic coated ductile iron saddle with stainless steel straps and hardware, and nitrile or neoprene gaskets.
      b. Type: For ductile iron pipe 4 inches and less, single strap saddles may be used. For pipe greater than 4-inch, double strap saddles shall be used.
      c. Manufacturers: Smith-Blair Model 315, 317, or 366; JCM Model 406; or equal.
2.06 ACRYLONITRILE-BUTADIENE-STYRENE DRAIN/WASTE/VENT (ABS DWV) PIPE:

A. Pipe and Fittings: ABS DWV pipe and fittings, Schedule 40 ASTM F628 and ASTM D2661. All products shall bear the seal of a nationally-recognized listing or certifying agency.

B. Joints: Solvent weld.

2.07 POLYVINYL CHLORIDE PIPE:

A. Pipe: Schedule 80 polyvinyl chloride (PVC), gray, normal impact, Type 12454 B, ASTM D1784 and ASTM D1785. Pipe shall bear the National Sanitation Foundation (NSF) label.

B. Joints: Solvent weld, except flanged or threaded permitted where required at equipment connections and where required on the Drawings. Use Military Specification T-27730A rate tape for threaded joints. Threaded joints shall not be used for hypochlorite service.

C. Fittings: Solvent weld, socket type, of same material as the pipe, Schedule 80, ASTM D2467.

D. Cement: ASTM F493, solvent weld cement IPS 724 CPVC as supplied by Harrington Plastics, no equal.

E. Pipe Cleaner: As recommended by the solvent supplier for the schedule and size to be joined.

F. Double contained piping is required for all buried PVC hypochlorite (NaOCL) tubing as indicated in the pipe schedule or elsewhere in the Drawings and Specifications.
   1. Provide Schedule 40 PVC containment pipes for all buried carrier tubing.
   2. Joints: Solvent weld except flanged where required.
   3. Fittings: Solvent weld, socket type, of same material as the pipe, Schedule 80, ASTM D2467.

G. Tubing for hypochlorite service as follows:
   1. Tube: Unpigmented reinforced PVC, Nalgene 980; Norton Tygon B-44-4XI.B; or equal.
   2. Fittings: PVC barbed.
   3. Minimum working pressure 145 psi at 70°F, 25% of burst pressure.

2.08 COPPER TUBING AND FITTINGS

A. Pipe: Copper, ASTM B-280:
   1. Buried: Type ACR, type K annealed tempered copper tubing.
   2. Exposed: Type ACR, type L seamless copper tubing, hard drawn straight lengths.
B. Joints:
1. Buried: Where possible, provide continuous length of pipe for any buried segments. Buried fittings for copper shall be brass with a flared fitting.
2. Exposed: Brazed.

2.09 STAINLESS STEEL TUBING AND FITTINGS

A. Tube: Stainless Steel, Type 316 fully annealed ANSI B36.37, ASTM A269 rated 3,000 psi.
   1. Dimensions: 1/4-inch outside diameter x 0.035-inch wall
B. Joints: Compression or welded.
C. Fittings: Same material as tube:
   1. Compression: Imperial; Swagelok; or equal.
   2. Welded fittings and joints, where used, shall be stress relieved.

2.10 STAINLESS STEEL PIPE

1. Pipe: Stainless steel, ASTM A312 304L
2. Joints: Butt welded except where screwed or flanged joints are required adjacent to valves or equipment.
4. Flanges: Welding neck or slip-on, raised face, ASTM A182, F316L. ANSI B16.5 for dimensions. Class 150, drilling to match adjacent accessories or valves.
5. Gaskets: Full face gasket per ANSI B16.21, non-asbestos Hypalon, Viton or Teflon-bonded EPDM gasket.

2.11 BLACK (CARBON) STEEL PIPE

A. Pipe: Schedule 40 black steel, ASTM A53, Grade B, butt weld or seamless.
B. Joints: Butt welded or socket welded, except where otherwise shown on the Drawings and where screwed or flanged accessories or valves are required.
C. Fittings: Forged steel, butt weld type, Schedule 40 conforming to ASTM A234, or 2,000 psi forged steel socket weld fittings conforming to ASTM A105.
D. Flanges: Where required to connect to flanged equipment or valves, shall be slip-on or weld-neck type conforming to ASTM A105 or ASTM A181. Flange drilling and facing shall match that of the flanged valves or equipment to which the pipe connects.
E. Branches two sizes or smaller than pipe main may be made with factory fabricated steel welding saddles manufactured by Bonney; Ladish; or equal.

2.12 PIPE COUPLINGS AND FLEXIBLE PIPE PIECES

A. General: For typical pipe joints refer to pipe material specifications. Other joint devices shall be furnished where called for as specified below.
B. Flexible Couplings and Flange Coupling Adaptors:
1. Sleeve: Cast iron or fabricated steel.
2. Followers: Cast iron, ductile iron, or steel.
3. Sleeve Bolts: ASTM A325, Type 3; malleable iron; or equivalent, except for buried and submerged, which shall be Type 304 SS and Type 316 SS, respectively.
4. Coating: Fusion epoxy line and coat sleeve and followers.
5. Pressure Rating: 1-1/2 times the test pressure of the applicable service or 50 psi, whichever is greater.
7. Flanged Coupling Adaptor Flanges: Match mating flanges. If required by connecting valve or other device, provide flanges with inside diameter equal to nominal pipe diameter.
8. Manufacturers:
   a. Flexible Couplings:
      1) Connecting Pipe with Identical Outside Diameters: Smith-Blair 411 or 441; Dresser Style 38 or 53; or equal.
      2) Connecting Pipe with Slightly Different Outside Diameters: Smith-Blair 413 or R441; Dresser Style 162; or equal.
   b. Flange Coupling Adaptors: Smith-Blair 912 or 913; Dresser Style 127 or 128; or equal.
9. Gaskets: Oil and grease resistant; Smith-Blair Grade 60; Dresser Grade 42; or equal.
10. Joint Restraint: Provide joint harnesses (tie rod lug or attachment plate assemblies) designed for the test pressure or 50 psi, whichever is greater, across all flexible couplings and flange coupling adaptors, except where specifically indicated otherwise on the Drawings. For steel pipe the joint harness shall conform to the requirements of Chapter 13 of AWWA M-11, paragraph 13.10, Table 13-6 - Tie Bolt Schedule for Harnessed Joints. Use anchor pins with all flange coupling adapters.
11. Protection for Buried Couplings and Adaptors:
   a. Double wrap with polyethylene encasement, AWWA C105 and tape the edges of the encasement with PVC tape.

C. Flexible Rubber Spools:
1. Up to 12-inch Diameter:
   a. Type: Molded spherical rubber expansion joints with full rubber flanges and retainer rings.
   b. Materials: Neoprene cover over nitrile tube, reinforced with nylon or polyester body and galvanized steel retainer rings, except those used on chemical systems which shall have Hypalon cover over Hypalon tube, and Type 316 stainless steel retainer rings. Protect cover with Hypalon paint where exposed outdoors.
   c. Minimum Pressure Rating: 190 psi.
   d. Manufacturers: Proco Series 230; Holz Type 200; Garlock Style 204 HP; or equal.
2. Restraint: Provide galvanized steel control rod-compression sleeve assemblies for all flexible spools, except where pipelines cross structural expansion joints.
or where specifically omitted by note in the Drawings. Number and size of control rods shall be as required for the test pressure of the pipe system or 50 psi, whichever is greater.

3. Provide full size intermediate metal pipe flanges where rubber spool connects with wafer style valves, lug style valves or other pipeline items that do not have full face metal flanges.

2.13 VALVES AND ACCESSORIES

A. Valve and Accessory System Designation: Most valves and accessories to be furnished and installed are identified by a valve and accessory system designated by a letter symbol in the Pipe Schedule.

B. General Requirements for Valves:
1. All valves of each type shall be the product of one manufacturer.
2. All valves shall be furnished with operators, handwheels, levers, or other suitable type wrench including handles as specified herein or as shown on the Drawings. Valves 4-inch and larger located more than 7 feet above the floor level shall be furnished with chain operators. Chains shall be galvanized and shall extend to within 3 feet of the floor. Provide hook so that chain may be stored clear of walkways.
3. All threaded stem valves shall open by turning the valve stem counterclockwise.
4. All exposed valves and valve operators shall have a non-bleeding shop coat, unless otherwise specified. Buried valves and operators shall be coated as specified in Section 09960.

C. Valve and Accessory Systems: See Pipe Schedule on Sheet G0.4.

1. **Valve and Accessory System A:**
   Applicable Service Condition: Clean Water and air in ferrous piping. See system D for water service in copper piping.
   a. Exposed Gate Valves through Size 2-inch:
      1) Rating: 200 psi WOG.
      2) Type: Rising stem, screw in bonnet, solid wedge disc, handwheel operated.
      3) Connections: Threaded.
      4) Materials: All bronze, UNS 83600, ASTM B62, B505 or B584.
      5) Manufacturers: Jenkins Figure 47; Crane No. 428; or equal.
   b. Exposed Gate Valves 2-1/2 through 12-inch:
      1) Rating: 200 psi WOG.
      2) Type: AWWA C509, resilient seated, rising stem, outside-screw-and-yoke (OS&Y), handwheel operated.
      3) Connections: Flanged, 200 psi WOG.
      4) Materials: Cast iron or ductile iron body, bronze stem.
      5) Protective coating: Epoxy lined and coated per AWWA C50
      6) Listing: UL/FM
      7) Manufacturers: M&H 4068-02, Mueller, Kennedy, American
   c. Buried Gate Valves 2 through 12-inch:
      1) Rating: 200 psi WOG.
      2) Type: AWWA C509, resilient seated, non-rising stem, 2-inch operating nut.
3) Connections: Mechanical joint with Magalug type joint restrain by Ebba Iron or equal.
4) Materials: Cast iron or ductile iron body, bronze stem.
5) Protective coating: Epoxy lined and coated per AWWA C50
6) Listing: UL/FM
7) Manufacturers: M&H, Mueller, Kennedy, American
8) Installation: Provide 2-inch square standard AWWA operating nut, with extension stem to reach the ground surface and valve box as shown on the Drawings.

d. Globe Valves through size 3-inch:
1) Rating: 300 psi WOG.
2) Type: Union bonnet, handwheel operated, straight or angle pattern.
3) Connections: Threaded.
4) Materials: All bronze, ASTM B62 alloy 83600 and ASTM B16 except disc shall be Teflon.
5) Manufacturer: Jenkins 106A; Crane 7TF; or equal.
e. Needle Valves through size 2-inch
1) Rating: 400 psi WOG.
2) Type: Rising stem, screw in bonnet, handwheel operated.
3) Connections: Threaded.
4) Materials: All bronze, UNS 83600, ASTM B62, B505 or B584.
5) Manufacturers: United Model 79; or equal.
f. Ball Valves through size 4-inch in metal piping:
1) Rating: 400 psi WOG.
2) Type: Lever.
3) Connections: Threaded.
4) Materials: Bronze body ASTM B584 alloy 83600 or 84400, chrome-plated ball, teflon seats.
5) Manufacturers: Apollo 70-100; Watts B-6000; or equal.
g. Swing Check Valves through size 2-inch:
1) Rating: 300 psi WOG.
2) Type: Swing, composition disc.
3) Connections: Threaded.
4) Materials: All bronze, ASTM B62 body, ASTM B61 and B584 alloy 87600 other bronze parts, except disc shall be teflon.
5) Manufacturers: Jenkins 352; Crane 141; or equal.
h. Swing Check Valves 2-inch and larger:
1) Rating: 175 psi up to 12-inch, 150 psi for 14-inch to 24-inch.
2) Type: Swing, metal seats, outside spring and lever, AWWA C508.
3) Connections: Flanged, 125-pound ANSI.
4) Materials: Cast iron, bronze trim.
5) Manufacturers: APCO Series 6100, M & H Style 259; equivalent by Clow; or equal.
i. Pressure Gauge Assembly:
1) Complete assembly shall include isolation valve, pulsation dampeners or snubbers. Provide a support plate to the nearest flange.
2) Pressure gauges shall have a dial size not less than 4-1/2 inches, phenolic or polypropylene flangeless case, bronze brushed movement, ½-inch NPT bottom entry, phosphor bronze or stainless steel bourdon tube, liquid filled 1% accuracy, friction mounted adjustable pointer,
black figures on white dial, glass or acrylic window. Label face of dial for measurement in psi. Range sized so anticipated pressure near midpoint of scale. Complete gauge shall be Ashcroft 1279; Trerice Series 450; or equal.

3) Isolation valves shall be Type 316 stainless steel needle valves (unless ball valves are shown on the Drawings); Trerice 735 or 740; Ashcroft 7004L; or equal.

4) Pulsation dampeners and snubbers shall be stainless steel for the specific service involved, and shall be Chemquip 25B; Trerice No. 870; or equal.

j. Strainers:
1) Rating: 125 psi.
2) Type: Y-type basket strainers, 20 mesh.
3) Connections: Threaded or flanged.
5) Manufacturers: Bailey 100A; Hoffman Series 400, 450; or equal.
6) Installation: Each to be complete with ball valve on blowoff and piping to drain.

k. Solenoid Valves: Valves shall be for 150-psi water pressure, 120-Volt ac service, with a watertight enclosure. Valve body shall be brass, seats Buna-N, with stainless steel plug. Valves shall be normally closed except where noted otherwise. Provide manual override control. Valves shall be ASCO Bulletin 8211; Skinner L or R Series; or equal.

l. Pressure Reducing Valves:
1) Self-Contained: Watts No. U5B for low flows or 223B for flows to 170 gpm; Cashco Model D for low flows or Model 8310 DS for flows to 170 gpm.

m. Rotameters: The tube shall be readily field removable for cleaning. The float shall be PVC. All other wetted parts shall be Type 316 stainless steel or plastic, except O-rings shall be EPDM unless otherwise recommended by the manufacturer. End fittings shall be chosen to suit the process fluid and the installation requirements in the field. The metering scale shall be at least 250 mm in length with GPH graduations. Meters shall have a minimum rangeability of 10:1. The metering scale shall read in gph or gpm as appropriate. Accuracy shall be ±2.5% of full scale for flow rates in the upper 90% of the maximum flow range specified. Rotameters shall be manufactured by Krohne, Brooks Instrument; SK Instrument; Wallace & Tiernan; Fischer & Porter; or equal.

2. Valve and Accessory System B:
   Applicable Service Conditions: Sludge, drainage, sewage and wastewater at working pressures to 100 psig.

a. Plug valves through 2-inch: Lukenheimer Figure 454 with lever, James Jones equivalent, or equal. Connections shall be threaded or socket welded, as required.

b. Plug valves 2-inch and larger:
   1) Rating: 175 psi through 12-inch, 150 psi 14-inch and larger.
   2) Type: Resilient faced eccentric plug, lever operated 4-inch and smaller, worm geared handwheel operated 6-inch and larger, or pneumatically actuated as shown on the Drawings. Valves shall provide drip tight shutoff in both directions.

   3) Connections:
a. Exposed: Flanged, 125-pound ANSI, except screwed connections may be used for 2-inch valves.
b. Buried: Mechanical joint.

4) Materials: Cast iron body, welded nickel seat, NBR coated plug, NBR packing or U-cup stem seal. Valves shall have interior and exterior metal surfaces other than the plug and valve seat coated with two coats of high-solids epoxy with total dry film thickness 12 mils minimum.

5) Manufacturers: DeZurik PEC, Milliken, Clow Eccentric Plug Valve, or equal.

6) Installation: Unless otherwise necessary for proper installation or permitted by Engineer, all eccentric plug valves shall be installed with shaft horizontal and with plug in upper half of body. Valves in sewage lines shall be installed with seat on upstream end.

c. Check Valves: Unless specifically called out otherwise by the Drawings or Specifications, provide swing-type check valves. Swing check valves shall be as specified above for System A.

d. Pressure Gauges:
   1) Unless indicated otherwise, use wafer style, Red Valve™ Series 40 Pressure Sensor ring with 2.5-inch diameter steel cased pressure gauge with pressure range of 0-100 psi.
   2) Where indicated on the Drawings, use the following components to provide a complete working pressure gage assembly.
      a) Complete installation shall include 3/4-inch plug valve isolation at the main, a gauge protector made specifically for solids handling service, a snubber and gauge. Provide a support plate to the nearest flange.
      b) Plug Valve: Shall be DeZurik PEC; or equal. Connections shall be threaded.
      c) Protector: Shall be for slurry service with flushing connection. Body shall be steel or cast iron. Diaphragm shall be removable of Type 316 stainless steel. Complete unit shall be Trerice, M & G (U.S. Gauge), or equal.
      d) Gauges and Snubbers: Shall be as specified for System A.
      e) Installation: All protectors and gauge bourdon tubes shall be evacuated of air, glycerine filled at the factory and factory calibrated.

e. Sewage Combination Air Valves (SCAVs):
   a) Function: Exhausts large volumes of air during pipeline filling and allows air back in when pipeline pressure drops below atmospheric pressure.
   b) Materials: Cast or ductile iron body, stainless steel float.
   c) Pressure rating: 150 psi.
   d) Manufacturer: Apco Series 440; equivalent by Valmatic; or equal

f. Line Stop Saddle:
   a. Rating: 150 psi water
   b. Service: Raw sewage
   c. Outlet: Carbon steel flange with set pins and completion groove.
   d. Gasket: Full 360° contact, gridded SBR compound
   e. Body: Carbon steel, 16 mil fusion bonded epoxy coated and lined

g. Knife Gate Valves:
a. Rating: 150 psi water
b. Service: Raw sewage
c. Type: Resilient seated, hand wheel operated.
d. Connection: Lugged, ANSI 150 pattern with through bolting,
e. Packing: PTFE impregnated synthetic fiber
f. Body: 316 stainless steel
g. Gate: 316 stainless steel
h. Manufacturers: DeZurik, KGL or equal


a. Ball Valves Through 4-inch Size:
   1) Rating: 150 psi at 75°F.
   2) Type: Double union.
   3) Connections: Socket.
   4) Materials: PVC body, teflon seats and EPDM O-ring seals, except Viton O-ring seals with chlorine solution.
   5) Manufacturers: R&G Sloane, Asahi/America Pro Block, or equal.

b. Check Valves Double Union Type:
   1) Size: Up to 2-inch
   2) Rating: 150 psi at 75°F.
   3) Type: Ball for horizontal or vertical service.
   4) Connections: Union ends for socket weld.
   6) Manufacturers: Chemtrol True Union BC, Plastiline No. 8611, or equal.

c. Check Valve Swing Type:
   1) Size: 2-inch and larger
   2) Rating: 100 psi.
   3) Type: Disc for horizontal or vertical service.
   4) Connections: Flanged ends.
   5) Materials: PVC body, EPDM seat and seal.
   6) Manufacturers: Asahi, or equal.

d. Diaphragm Valves:
   1) Rating: 150 psi.
   2) Type: Weir type diaphragm.
   3) Connections: Flanged or true union.
   4) Materials: PVC bodies with EPDM/TFE bonded diaphragms.
   5) Manufacturers: Asahi/America Type 72, Gemü, or equal.

   6) Actuators:
      a) Type: Manual, except where specified otherwise, or shown otherwise on Drawings. Provide local, visual, valve position indicators on all actuators. Provide manual override on all motor actuators.
      b) Motor Actuators: Provide motor, limit switches and gearing within a NEMA 4 enclosure. Motor shall be reversible for use with 115V single-phase power. Unit shall accept remote open and close dry contacts and shall include position indicating limit switches for remote indication of open and closed positions.

e. Solenoid Valves: Valves shall be for 140-psi inlet pressure, 120-Volt ac service, with a NEMA 4X enclosure. Valve body shall be PVC, Viton seats,
Teflon™ diaphragm, and stainless steel fasteners. Valves shall be normally closed except where noted otherwise. Provide manual override control. Valves shall be Plast-O-Matic; or equal.

f. Pressure Relief Valves:
   1) Size: Up to 2 inches.
   2) Pressure Rating: 150 psi.
   3) Set Pressure Range: 5 to 100 psi.
   4) Material: PVC body, Teflon™ diaphragm, Viton non-wetted seal.
   5) Manufacturers: Plast-O-Matic Model RVDT, or equal.

g. Pressure gauges shall be as specified for System B, except as follows:
   1) Gauges shall have molded PVC housing, Plast-O-Matic or equal.
   2) Provide protectors with a PVC body, PTFE diaphragm, and vibration snubber. Series GGM True Blue Gauge Guard by Plast-O-Matic, or equal.
   3) Isolation valves shall be PVC.

h. Plug valves: As specified for System B.

i. Calibration Chambers:
   1) Size: 1,000 ml with 1-inch (minimum) female NPT inlet/outlet and vent.
   2) Materials: PVC.
   3) Graduated in ml and gallons.
   4) Manufacturers: Accudraw by Primary Fluid Systems, or equal.

j. Eductors:
   1) Type: Liquid-driven self-priming eductor. No moving parts or seals.
   2) Rating: Vacuum up to 25 inches Hg; 150 psi pressure.
   3) Materials: PVC.
   4) Connections: NPT.
   5) Manufacturers: Fox Valve, or equal.

k. Injection Quill with Corporation Stop:
   1) Rating: 125 psi at 100°F.
   2) Material: CPVC injection quill and brass corporation stop with protection chain.
   3) Minimum Insertion Length: 8-½ inches.
   4) Manufacturers: Neptune Chemical Pump Co., or equal.

l. Pull boxes (for hypochlorite system)
   1) Location: tubing pull boxes shall be located every 50 feet or less, with no more than one, 90-degree bend between boxes or between box and structure penetration.
   2) Box: 11"x18"x26" deep polymer concrete or plastic valve vault, bottomless, drilled or with knockouts, with H-20 rated bolted cover. Install as necessary for H-20 loading. Provide vertically elongated penetrations to allow for settling of adjacent structures (pipe diameter plus 1.5-inches above and below pipe)
   3) Connection within box: connect two ends of tubing with barbed x barbed connection. Leave 12 inches minimum between ends of carrier pipe for access to barbed fitting.

m. Buried valve boxes (for hypochlorite system)
   1) Location: as shown on drawings.
   2) Box: 38-1/2"x62-5/8"x36" deep polymer concrete valve vault, bottomless, drilled or with knockouts. Provide vertically elongated
penetrations to allow for settling of adjacent structures (pipe diameter plus 1.5-inches above and below pipe) Model No. S3660S0B0A by Oldcastle Precast, or equal.

3) Connection within box: as shown in drawings.

4. Valve and Accessory System E:

a. Applicable Service Conditions: Clean water at pressures to 150 psi and temperatures to 150°F utilizing copper piping.

b. Gate Valves through 2-½-inch:
   1) Rating: 200 psi water.
   2) Type: Rising stem, solid wedge.
   3) Connections: Solder ends for copper pipe.
   4) Materials: All bronze.
   5) Manufacturers: Jenkins Figure 1242, Crane No. 1334, or equal.

c. Check Valves through 2½-inch:
   1) Rating: 200 psi water.
   2) Type: Regrinding swing check.
   3) Connections: Solder ends for copper pipe.
   4) Materials: Bronze with bronze or brass disc.
   5) Manufacturers: Jenkins Figure 1222, Crane No. 1342, or equal.

d. Pressure Relief Valves:
   1) Rating: 150 psi for valves 2-inch and smaller.
   2) Type: Adjustable spring loaded.
   3) Connections: Threaded.
   4) Materials: Bronze body.
   5) Manufacturers: Consolidated 2478; Farris 1400S; or equal.

e. Ball Valves
   1) Rating: 600 psi WOG.
   2) Type: Three piece, full port, lever handle.
   3) Connections: Solder end
   4) Materials: Bronze body and ball, teflon seats and packing.
   5) Model: Apollo 82-200 Series or equal.

f. Pressure Reducing Valve
   1) Working Pressure: 180 psig
   2) Pressure Adjustment: 25 to 75 psi
   3) Connections: solder with double union
   4) Materials: Bronze body, stainless steel strainer and seat
   5) Model: Conbraco Series 36C or equal

g. Strainers shall be as specified under Valve and Accessory System A.
   1) Rating: 400 psi WOG at 150°F.
   2) Type: Y-type basket strainers.
   3) Connections: Solder
   4) Materials: Bronze body, 304 stainless steel screen
   5) Model: Conbraco 59 Series or equal.

h. Solenoid Valves: As specified under Valve and Accessory System A.

i. Water Hammer Arresters shall be Wade Shokspop No. W-10, Zum Z-1700.

j. Valve boxes (for foam spray water system)
   1) Location: At supply to foam spray water at Oxidation Ditch.
   2) Box: 11"x18"x26" deep polymer concrete or plastic valve vault, bottomless, drilled or with knockouts, with H-20 rated bolted cover. Install as necessary for H-20 loading.
   3) Connection within box: As shown on drawings
5. **Valve and Accessory System G:**
   a. Applicable Service Conditions: Polymer.
   b. Ball Valves
      1) Rating: 150 psi at 75°F.
      2) Type: Double Union.
      3) Connections: Socket.
      4) Materials: PVC body, teflon seats, and EPDM O-ring seals.
      5) Manufacturers: R&G Sloan, Asahi/America Pro Block, or equal.
   c. Check Valves
      1) Rating: 150 psi at 75°F.
      2) Type: Ball for horizontal or vertical service.
      3) Connections: Union ends for socket weld.
      4) Materials: PVC body and Viton O-ring seals.
      5) Manufacturers: Chemtrol True Union BC, Plastiline No. 8611, or equal.
   d. Pressure Relief Valves
      1) Type: Spring operated safety relief valve.
      2) Connections: NPT.
      3) Materials: CPVC or PVC body, Teflon diaphragm.
      4) Pressure Settings: 5 to 150 psig.
      5) Model: Plast-O-Matic RVD or equal.
   e. Strainers
      1) Rating: 150 psi.
      2) Type: Wye-type basket strainers. Strainer screen size as recommended by feed pump supplier.
      3) Connections: Threaded.
      4) Materials: PVC.
      5) Manufacturers: Chemtrol, GF, or equal.
      6) Installation: Each to be installed with ball valve blow-off and piping to drain.
   f. Pressure Gauges: As specified for Valve and Accessory System B, except provide protector body and diaphragm materials appropriate for the chemical solutions to which they will be exposed.
   g. Calibration Chamber
      1) Size: 1000 ml with ½-inch (minimum) female NPT inlet/outlet and vent
      2) Materials: PVC
      3) Graduated in ml and gallons
   h. Flexible Rubber Spools:
      1) Type: Spherical rubber expansion joints with full rubber flanges and retainer rings.
      2) Materials: Teflon™ tube, body, and cover, 316 SS retaining rings and bolts.
      3) Pressure rating: 150 psi.
      4) Model: Holtz Style 530, Garlock EZ-Flow or equal.

6. **Miscellaneous Valves and Accessories:**
   a. Hose Bibbs and Related Accessories:
      1) Hose Bibs: Supply hose bibs for potable and utility water as shown on the Drawings.
         a. Indoor: Nibco Model 55; Arrowhead Brass Model 353; or equal. (¾-inch)
         b. Outdoor (Non-freezing type): Zurn Z-1390; or equal (1.25-inch).
      2) Hose Racks: Supply a hose rack for each hose bib as shown on the Drawings and specified below:
a. Mount hose racks as close as practical to the hose bib. A Warning Sign, as shown on the Drawings, shall be placed at each Utility Water hose bib.


4) Nozzles: Provide nozzles as follows:
   a) Provide (6) hose nozzles with a 1-inch discharge and 1.25" x 1" reducing fitting, Model SFM by Elkhart Brass or approved equal.
   b) Provide (4) hose nozzles with a 3/4-inch discharge by Elkhart Brass or approved equal.

b. Link-Type Seals: Link-type seals shall be interlocking synthetic rubber links connected by stainless steel bolts and nuts to form a continuous belt. Tightening of the bolts shall expand the rubber to form a watertight seal of the annular space between a pipe and the hole or sleeve in the wall.

c. Telescoping Skimmer:
   1) Provide telescoping skimmer assemblies complete with manual lifting device, stem and guides, telescoping funnel tube, and gasketed wiper compensation flange set, all as detailed on the Drawings and specified herein. The lifting device shall hold its setting and not move until the handwheel is turned. Provide adjustable restraints on lifting device/stem assembly to limit the telescoping lift tube travel to settings shown on the Drawings. Provide a 2-foot-diameter funnel section integral with the telescopic lift tube. Lift tube and funnel shall be Schedule 10 Type 316 stainless steel.

   2) Lift Device: The lift device shall consist of a cast iron handwheel, bronze lift nut, stop nut and 1-inch-diameter Type 316 stainless steel rod. The device shall be similar and equal to Rodney Hunt Model S-2600; equivalent unit as manufactured by Link-Belt Company; or equal. The lifting stem connection at the telescoping valve shall be such that it is keyed to the telescoping valve tube and is not left free to rotate after the connection bolt is placed on the end of the rod.

   3) Stem Guide: The stem guide shall be of cast iron with a two-piece collar and of ample strength to withstand the loads placed on them by the telescoping valve operation. The anchor bolts shall be galvanized steel.

d. Pipe Service Saddles: Service saddles shall be provided and installed where shown on the Drawings.
   1) Cast or Ductile Iron Pipe: Service saddles shall be provided and installed where shown on the Drawings. Service saddles for ductile iron and cast iron pipe shall be as specified in Paragraph 2.05.

   2) PVC Pipe: Service saddles for PVC pipe shall be the broad band strap or type with wrap around rubber gasket and be suitable for use in service up to 150 psi working pressure and 150°F. Body shall be bronze or stainless steel with 3/4-inch NPT tap, except where other size is required on the Drawings. Service saddle shall be Smith-Blair 397; or equal.

   3) Steel Pipe: Service saddles for steel pipe shall have double stainless steel straps and fusion epoxy coated ductile iron body. Service saddle shall be JCM Model 425, or equal.

e. Valve Boxes for Buried Valves: Adjustable type including base casting, cast iron, screw-type, installed with top set at finished grade. All valve boxes and...
covers shall be suitable for H20 AASHTO wheel load. Covers for all boxes shall have cast thereon, an appropriate name designating the service for which the value is intended. Clow Figure F-2454 with Figure F-2476 extension; equivalent products by Mueller; or equal.

f. Concrete Valve Vaults: As specified in Section 02085.
g. Valve Tags: Plastic, fiberglass, or plastic material, 2-inch square with grommeted hole. The tags shall be attached to valves with a brass jack chain. For buried installations use a nylon strap. Lettering shall be stamped or cut into the tag at least 3/16-inch high.

h. Quick-Disconnect Assembly: Consists of a male/female coupling with cam seated washer type seal. Couplings shall be "Kamlock" by OPW or equivalent. Coordinate coupling size with equipment and Owner for compatibility with local supplier's chemical delivery equipment.

i. Groundwater Pressure Relief Valves: 4-inch-diameter, cast iron, with removable cover, lead-to-lead seat, internal self-contained lock, and removable grate. Neenah Foundry R-5000-C; Clow F-1492; or equal.

j. Flap Valves: Flap valves for end closure of outfall lines shall swing open under direct pressure and close under gravity. The valve shall seal under back pressure by holding the flap against the seal. Flap valves shall be of circular port design with offset single pivoted hinge. They shall be of the iron body bronze mounted type and furnished with flanged end or hub end as indicated on the Drawings.

The assembly shall consist of three parts: flap gate, body and hinge pin. The flap gate and body shall be cast iron conforming to ASTM specifications A-126 Class B. The seats and hinge pin shall be furnished of bronze. The flap gate seat ring shall be rolled into a dovetailed groove under pressure to make one inseparable unit. The body seat ring shall be threaded and screwed into place in the body. Both gate and body seat ring faces shall be machined to a smooth finish. Valves shall be manufactured by M&H approved equal.

k. Electric Heat Tape:

Hot Water Piping: Heat tape shall be self-regulating industrial grade heating cable to be applied to the hot water piping. Cable shall be braided, with approximately 4 watts per foot capacity at 115°F using 208 volts, single-phase electrical wiring. Heating cable and components must be U.L. approved, and shall operate without the use of thermostats. System shall include all necessary components including power connection kits, tees, seals, tape, and labels. Cable shall be attached to piping by means of a fiberglass tape or nylon straps. A 1-inch "System A" insulation shall be applied after cable has been installed and tested. Installation and testing shall be strictly in accordance with manufacturer's instructions. Cable shall be Raychem, HWAT; or equal.

l. Foam Spray Devices:

1) Spray Nozzles: Nozzles for the foam spray system in the oxidation ditch shall be Spraying Systems Co. Model 22561-10535.5, or equal, that provide the following performance characteristics, Spray Angle, degrees – 105, Flow Rate, gpm – 5, Pressure loss, psi – 20. The nozzle shall be fitted with a counterweight lever that is angled at a minimum of 30 degrees form the nozzle body's axis. The counterweight lever shall be easily lifted to flush the nozzle of clogging material. The nozzle shall be constructed of brass with a ¼-inch NTP male fitting.
2) Adjustable Ball Fittings: Adjustable ball fittings for the foam spray system in the oxidation ditch shall be Spraying System Co. Model 36275-1/4x1/4, or equal. The ball fittings shall allow easy adjustment of the spray nozzles spray angle and shall have a minimum total angle of adjustment of 45 degrees. The ball fittings shall be constructed of brass with 1/4-inch NPT male inlet connections and 1/4-inch NPT female outlet connections.

m. Pipe Insulation Systems
   1) Insulation System A:
      a) Material: Insulation shall be a pre-molded fiberglass with a maximum "K" factor of 0.25 at 70°F and having a factory-applied jacket. Fittings shall be insulated with insulating cement or mitered section of pre-molded fiberglass.
      b) Fittings shall be covered with a Zeston, Thermazip, or equal jacket. Pipe insulation shall be Schuller "Micro-Lok 850-AP" with foil scrim kraft jacket, with laps and butt straps secured with Benjamin Foster or Arobol adhesive; Owens-Corning Fiberglas Type 25 ASJ/SSL; or equal. Insulation exposed to the weather shall have, in addition, an aluminum waterproof jacket alloy 3003 (0.024-inch); Childers, Alcorjac, or equal.
   2) Insulation System C:
      a) Material: Insulation shall be nominal 3/8-inch wall thickness flexible closed celled foamed plastic. Insulation shall have a "K" factor of not more than 0.30 at 70°F. Insulation shall have a usage range from -30°F to 220°F. Insulation shall be Armstrong Armaflex 22; Johns-Manville Aerotube; or equal.
      b) Application: Seal all slit and butt joints with adhesive supplied by manufacturer. Fittings shall be covered with mitered insulation according to manufacturer's recommended procedures and sealed with adhesive. Insulation shall have first class appearance.
      c) Finish: Finish all exposed insulation with two coats of manufacturer supplied finish in a color selected by the Owner's representative.

2.14 PIPE SUPPORTS

A. Manufacture and Design: Pipe supports shall to the maximum extent possible be standard factory fabricated units conforming to the typical supports and braces shown in the Drawings and as specified below. Where required support cannot be provided by standard factory fabricated units, and is not detailed on the Drawings, the Contractor shall provide special pipe supports. Supports shall be manufactured or special fabrications or combination as shown on the Drawings or specified. Special fabrications shall be in conformance with Section 05500. Provide 3/4-inch chamfer on corners of all support elements and file or grind smooth. Supports designated to allow axial pipe movement shall have smooth and even contact surfaces.

B. Materials: All support systems shall be galvanized steel except that those that are submerged or that are located within a tank, channel, or other structure designed to hold water, below the top of surrounding walkway elevation or tank wall top, or otherwise called out on the Drawings, shall be Type 304 stainless steel. Trays for
continuous support of plastic pipe or tubing shall be made of 20-gauge galvanized steel.

C. Insulation Protection Shields: Provide insulation protection shields at all pipe supports for insulated piping.

D. Provide plastic caps with rounded corners on all exposed ends of channels.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

A. General Handling and Placing:
1. Exercise great care to prevent injury to or scoring of the pipe lining and coating, as applicable, during handling, transportation or storage. Handle fusion epoxy coated pipe and ceramic epoxy lined pipe in accordance with AWWA C213. Do not store pipe on rough ground and do not roll the pipe on the coating. Any damaged pipe sections, specials, or fittings shall be repaired or replaced at the expense of the Contractor as satisfactory to the Engineer.
2. Carefully inspect each pipe, fitting, valve and accessory before installation to insure there is no defective workmanship or obstructions. Inspect the interior and exterior protective coatings and patch all damaged areas in the field or replace to the satisfaction of the Engineer.
3. Place or erect all piping to accurate line and grade and backfill, support, hang, or brace against movement as specified or shown on the Drawings, or as required for proper installation. Remove all dirt and foreign matter from the pipe interior prior to installation and thoroughly clean all joints before joining.
4. Use reducing fittings where any change in pipe size occurs. Do not use bushings unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines.
5. Cast all metallic pipes and sleeves 6-inch and larger into new concrete walls without blockout. Pipes 5 inches and smaller may be cast in place or installed in a smooth core drilled hole using a link type seal at the Contractor's option. Maintain at least 1/2-inch clearance between reinforcing steel and metal pipe in penetrations.
6. Cover polyvinyl chloride (PVC) pipe stored outside for more than two months with canvas or other opaque material. Provide for air circulation under the covering.
7. Certain installation requirements are contained in Section 15800.

B. General Buried Piping Installation:
1. Trenching, bedding, and backfill for buried piping shall be as shown on the Drawings and as specified in Section 02301.
2. Where pipe grade elevations are shown on the Drawings, install the pipe with straight grades between the indicated elevations.
3. Where no pipe grade elevations are shown on the Drawings, install buried piping with at least 3 feet of cover to finished grade. Where piping crosses under buried electrical ducts, provide at least 4 feet 6 inches of cover. Provide 12 inches minimum separation between the buried pipes and ducts.
4. Provide each pipe with a firm, uniform bearing for its full length in the trench except at field joints. Do not lay pipe in water or when trench conditions or weather are unsuitable for such work.

5. Protect buried piping against thrust by use of restrained pipe joints. All exposed free pipe ends shall be securely braced. Cap or plug pipe ends that are left for future connections as shown on the Drawings and in a manner favorably reviewed by the Engineer.

6. Where piping leaves a structure or concrete encasement, provide a joint capable of angular deflection within 12 inches of the structure. Conform to details on the Drawings.

7. Snake buried PVC pressure pipe from side to side in the trench in long sweeps.

8. Concrete Encasements: All piping and conduits installed under slabs or footings on earth or crushed rock shall be encased in concrete not less than 6-inch thickness on all sides and extending up to the bottom of the slab or footing, unless otherwise specifically noted on the Drawings. Encasement shall extend to within 6 inches of the first pipe joint beyond the slab or footing. Provide concrete encasement whether or not the encasement is shown on the Drawings. Provide encasement under slabs on earth or crushed rock even if the structure is supported on piles, caissons, or footings. Provide continuous concrete cradles where shown.

9. Do not pull bell and spigot, gasketed joints more than 50% of the maximum deflection permitted by the pipe manufacturer.

10. Coat bolts on buried flanges or other buried appurtenances in accordance with Section 09960. Wrap the appurtenance with polyethylene encasement and tape the encasement tightly closed to the pipe.

C. General Exposed Piping Installation:

1. Unless shown otherwise, install piping parallel to building lines, plumb and level.

2. Install piping without springing or forcing the pipe in a manner that would set up stresses in the pipe, valves, or connected equipment.

3. Set all pipe flanges level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All bolt holes in flanges shall straddle vertical centerline of pipes.

4. Flexibility and Expansion: Provide flexible couplings, flexible hose, or flexible spools for all piping connections to motor driven equipment and where otherwise shown. The Contractor may install additional flexible couplings at favorably reviewed locations to facilitate piping installation, provided that he submits complete details describing location, pipe supports, and hydraulic thrust protection. Anchor piping subject to expansion or contraction in a manner permitting strains to be evenly distributed. Sleeves for branches through walls from adjacent mains shall be of sufficient size to allow for free side motion of covered pipe in sleeves.

5. Install unions or flexible connections where shown on the Drawings, and at all non-motor-driven equipment to facilitate removal of the equipment.

6. Provide valves wherever equipment drain connections are furnished and carry the discharge pipe to the nearest floor drain, drain trench or sump. Where no receptacle for drain exists, install drain piping to 1-inch above the floor. Drain piping and valve materials shall conform to the requirements of the system served.
7. Where piping conveying liquids passes over motor control centers, electrical panels and other electrical devices, install a protective drainage tray below the piping.

D. Pipe Welding:
1. General: Unless specified otherwise, shop and field welding of pipe shall conform to ANSI B31.1 as amended by this paragraph.
2. All field and shop welding shall be done by the electric arc process unless otherwise specified. All field welding shall be done in passes not thicker than 1/4-inch. Size and type of electrodes, and current and voltages used, shall be subject to the favorable review of the Engineer. Give particular attention to the alignment of edges to be joined, so that complete fusion and penetration will be effected throughout the bottom of the weld. Welds shall contain no valleys or undercuts in the center or edges of the weld. Thoroughly clean each pass, except the final one, of dirt, slag, and flux before the succeeding bead is applied.
3. Clean completed field welds of pipe joints of dirt, slag and flux, and then visually inspect. Completely chip out all defects in welds discovered during field inspection in a manner that will permit proper and complete repair by welding subject to the favorable review of the Engineer. Under no circumstances will caulking of defective welds be permitted.
4. All welding shall be done by experienced, skilled operators familiar with the methods and materials to be used. Hand welding will be done only by welders qualified under the standard qualification procedure of Section IX of the ASME Boiler and Pressure Vessel Code. The Contractor shall conduct tests of his welders, when required by the Engineer, in accordance with that code and in the presence of the Engineer. An independent testing laboratory, favorably reviewed by the Engineer, shall supervise the testing and determine the quality of the test work. Weld specimens in the same positions as those in which the welder is to qualify his work. The Engineer may require test specimens at any time. Any welder whose work is found unsatisfactory shall not remain employed on this Contract, regardless of the quality of his earlier work. Each hand weld specimen shall be plainly marked with the welder's identifying symbol. The Contractor shall furnish all materials required and pay all costs for qualifying welders.
5. Field welds shall follow as closely as possible to the laying operation. All field welds shall be complete before lining or coating of the joints in steel pipe is begun. Where pipe is fusion epoxy lined and/or coated, follow AWWA C-213 procedures for field welded joints.
6. A single, continuous, watertight, full fillet weld shall be the minimum required at all field joints. Double weld joints will be required on all piping specifically noted to be double welded.
7. See installation specifics for welding of cement mortar lined steel pipe.

3.02 PIPING INSTALLATION SPECIFICS

A. Acrylonitrile-Butadiene-Styrene Drain/Waste/Vent (ABS DWV) Pipe:
1. Solvent Weld Joints:
   a. Cut pipes squarely, ream and deburr inside and out.
b. Solvent Weld Joints: Make joints similar to ASTM D2855, in accordance with manufacturer's directions. Handle cements and primers in accordance with ASTM F402.

B. Black (Carbon) Steel Pipe:
1. Install and weld in accordance with ANSI B31.1.
2. Threaded joints shall have connections metal-to-metal tight. Remove all burrs from the ends of the pipe and clean threads of all oil and chips. Coat male threads with a joint lubricant.
3. The interior of piping materials, valves, and fittings shall be kept clean and dry prior to and during installation. As each portion of the pipeline is assembled, the open end of the pipeline shall be routinely capped to prevent the entrance of moisture.

C. Copper Pipe:
1. Bends shall be made in a manner that does not crimp or flatten pipe.
2. Dielectric unions shall be installed at connections with ferrous piping.
3. Pipe shall have joints squarely cut clean, soldered joints shall be properly fluxed and heated before solder is placed in the joint. Joints must be driven up tight before solder is added. Compression and flared joints shall be made up in accordance with the fitting manufacturer's installation instructions. Brazing shall be in accordance with ANSI B31.1.

D. Ductile Iron Pipe:
1. Restrained Push-on Pipe:
   a. Install buried pipe in accordance with AWWA C600.
   b. Support and brace encased pipe to support the pipe and to prevent movement during testing and placement of the concrete encasement. The braces and supports shall be erected of materials and by methods, which will prevent any future contact of the pipe with the environment surrounding the encasement.
   c. Wrap buried pipe with 8 mil polyethylene film in accordance with AWWA C105. Continuously seal seams and overlaps with polyethylene adhesive tape. Seal circumferential overlaps with two turns of polyethylene adhesive tape, half lapped. Gather excess polyethylene on top of pipe so as not to block backfill material from getting under bottom of pipe. Use caution so as not to rip or cut the polyethylene film. Seal any rips or cuts in the film with polyethylene adhesive tape.
   d. Pull the slack out of restrained joints after they are made up.
2. Flanged Pipe:
   a. Flanged Joints: Flanged joints shall be made up tight with care being taken to avoid undue strain in the flanges, fittings, and other accessories. Bolt holes shall be aligned for each flanged joint. Bolts shall be full size for bolt holes; use of undersize bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Adjoining flange faces shall not be out of parallel to such a degree that the flanged joint cannot be made watertight without overstraining the flange. Any flanged pipe or fitting whose dimensions do not allow the making of a proper flanged joint as specified herein shall be replaced by one of the proper dimensions. Clean flanges before jointing is started. Buried flanged pipe connections shall be made with the smallest practical "bell" hole. After the joint is
completed take special care to completely fill the "bell" hole under and around the pipe with compacted backfill. Wrap buried flanged pipe with polyethylene as described above in part 3.02.D.1.c for buried restrained push-on pipe.

E. Polyvinyl Chloride Pipe:
1. No work shall be performed until the pipe manufacturer provides onsite installation training and certifies the plumbers are trained per ASTM 2855. The Owner's inspector shall be present for the training session.
2. Place PVC pipe within the installation areas at least 24 hours prior to installation to permit temperature equalization.
3. Cut pipe ends squarely, ream and deburr inside and out, and bevel the ends.
4. Solvent Weld Joints: Clean pipe ends and sockets and join in strict conformance with the pipe manufacturer's instructions.
5. Make joints in strict accordance with ASTM D2855. Strictly follow all of the manufacturer's recommended steps. Handle solvent cements and primers in accordance with ASTM F402.
6. Install spray shields at all flanged and threaded joints on sodium hypochlorite piping.

F. Stainless Steel Pipe:
1. Install and GTAW weld in accordance with CGA G-4.4 and ASME B31.3.
2. Back purge all welds with cover gas.
3. Seal weld all slip on flanges.
4. Provide anti-seize compound on threaded connections.
5. All points of connection shall be temporarily plugged or capped to exclude moisture, dust or other contaminants or impurities prior to being connected.

3.03 COUPLING INSTALLATION

A. Flexible Couplings and Flange Coupling Adaptors: Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Wipe gaskets clean before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Tighten bolts progressively, drawing up bolt on opposite sides a little at a time until all bolts have a uniform tightness. Workers tightening bolts shall be equipped with torque-limiting wrenches or other favorably reviewed type.

B. Tie Rods: Except where double nutting is required, install the nuts snug. Tighten the nuts gradually and equally at opposite sides of the pipe until snug to prevent misalignment and to ensure that all rods carry equal loads. Double nut each end of each tie rod where the coupling is intended to allow movement after installation (i.e., at pipe connections outside structures). The space between the pairs of nuts shall be 1/2 inch greater than the distance between the lugs.

C. Flexible Rubber Spools:
1. Install in accordance with manufacturer's instructions. Unless otherwise shown on the Drawings, install flat with 1/2 the maximum expansion.
2. Connect rubber spools only to full-face metal flanges.
3. Paint buried galvanized steel retainer rings, bolts and other appurtenances in accordance with Section 09960.

3.04 INSTALLATION OF VALVES AND ACCESSORIES

A. Install valves and accessories such that all parts are easily accessible for maintenance and operation.

B. Where valve handwheels are shown on the Drawings, valve orientation shall be as shown. Where valve handwheels are not shown, orient valves to permit easy access to the handwheels or handles and to avoid interferences.

C. Install pressure gauges in a position to permit reading them from a point approximately 5 feet above floor level.

D. Rigidly support pressure switches and connect them to piping and equipment using a suitable flexible linkage that will not permit transmission of vibrations from the piping or equipment to the pressure switches.

E. Provide a union adjacent to each screwed end valve and accessory with additional unions as necessary to facilitate removal.

F. Provide a shutoff valve below each pressure gauge or protective device unless otherwise specified.

G. Connections between ferrous and non-ferrous piping, valves, accessories or pipe supports shall be made using a dielectric coupling, union, or flange.

H. Where valves or other pipeline items require metal full-face connecting flanges, provide intermediate flanges if the connecting flange is not adequate.

I. Install butterfly valves in accordance with AWWA C504, Appendix A, Sections A.2 through A.5, inclusive.

J. Provide test plugs on all closed water systems and where indicated on Drawings. Locate test plugs where they will be easily accessible, have adequate clearance for insertion and removal of gauge needles, and position to allow unobstructed viewing of gauges.

3.05 INSTALLATION OF PIPE SUPPORTS

A. General:
1. Install and adjust supports for each pipeline such that the pipeline is true to the indicated line and grade.
2. Locate anchors and braces for any single support on a continuous structure; that is, not on two sides of a structural expansion joint.
3. Tighten clamps to develop full friction along the pipeline except where loose fitting clamps are called for.
3.06 PIPE AND VALVE IDENTIFICATION

A. General: Identify all exposed piping in this project by painting, banding, system name labels, and direction arrows. The color and banding shall be as selected by the Engineer. Identify all buried and exposed valves with tags as specified below.

B. Exposed Pipe Identification: Before painting, banding and labeling, pipes shall be identified by the Contractor with temporary wired-on cardboard tags showing the proposed marking for review by the Engineer.

C. Piping: Paint all exposed pipes with the appropriate paint system as specified in Section 09960 and provide pipe markers as specified in Section 10400.

D. Valves: Provide each valve with a valve tag identifying the pipeline contents, and either its valve number, or the area or item served by the valve for valves without a valve number. Contents shall be as designated in the Piping Schedule.

3.07 CLEANING

A. Prior to testing, thoroughly clean the inside of each completed piping system of all dirt, loose scale, sand and other foreign material. Cleaning shall be by sweeping, flushing with water or blowing with compressed air as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 3 feet per second. The Contractor shall install temporary strainers, temporarily disconnect equipment or take other appropriate measures to protect equipment while cleaning piping.

B. Special attention and skill is required to properly clean piping, valves and accessories for chlorine solutions. After erection, the chlorine solution piping shall be flushed with clear water until there is not evidence of dust, dirt or debris.

3.08 FIELD TESTING

A. General: Perform leakage tests on all pipe installed in this project. Furnish all equipment, material, personnel and supplies to perform the tests and make all taps and other necessary temporary connections. The test pressure, allowable leakage and test medium shall be as specified and as shown in the following schedule. Test pressure shall be measured at the highest point on the line unless specifically noted otherwise. Leakage tests shall be performed on all piping at a time agreed upon and in the presence of the Engineer.

B. Buried Piping: The leakage test for buried piping shall be made after all pipe is installed and backfilled. However, the Contractor may conduct preliminary tests prior to backfill. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.

C. Exposed Piping: All supports, anchors and blocks shall be installed prior to the leakage test. No temporary supports or blocking shall be installed for final test.

D. Encased Piping: The leakage test for encased piping shall be made after all pipe is installed and encased, and before any structures are constructed above it.
However, the Contractor may conduct preliminary tests prior to encasement. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.

E. Accessories: It shall be the responsibility of the Contractor to block off or remove equipment, valves, gauges, etc., which are not designed to withstand the full test pressure.

F. Testing Apparatus: Provide pipe taps, nozzles and connections as necessary in piping to permit testing including valves to isolate the new system, addition of test media, and draining lines and disposal of water, as is necessary. These openings shall be plugged in a manner favorably reviewed by the Engineer after use. Provide all required temporary bulkheads.

G. Pneumatic Testing: Piping tested by air or another gas shall show no reduction of pressure during the test period after corrections have been made for changes in temperature in conformance with the following relationship:

\[
\frac{P_1}{T_1} = \frac{P_2}{T_2}
\]

Where \(T_1\) and \(T_2\) are the absolute temperatures of the gas in the pipe and \(P_1\) and \(P_2\) are the absolute pressures. The subscript "1" denotes the starting conditions and the subscript "2" denotes the final conditions.

H. Precautions for Pneumatic Testing: Where air is called for as the test medium, the Contractor shall take special precautions to protect personnel. During the initial pressurization of a pipeline to the specified test pressure, personnel shall be protected by suitable barricades or shall remove themselves from the location of the pipeline under test.

I. Correction of Defects: If leakage exceeds the allowable, the installation shall be repaired or replaced and leakage tests shall be repeated as necessary until conformance to the leakage test requirements specified herein have been fulfilled. All visible leaks shall be repaired even if the pipeline passes the allowable leakage test.

J. Reports: The Contractor shall keep records of each piping test, including:

1. Description and identification of piping tested.
2. Test pressure.
3. Date of test.
4. Witnessing by Contractor and Engineer.
5. Test evaluation.
6. Remarks, to include such items as:
   a. Leaks (type, location).
   b. Repairs made on leaks.
7. Test reports shall be submitted to the Engineer.

K. Venting: Where not shown on the Drawings, the Contractor may install valved "tees" at high points on piping to permit venting of air. Valves shall be capped after testing is completed.
L. Testing Specifics: Piping shall be tested as indicated in the following Schedule. All other piping systems shall be tested as required for the pipe type used.

<table>
<thead>
<tr>
<th>System</th>
<th>Pipe Material</th>
<th>Test Pressure (psi)</th>
<th>Test Medium</th>
<th>Duration (hours)</th>
<th>Allowable Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Piping (gravity)</td>
<td>DI</td>
<td>50</td>
<td>Water</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>Process Piping (pressure)</td>
<td>DI</td>
<td>50</td>
<td>Water</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>NaOCL</td>
<td>PVC</td>
<td>50</td>
<td>Water</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>Utility Piping (pressure)</td>
<td>DI</td>
<td>50</td>
<td>Water</td>
<td>2</td>
<td>None</td>
</tr>
</tbody>
</table>

3.09 DISINFECTION OF POTABLE WATER SYSTEMS

A. General: Clean and disinfect potable water systems in accordance with the following procedures. Disinfection shall follow successful pressure testing.

1. Preparation: Provide the system with a 1-inch-minimum service cock or valve or other means to inject chlorine solution at a point within 2 or 3 feet of its junction with the supply source. When system is complete thoroughly flush it by fully opening every outlet until clear water flows from all of them.

2. Disinfecting Agent: Sodium hypochlorite or calcium hypochlorite in sufficient quantities to produce chlorine concentration of at least 50 parts per million in the system.

3. Disinfecting Procedure:
   a. Connect a hand-operated pump, or other means of injecting the disinfecting agent, to one-inch minimum service cock or valve or other injection device. Pump must provide a pressure greater than that of supply of system.
   b. With system completely full of water and supply valve open, proceed to adjust every outlet of system so that a trickle of water flows from each.
   c. Inject disinfectant slowly and continuously at an even rate, not in slugs, until a test at each outlet shows a free chlorine residual concentration of at least 50 parts per million.
   d. Close all outlets and valves, including valve connecting to supply line and 1-inch minimum service cock on solution injection connection. Maintain condition for 24 hours. After 24 hours test for residual chlorine at each outlet. The free residual chlorine concentration indicated should be not less than 10 ppm. If the indicated free chlorine concentration is less than 10 ppm, the disinfection procedure must be repeated until an approved result is obtained.
   e. When the above procedure has been completed to the satisfaction of the Engineer, flush out entire system with fresh water until tests at all outlets show a residual of not more than 0.5 ppm.

B. Chlorine Residual Testing: AWWA C651, Appendix A, DPD Drop Dilution Method, except where otherwise specified. Testing shall be performed by the Contractor.
C. Bacteriological Analyses of Water: After the completion of disinfecting procedure, including the final flushing as described hereinbefore, the Engineer will obtain water samples from this system for bacteriological analyses for testing by the Owner. Requirements for satisfactory disinfection of water supply are that bacteriological analyses (Heterotrophic plate count) indicate that water samples are negative for coliform organisms, and that total plate count is less than 100 bacteria per cubic centimeter. If bacteriological analyses do not satisfy above requirements, then disinfection procedure must be repeated until these requirements are met.

D. Disposal of Disinfection Solution: Dispose of disinfection solution into the wastewater treatment plant headworks.

END OF SECTION
SECTION 15400
PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Hot and cold (domestic) water systems.
   2. Emergency showers and eyewashes.
   3. Plumbing fixtures and trim.
   4. Testing.

B. Related Sections:
   1. Section 07900: Joint Sealants
   2. Section 11003: Disinfection
   3. Section 15050: Piping, Valves and Accessories

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI) Publication:
   2. Z21.10.1 Storage Water Heaters
   3. A117.1 Specifications for Making Buildings and Facilities Accessible to
      and Usable by the Physically Handicapped

B. Underwriters Laboratories Inc. Standards:
   1. U.L. 174 Standards for Safety

C. Sheet Metal and Air Conditioning Contractors National Association
   (SMACNA):

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Provide as applicable installation drawings and list of recommended spare parts.
   Also provide operation and maintenance manuals where available from
   manufacturers

1.04 QUALITY ASSURANCE

A. Codes: Comply with the rules and regulations of authorities having jurisdiction over
   the work specified herein, including the applicable Plumbing Code with
   amendments.

B. Permits and inspections shall be in accordance with General Conditions.
C. The Drawings shall be taken in a sense as diagrammatic. Size of pipes and general method of running them are shown, but it is not intended to show every offset and fitting nor every structural difficulty that may be encountered.

D. ADA compliance means that the plumbing item is accessible and usable by persons with disabilities.

1.05 SEISMIC PROTECTION

A. Provide equipment and piping with seismic protection as specified and as recommended by "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping System," latest edition by SMACNA.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide equipment and materials conforming to the standards and manufacturers' serial numbers shown, or equal.

2.02 PLUMBING FIXTURES AND ACCESSORIES

A. Water Closets: White vitreous china, 1.6 gallons per flush, elongated bowl, syphon jet, open-front seat, and meet or exceed ANSI A112.19.2. Locate controls for flush valves on the wide side of the water closet area. Top of 2-inch maximum height seat on ADA water closets shall be between 17 and 19 inches above finished floor. Provide shutoff stop on supply.

1. WC-2. ADA water closet shall be 17-inches high, floor-mounted, pressure-assisted close-coupled tank, American Standard Cadet 2168.100; Kohler Highline Pressure Lite K-3544; or equal.

B. Lavatories: White vitreous china, complete with faucet-drain assemblies, traps, and angle stops. Angle stops and supplies shall be Chicago Faucet Co.; T&S Brass; or equal. Lavatory "P" traps, hot water piping and valves shall be insulated with replaceable contour molded fire-resistive foam similar to "Lav-Guard" by Trubro; "Skalgard" by TCI Products; or equal. Lavatories shall meet ADA Specifications. Faucets shall be lead free.

1. LAV-1: Wall-hung Lavatory: D-shaped bowl, front overflow, self-draining deck, faucet ledge, 8-inch faucet spacing. Provide widespread faucet with flexible connections, pop-up drain, polished chrome finish, wrist blade handles, strainer, and 2.5 gpm flow restrictor; American Standard Lucerne with Heritage faucet; Kohler; or equal. Furnish lavatories complete with concealed arm carrier.

2. LAV-4: Kitchenette Sink: 18-gauge, type 304 stainless steel, self-rimming with a back ledge. Provide sound deadening coating. Sink shall have inside bowl dimensions of 16-inch x 22-inch x 7-1/2-inch deep; Just Stylist Group A; Elkay; or equal. Sink faucet: Elkay Model 2472 with remote 4-inch wrist blade handles; Just, or equal. Locate drain opening at rear of sink with stainless steel flat grid strainer. Provide P-trap with threaded cleanout.
C. Service Sinks: 22"x18" size, single compartment, 3-inch outlet, complete with faucet assembly, rim guard, wall hanger, P-trap standard, mixing faucet, and service supplies with angle stops. Angle stops and supplies: Chicago Faucet Co.; T&S Brass; or equal
1. SVS-2: #14 gauge Type 304 stainless steel: Elkay Model ESSB-2118; or equal.

D. Laboratory Sink:
1. General: Provide laboratory sinks of corrosion-resistant black, epoxy-resin material, having coved corners, with bottom sloped to drain. Drain outlets shall be 1-1/2-inch size. Refer to Architectural Drawings and Specifications for dimensions and counter details.
2. Sink Faucets and Drains:
   a. Sink faucet assemblies: Chicago Faucet Company model 947 with 4-inch wrist blade handles; T&S Brass; or equal.
   b. Sink drain assemblies: Lab-Line/Enfield W301 outlet with W131 adapter, W1021 trap and W321 overflow; R&G Sloane Manufacturing Company 7841 A outlet with 7218 adapter, 7225 P-trap and 7842 overflow; or equal.

E. Mop Sink:
1. MS-1: 24-inch x 24-inch Terrazo by Florestone with American Standard faucet no. 8344.111; Kohler K8904; and American Standard 7721.038; Kohler K9146 chromeplated strainer. Provide shutoff stops and access door in wall.

F. Shower Stall:
1. SH-1: Three-walled fiberglass compression-molded stall, slip-resistant base with integral drain, molded toiletry shelves, Class B flame spread rating; 36'x60" seated shower with grab bars, hinged shower door, tempered glass; American Standard; Kohler; Sterling; or equal. Provide a pressure balanced anti-scale mixing valve with each shower.
2. SH-2: ADA compliant, barrier-free shower, features as described for SH-1. Refer to the Drawings for shower dimensions.

G. Emergency Shower and Eyewash Units:
1. EWS-1 (Eyewash and Shower Combination Unit): Haws model 8330; Western Drinking Fountain Company no. W9341; or equal.

H. Water hammer arrestors shall be Wade "Shokstop"; Zurn no. Z-1700; or equal.

I. Floor Drains and Traps: Cast iron drains having inside caulk or push-on compression type neoprene gasket joints.
1. FD-1 (For Industrial Areas): Zurn Z-520; Wade 1340; or equal, complete with primer connection.
2. FD-7 (For Finished Floors): Zurn Z-415, Wade W-1100; or equal, complete with trap, vent, heelproof strainer; and trap primer connections.
3. FD-8 (Trench Drains): Concrete channels complete with cast-in iron edge rails, installed with standard bolted ductile iron gratings. ACO Drain S 100 Channel Brute with 4-inch width and 0.6% down-slope; or equal.
4. FD-9 (Process Drain): Zurn Z-505 with epoxy coating, Wade, or equal. Trap, primer, and vent connections are not required.

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4. Traps: Provide traps for all floor drains unless noted otherwise. Traps assembly shall include primer and vent connections as required. Zurn Z-1000, Wade, or equal. Provide PVC P-traps with solvent weld joints for acid-resistant drain systems.

J. Trap Primers: Precision Plumbing Products Trap Primer Valves; E&S Valve Co. "Primer Valve"; or equal.

K. Floor Cleanouts: Zum Z-1400; Wade 6000; or equal. Provide scoriated top.

L. Area Cleanouts: Zum Z-1454; Wade W-8530; or equal.

M. Wall Cleanouts: Zum Z-1440; Wade W-8550; or equal.

N. Water Heaters: Provide a seismic restraint for all water heaters.
1. WH-3 electric tank-type water heater:
   a. Electric storage type, nominal 20-gallon tank, insulated, glass lined, enclosed controls, UL approved. Element shall be 6000 watts and operate on 208-volt, 1-phase power.
   b. Rheem, State; or equal.
2. WH-2 point-of-application type electric water heater:
   a. Factory assembled, compact, packaged electric water heater bearing the UL label to heat not less than 0.5 gpm of 60°F cold water to 100°F utilizing 3000 watt heating elements for use with 115 volt, 1 phase, 60 Hz. electric service.
   b. Water heater shall be for under-sink mounting and shall include combination temperature and pressure relief valve, automatic control, disconnecting means, thermal insulation, contactor and overheat cut-outs.
   c. Chronomite Laboratories, Inc. "Instant-Flow" model S-30L/110 VAC; International Technology Sales Corp. model MDT 3000/120; or equal.

O. Access Doors for Wall Cleanouts, Trap Primers and Water Hammer Arrestors: Furnish access doors to meet the requirements of Section 08305. Coordinate with the trade in whose work the doors will be installed.

P. Backflow Preventer: All backflow preventers shall be approved by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California. Provide straight configuration with shutoff valves and test cocks, unless shown otherwise on the Drawings.
   1. Pressure rating: 175 psi
   2. Temperature rating: 32 to 140 F
   3. Connections: ANSI Class 125 flanges, threaded for assemblies 2-inch and less.
   4. Type:
   5. BFP-1: reduced pressure assembly, Febco Model 860, Watts Series 909, or equal.
2.03 ELECTRIC HEAT TAPE (HOT WATER PIPING)

A. Provide self-regulating industrial grade heating cable to be applied to the hot water piping. Cable shall be braided, with approximately 4 watts per foot capacity at 115°F using 208 volts, single phase electrical wiring.
   1. Heating cable and components must be UL approved, and shall operate without the use of thermostats.
   2. System shall include all necessary components including power connection kits, tees, and seals, tape and labels.
   3. Cable shall be attached to supply piping by means of a fiberglass tape or nylon straps.
   4. A 1-inch "System "A", Section 15050, insulation shall be applied after cable has been installed and tested. Installation and testing shall be strictly in accordance with manufacturer's instructions.
   5. Raychem; HWAT; or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install escutcheons secured to pipe with set-screw where pipes or tubing pass through exposed walls or ceilings.

B. Provide all fixtures with traps and vents unless otherwise indicated on the Drawings.

C. Provide unions or flanges where equipment is installed in piping. Also provide dielectric unions or couplings at points of connection of ferrous to non-ferrous metal piping.

D. Make connections to piping components included in Laboratory Equipment specified in Section 11600.

E. Provide a shut-off stop valve in the branch of every water, air, gas or vacuum pipe service upstream of every fixture or outlet.

F. Provide identification nameplates for each item of mechanical equipment. Refer to Section 11001.

G. Furnish and install all supports, bracing and blocking required for the proper installation of the plumbing work specified herein.

H. Water hammer arrestors shall be installed in water systems upstream of each solenoid valve, quick closing valve, and emergency shower.

I. Vent flashing at roof, unless otherwise shown on the Architectural Drawings, shall be a 4 lb lead sheet extending from a 4-inch (minimum) skirt at roof line, up to the open end of vent. At the open end of vent, the lead sheet shall be turned down into the vent opening.
J. Sinks which are installed in countertops shall be delivered to the countertop manufacturer so that openings can be coordinated. Sink shall then be shipped to the job site for final installation.

K. Provide valves where equipment drain connections are furnished and carry the discharge pipe to the nearest floor drain, drain trench or sump. Where no receptacle for drain exists, install drain piping to 1-inch above the floor. Drain piping and valve materials shall conform to the requirements of the system served.

3.03 TEST AND INSPECTION

A. Test the systems and arrange for inspection by the proper authorities.

B. Water piping shall be hydraulically tested at not less than working pressure psig and demonstrated to be leak-free for a one-hour test period.

C. Waste, drain and vent piping shall be tested in conformance with the Uniform Plumbing Code with local amendments. Storm drain (rainwater) piping shall be tested similar to waste, drain and vent piping.

END OF SECTION
SECTION 15800
HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements of Section 11001 form a part of this Section. Furnish all labor, materials, equipment, services and incidentals required to provide complete, integrated, and operating, Heating, Ventilating and Air Conditioning Systems for the buildings and structures in this project. Materials and equipment to be supplied shall be new, of the best quality as specified and as shown on the Drawings.

B. Work Included in This Section:
1. Fans, ductwork, dampers, registers, grilles, diffusers, ductwork insulation and ductwork support systems.
2. Electric Heaters.

1.02 SUBMITTALS

A. Provide shop drawings and technical literature covering all equipment and accessories being furnished under this Section. The data shall include information to demonstrate compliance with all of the requirements of these Specifications.

B. Manuals: Furnish manufacturer's installation, lubrication and maintenance manuals, bulletins and parts lists. Furnish separate list of recommended spare parts.

C. Affidavits: Furnish affidavits from the manufacturers stating that the equipment has been properly installed and tested and each is ready for full time operation.

1.03 QUALITY ASSURANCE

A. Codes: Comply with all rules and regulations of authorities having jurisdiction over the work specified herein.

B. Permits and inspection shall be in accordance with Division 1 of these Specifications.

C. All equipment furnished under this Section shall: (1) be of a design and manufacturer who has been regularly engaged in the design and manufacture of the equipment; and (2) be demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.

D. The Drawings shall be taken in a sense as diagrammatic. Size of ducts and pipes including general method of running them are shown, but it is not intended to show every offset and fitting nor every structural difficulty that may be encountered.
1.04 SEISMIC PROTECTION

A. Equipment specified in this Section is classified as essential for seismic protection as specified in Division 1.

PART 2 - PRODUCTS

2.01 DUCTWORK

A. Ductwork:
   1. Ductwork shall be galvanized steel of the gauge and fabrication that conforms to SMACNA "HVAC Duct Construction Standards, Metal and Flexible." Where ductwork is completely concealed, fibrous glass ductwork conforming to SMACNA "Fibrous Glass Duct Construction Standards" may be utilized at the Contractor's option. The fume hood supply and exhaust ductwork shall be Type 316 stainless steel of the gauge and fabrication that conforms to SMACNA "Low Pressure Duct Standards."
   2. Polyvinyl Chloride (PVC) ductwork shall be fabricated in accordance with SMACNA Thermoplastic Duct (PVC) Construction Manual for 10-inch W.G. negative pressure on suction sides of fans and for 10-inch W.G. positive pressure on fan discharges. Duct supports, access doors and flanged joints shall conform to the details of construction as described in this manual. The plastic sheet from which the duct is fabricated shall meet ASTM D1971, specification for rigid PVC plastic sheet. The flame spread of the PVC shall be a maximum of 25 when tested in accordance with ASTM E84-69.

B. Flexible Duct Connections: Flexible connections in ducts shall be made of neoprene fiberglass cloth, installed in folds; and of sufficient length to accommodate the maximum deflection resulting from vibration and contraction without causing strain. Minimum length in folded position shall be 4 inches. Flexible duct connections shall be Ventfabrics Inc. "Ventglas" Duro-Dyne Corp. "Neoprene or equal.

C. Flexible Duct Branches: Flexible branches shall be U.L. listed, insulated factory-fabricated assemblies. Flexible ducts shall meet the duct insulation requirements of the Uniform Mechanical Code. Flexible ducts shall be JP Lamborn Type PR-25; ATCO Series 40; or equal.

D. Duct sealant (for sealing joints) shall be Arabol and Canvas; Hardcast; or equal.

E. Duct Supports: Duct support details and spacing shall conform to the most current edition of the SMACNA "HVAC Duct Construction Standard, Metal and Flexible." The specific support detail utilized shall be as appropriate for each particular duct and location, except as otherwise shown. Duct supports shall be hot-dip galvanized after fabrication.

F. Fiberglass wrapping, where indicated, shall be fiberglass of 1-1/2-inch thickness; Owens-Corning "Fiberglas All Service Duct Wrap"; Johns-Manville "Microlite"; or equal.
G. Ductwork: Galvanized steel (LFQ) ductwork shall have not less than 1-1/4 ounces of galvanized coating (total for both sides) per square foot of sheet.

2.02 REGISTERS AND DIFFUSERS

A. Ceiling diffusers (CD) shall have air patterns and size as indicated on the Drawings. For hung tile ceilings, frames shall be lay-in type. For hard ceilings, frame shall be flush mounting type. Where lights are surface mounted, diffusers shall be of dropped face design. Provide rectangular to round adaptor for connecting to ductwork. Diffusers shall be Titus "MCD" Series; Tuttle and Bailey SQD; or equal.

B. Side wall diffusers (SWD) shall have air patterns and sizes as indicated on the Drawings. Provide rectangular to round adaptor for connecting to ductwork. Diffusers shall be Titus Model 300 FL; Tuttle and Bailey; or equal.

C. Ceiling return air registers (CR) shall be of sizes indicated on the Drawings. For hung tile ceilings, frames shall be lay-in type. For hard ceilings, frame shall be flush mounted type. Register shall be Titus Model 50F; Tuttle and Bailey model CRE; or equal.

D. Side wall return (SWR) shall have sizes as indicated on the Drawings. Return registers shall be Titus model 50F; Tuttle and Bailey model CRE; or equal.

2.04 DAMPERS

A. Volume Dampers: All volume dampers shall be made of material (similar to the ductwork) two gauges thicker than the duct in which the damper is located. Each damper shall have an operator with indicator handle and a locking mechanism. Damper operator shall be Young Regulator Company "Valcalox" No. 403B; Ventfabrics Inc. "Ventloc" No. 637; or equal. Volume dampers for rectangular odor control ductwork shall be of the opposed blade type with locking quadrants.

2.05 FANS

A. In-Line Centrifugal Fans: In-line centrifugal fans shall be factory fabricated assemblies having fan, fan motor, and fan housing. Fan capacities, electrical characteristics, special features and accessories shall be as indicated in the fan schedules. Where indicated, corrosion-resistant, factory applied coatings shall be "Eisenheiss," or air-dried "Heresite," applied in strict conformance with the paint manufacturer's instructions. Fans shall bear the AMCA seal. Direct drive fans shall be Greenheck type SQ; Carnes type VIDK; or equal. Belt-driven fans shall be Greenheck type BSQ; Carnes type VIBK; or equal.

B. Ceiling Exhaust Fans: Ceiling exhaust fans shall be factory fabricated assemblies complete with fan, motor, inlet grille, acoustically insulated housing, and integral backdraft damper. Fans shall bear the AMCA seal. Fans shall have the capacities and electric service characteristics as shown in the fan schedules. Fans shall be Carnes VCDB; Greenheck model SP; or equal.
C. Combination Ceiling Exhauster, Light and Heater:
1. Utilize combination ceiling exhaust fan, light and heater as specified for respective applications as scheduled and noted on Drawings.
2. Size, capacities, performance, characteristics, and arrangement as scheduled or noted on Drawings.
3. Acceptable manufacturers: Subject to compliance with requirements:
   a. Nutone.
   b. Broan.
4. Combination units shall be factory packaged assemblies having air exhaust, lamp wattage and heating element capacities as scheduled and noted on the Drawings.
5. Assemblies shall bear the UL label.
6. Electrical power: 115 volt, single phase, 60 Hz.
7. Assemblies shall be furnished complete with triple toggle wall switch for individual control of each component.

D. See Fan Schedule at end of this Section for specific requirements.

2.06 ELECTRIC HEATERS

A. Electric Unit Heaters: Electric unit heaters shall be factory fabricated unit heater assembly bearing the Underwriters Laboratories label. Heaters shall be assembled in heavy gauge steel cabinets, shall have horizontal air flow discharge and shall be furnished with wall or ceiling mounting support brackets, contactors, relays, transformers, thermostats, internal wiring, adjustable air flow louvers, and interwiring between the components. Thermostats shall be either 24-volt or 120-volt type for remote mounting. Unit heaters shall be Reznor Model EGE; Chromalox Model LUH; or equal.

B. Electric Duct Heaters: Duct heaters shall be 6-inch by 6-inch flanged type, assembled with heavy gauge steel frame for duct installation and shall be supplied with contactors, relays, transformers, duct thermostats, internal wiring and interwiring between the components. Electric duct heater shall be Reznor Model EDFF; Markel; or equal.

2.08 SPLIT SYSTEM AIR CONDITIONING EQUIPMENT

A. Split Systems 5 Tons and Under for Solids Processing Building:
1. Air conditioning system shall be a split, ductless system consisting of an indoor fan coil unit and an outdoor condenser. The indoor fan coil unit shall be a ceiling suspended unit. The condenser shall be designed for outdoor service. Refrigerant piping between the fan-coil unit and condenser shall be as recommended by the manufacturer for this installation. Accessories shall include:
   a. Integral condensate pump and fresh air intake kit on the fan coil unit
   b. Wired remote controller.
   c. Freeze-up, high discharge temperature, and self-diagnostics on the fan coil unit.
   d. High and low pressure safety switches, low voltage startup capability, crank case heater, and fluid line filter drier on the condenser unit.
2. Manufacturer: Split, ductless system shall be Carrier Model 53QAB; York; or equal.
3. See Split System Air Conditioning Schedule at the end of this Section for specific requirements.

B. Split Systems 5 Tons and Under for Operations Building:
1. Air conditioning system shall be a split, ducted system consisting of an indoor fan coil unit and an outdoor heat pump. The indoor fan coil unit shall be attic mounted unit. The heat pump shall be designed for outdoor service and have added heating capacity to handle below freezing temperatures. Refrigerant piping between the fan-coil unit and heat pump shall be as recommended by the manufacturer for this installation. Accessories shall include:
   a. Integral condensate pump and fresh air intake kit on the fan coil unit
   b. Wired remote controller.
   c. Freeze-up, high discharge temperature, and self-diagnostics on the fan coil unit.
   d. High and low pressure safety switches, low voltage startup capability, crank case heater, and fluid line filter drier on the heat pump unit.
2. Manufacturer: Split, ducted system shall be Carrier Model 38YRA Heat Pump with a FB4A Fan Coil; Trane XB12; or equal.
3. See Split System Air Conditioning Schedule at the end of this Section for specific requirements.

2.09 TEMPERATURE CONTROL SYSTEMS

A. Thermostats: Provide thermostats as shown on the Drawings, and for all equipment identified as thermostat-controlled. Thermostats shall be wall-mounted and have a minimum 40 to 90°F temperature range. Multi-stage thermostats shall be provided whenever more than one temperature setpoint is indicated. Provide thermostats meeting the following requirements unless noted otherwise on the Drawings or in the Specifications.
   1. Digital automatic-setback thermostats shall be provided in finished areas. Thermostats shall have weekday/Saturday/Sunday programs, four available programs per day, and heat/cool/fan only modes of operation.
   2. Low-voltage or line-voltage thermostats shall be provided in unfinished areas. Thermostats shall include an integral room thermometer.
   3. Areas identified as corrosive, washdown, or explosion-proof shall be provided with heavy-duty thermostats with remote bulbs. Provide a separate room thermometer with each thermostat.
   4. Thermostats integral with the equipment shall only be provided where noted in the Specifications.

B. Variable Air Volume and Temperature Systems: Provide a VVT system for controlling 2 separate zones from AC-100A, AC-100B packaged heat pump. VVT system shall include a bypass damper, zone dampers, control panel, thermostats, and all other items necessary for a fully functioning system. VVT control circuits shall be 24 volt. 120 VAC power will be supplied to the control panel; provide transformers as necessary to power and control the VVT system. VVT system shall be Carrier 33CS; Trane VariTrac; or equal.
C. The Contractor shall submit temperature control diagrams for all heating, ventilating and air conditioning systems included in this project.

PART 3 - EXECUTION

3.01 GENERAL

A. Protection: Fully protect all unfinished parts of the materials and equipment against damage from whatever cause during the progress of the work and until final completion. All materials and equipment shall be covered while in storage and during construction in such manner that no finished surfaces shall be damaged or marred and all moving parts shall be kept perfectly clean and dry.

B. Installation shall be in strict accordance with the best practice of the several trades and with the respective manufacturer’s instructions and recommendations. Installation shall include furnishing the required oil and grease for initial operation in accordance with the manufacturer’s instructions.

C. All sheet metal ductwork shall be erected in a first class and workmanlike manner and shall be in accordance with the "Duct Construction Standards, Metal and Flexible" of the Sheet Metal and Air Conditioning Contractors National Association, Inc., and as specified above. No ductwork shall be fabricated or installed until it has been carefully coordinated with other trades. All transverse duct joints shall be taped airtight. Duct dimensions shown are "net" inside clear. Each air supply outlet and each air return or outside air intake shall have either an integral volume control device or shall be furnished with a volume damper.

D. Testing and Adjusting Equipment and Controls:
   1. The equipment and controls of this Section shall be completely tested, adjusted and placed in operating condition.
   2. Retest equipment and controls, as necessary, during the progress of the work. No work shall be covered until it is properly tested and made tight.
   3. Supply the testing apparatus and make all necessary connections for applying the tests.
   4. When about to turn the apparatus over to the Owner, put all parts of the apparatus in perfect working order and thoroughly clean out all parts of the equipment.

E. Testing, Adjusting and Balancing of Heating, Ventilating and Air Conditioning Systems:
   1. All heating, ventilating and air conditioning systems installed under this Section shall be carefully adjusted by a qualified Air Balancing Contractor to deliver and exhaust air quantities as shown on the Drawings or described herein while maintaining the spaces served at the design temperature. A final balancing report shall be submitted to the Engineer showing the airflow CFMs, fan statics and motor amperages.
   2. After the systems have been completely installed, all equipment shall be carefully tested and adjusted. Adjust all dampers, registers and air diffusers for airflow and make an accurate velometer test of air quantities delivered and
removed from each opening. Any readjustments in the motors, drives, units, controls and other equipment found to be necessary in the opinion of the Engineer shall be made without additional cost and the entire system shall be placed in a satisfactory operating condition subject to the approval of the Engineer.

3. Air readings must be taken at each inlet and outlet, and fan speeds and dampers regulated until proper air volumes and diffusion are obtained at each inlet and outlet. Amperage and voltage readings shall be taken and noted, together with the nameplate amperage on the motors.

END OF SECTION
### APPENDIX A

### LEGEND

(Refers to the equipment schedules in Appendix A)

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>AC</td>
<td>air conditioning</td>
</tr>
<tr>
<td>AH</td>
<td>air handling unit</td>
</tr>
<tr>
<td>BD</td>
<td>belt drive</td>
</tr>
<tr>
<td>BTU</td>
<td>British thermal unit</td>
</tr>
<tr>
<td>CENT</td>
<td>centrifugal</td>
</tr>
<tr>
<td>CFM</td>
<td>cubic feet per minute</td>
</tr>
<tr>
<td>CHWS</td>
<td>chilled air supply</td>
</tr>
<tr>
<td>CHWR</td>
<td>chilled water return</td>
</tr>
<tr>
<td>CV</td>
<td>coefficient, valve flow</td>
</tr>
<tr>
<td>DB</td>
<td>dry bulb</td>
</tr>
<tr>
<td>DH</td>
<td>loss in feet</td>
</tr>
<tr>
<td>DD</td>
<td>direct drive</td>
</tr>
<tr>
<td>ESP</td>
<td>external static pressure</td>
</tr>
<tr>
<td>EWT</td>
<td>entering water pressure</td>
</tr>
<tr>
<td>F</td>
<td>fan</td>
</tr>
<tr>
<td>GPM</td>
<td>gallons per minute</td>
</tr>
<tr>
<td>H</td>
<td>heating</td>
</tr>
<tr>
<td>HWR</td>
<td>heating water return</td>
</tr>
<tr>
<td>HWS</td>
<td>heating water supply</td>
</tr>
<tr>
<td>LWT</td>
<td>leaving water temperature</td>
</tr>
<tr>
<td>MBH</td>
<td>BTU per hour (thousands)</td>
</tr>
<tr>
<td>MBTUH</td>
<td>thousands of BTUs</td>
</tr>
<tr>
<td>PROP</td>
<td>propeller</td>
</tr>
<tr>
<td>S.P.</td>
<td>static pressure</td>
</tr>
<tr>
<td>SQ. FT.</td>
<td>square feet</td>
</tr>
<tr>
<td>UH</td>
<td>unit heater</td>
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<tr>
<td>V</td>
<td>ventilating</td>
</tr>
<tr>
<td>VAV</td>
<td>variable air volume</td>
</tr>
<tr>
<td>WB</td>
<td>wet bulb</td>
</tr>
<tr>
<td>W.G.</td>
<td>water gauge</td>
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Heating, Ventilating, and Air Conditioning

FINAL
January 2004
037012.10
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## APPENDIX A

### AIR HANDLING SCHEDULE

<table>
<thead>
<tr>
<th>Unit Code</th>
<th>Location</th>
<th>Area Served</th>
<th>CFM</th>
<th>SP Inches W.G.</th>
<th>Cooling Capacity</th>
<th>Heating Capacity</th>
<th>Total Elec. Load</th>
<th>Volts Ph.</th>
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<tr>
<td>AC-700A</td>
<td>Solids Bldg</td>
<td>MCC Room</td>
<td>1200</td>
<td>.25</td>
<td>47,000 Btu/Hr</td>
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<td>1/8 hp</td>
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<td>AC-700B</td>
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<td>Exterior</td>
<td></td>
<td>.25</td>
<td>47,000 Btu/Hr</td>
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<td></td>
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<tr>
<td>AC-100A</td>
<td>Operations Bldg</td>
<td>Lab/office Area</td>
<td>800</td>
<td>.25</td>
<td>20,000 Btu/Hr</td>
<td>22,000 Btu/Hr</td>
<td>2kW</td>
<td>208/1</td>
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<tr>
<td>AC-100B</td>
<td>Operations Bldg</td>
<td>Lab/Office Area</td>
<td>2000</td>
<td>.25</td>
<td>20,000 Btu/Hr</td>
<td>22,000 Btu/Hr</td>
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### UNIT HEATERS SCHEDULE

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<tr>
<th>Unit Heater</th>
<th>Location</th>
<th>Area Served</th>
<th>Approx. CFM</th>
<th>KW</th>
<th>Voltage &amp; Phase</th>
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<tbody>
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<td>UH-100</td>
<td>Operations Bldg</td>
<td>Equip. Storage</td>
<td>450</td>
<td>7.5</td>
<td>208/1</td>
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<tr>
<td>UH-101</td>
<td>Operations Bldg</td>
<td>Equip. Storage</td>
<td>450</td>
<td>7.5</td>
<td>208/1</td>
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<td>H-701</td>
<td>Solids Bldg</td>
<td>Sludge Room</td>
<td>450</td>
<td>7.5</td>
<td>208/1</td>
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<td>H-702</td>
<td>Solids Bldg</td>
<td>Pump Room</td>
<td>450</td>
<td>7.5</td>
<td>208/1</td>
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### DUCT HEATERS SCHEDULE

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<th>Unit Heater</th>
<th>Location</th>
<th>Area Served</th>
<th>Approx. CFM</th>
<th>KW</th>
<th>Voltage &amp; Phase</th>
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<tr>
<td>H-700</td>
<td>Solids Bldg</td>
<td>Centrifuge Room</td>
<td>350</td>
<td>7.5</td>
<td>208/1</td>
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</table>
### APPENDIX A

#### FANS SCHEDULE

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<thead>
<tr>
<th>Fan</th>
<th>Location</th>
<th>Area Served</th>
<th>CFM</th>
<th>SP IN. WG</th>
<th>Fan RPM</th>
<th>Type</th>
<th>Arrangement</th>
<th>Motor HP</th>
<th>Volts Phase</th>
<th>Remarks</th>
<th>(See Notes)</th>
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<td>F-100</td>
<td>Operations Bldg</td>
<td>Bathroom</td>
<td>110</td>
<td>.125</td>
<td>950</td>
<td>Ceiling</td>
<td>Direct Drive</td>
<td>80 Watt</td>
<td>120/1</td>
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<td>2,3</td>
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<td>F-101</td>
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<td>Shower</td>
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<td>.125</td>
<td>950</td>
<td>Ceiling</td>
<td>Direct Drive</td>
<td>80 Watt</td>
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<td>Centrifuge Exhaust</td>
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<td>F-701</td>
<td>Solids Bldg</td>
<td>Centrifuge Rm</td>
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<td>.125</td>
<td>1,300</td>
<td>In-line</td>
<td>Direct Drive</td>
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<td>115/1</td>
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<td>F-702</td>
<td>Solids Bldg</td>
<td>Sludge Rm</td>
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<tr>
<td>F-703</td>
<td>Solids Bldg</td>
<td>Pump Room</td>
<td>250/500</td>
<td>.125</td>
<td>1,300</td>
<td>In-line</td>
<td>Direct Drive</td>
<td>1/25</td>
<td>115/1</td>
<td></td>
<td>3,4</td>
</tr>
</tbody>
</table>

**NOTES:**

(1) Coat entire fan with baked phenolic - see Specifications.
(2) Provide back draft damper.
(3) All one-phase fractional HP motors to be furnished with factory mounted disconnect switches.
(4) Provide 2-speed fan motor.
SECTION 15875
ODOR SCRUBBER

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

B. Related Sections:
   1. Section 07900: Joint Sealants
   2. Section 15050: Piping, Valves and Accessories

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Provide as applicable installation drawings and list of recommended spare parts. Also provide operation and maintenance manuals where available from manufacturers.

1.04 QUALITY ASSURANCE

A. Codes: Comply with the rules and regulations of authorities having jurisdiction over the work specified herein.

B. Permits and inspections shall be in accordance with General Conditions.

C. The Drawings shall be taken in a sense as diagrammatic. Size of pipes and general method of running them are shown, but it is not intended to show every offset and fitting nor every structural difficulty that may be encountered.

1.05 SEISMIC PROTECTION

A. Provide equipment and piping with seismic protection as specified in section 01190 and as recommended by "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping System," latest edition by SMACNA.

PART 2 - PRODUCTS

2.01 General

A. This specification defines the requirements for a Drum Scrubber-100 cfm, 300 cfm, and 500 cfm (DS-100, DS-300, DS-500) as manufactured by Purafil, Inc. Atlanta, Georgia; Calgon or equal.

B. The unit consists of dry scrubbing media contained in a linear, low density, polyethylene drum with a blower mounted on top of a FRP lid.

C. The unit shall be capable of scrubbing wastewater odors indicative of current plant requirements by containing multiple layers of dry scrubbing media.

D. The unit shall be designed to operate at 99.5+% gas removal efficiencies.
E. The configuration shall be arranged so that the contaminated air shall flow into the bottom inlet plenum and be drawn upwards through the media bed. Treated air shall discharge out the top of the vessel through a centrifugal air ventilator.

F. See odor control schedule for more detail.

2.02 Drum

A. The drum material shall be linear, low density, polyethylene, 1/4" (6.4 mm) in thickness.
B. Latches shall be stainless steel and rubber.
C. Fasteners shall be stainless steel.
D. The drum shall contain impregnated activated carbon, Odorcarb Media, followed by a 50/50 volume blend of activated carbon and active-oxidant impregnated alumina, Odormix Media, as manufactured by Purafil, Inc. unless otherwise specified or approved by the engineer.
E. The media shall be supported by an FRP air diffuser and surrounded by marble chips.
F. The inlet shall have a FERNCO flexible coupling.
G. The drum shall have a 0.75" (19 mm) dia. drain pipe with ball valve.
H. Polymedia filters shall be used to separate the marble chips from the Odorcarb media and the blower from the Odormix Media.
I. A grounding rod will be provided if required.

2.03 Blower Section

A. The blower shall be sized to deliver the cfm required at the appropriate IWG.
B. The blower/motor shall be covered with an FRP rainhood.
C. The blower shall consist of a direct-drive motor-fan assembly
D. The motor shall be pre-wired with a 6 ft (1.8 m) grounded power cord.

2.03 Blower Section

A. The Odorcarb Media shall consist of manufactured, generally spherical porous pellets. The pellets shall be formed from a combination of powered activated carbon, alumina, and other binders suitably impregnated with chemicals to enhance the capacity for removal of odorous gases. The pellets shall also chemically react to produce solid reaction products within the media. Impregnants shall be applied during pellet formation such that the impregnant is uniformly distributed throughout the pellet volume.

B. Odorcarb Media shall have the following physical properties:
   1. Moisture content: 35% maximum
   2. Average crush strength: 35% minimum - 70% maximum
   3. Average abrasion: 4.5 maximum
   4. Bulk density: 45 lbs/ft³ (721 kg/m³)
   5. Nominal pellet diameter: 1/16" (1.587 mm)

C. Odorcarb Media shall be UL Class 2 listed.
D. Odorcarb Media shall be capable of absorbing and removing odorous gases throughout the entire pellet.

E. The Odormix Media shall consist of an equal mix (by volume) of Odoroxidant Media and Odorkol Media. Odoroxidant Media shall be manufactured of generally spherical, porous pellets formed from a combination of powdered activated alumina and other binders, suitably impregnated with potassium permanganate to provide optimum adsorption, absorption, and oxidation of a wide variety of gaseous contaminants. The potassium permanganate shall be applied during pellet formation, such as the impregnant is uniformly distributed throughout the pellet volume and is totally available for reaction. Odorkol Media shall be a premium grade, activated carbon with a high surface area available for adsorption.

F. Odormix Media shall have the following physical properties:
   1. Odoroxidant Media
      a. Moisture content: 35% maximum
      b. Average crush strength: 35% minimum - 70% maximum
      c. Average abrasion: 4.5% maximum
      d. Bulk density: 50 lbs/ft\(^3\) (800 kg/m\(^3\))
      e. Nominal pellet diameter: 1/16" (1.587 mm)
      f. Potassium permanganate content: 8% minimum
   2. Odorkol Media
      a. Moisture content: 5.0% maximum
      b. CTC: 55 minimum
      c. Base material: activated carbon
      d. Bulk density: 30-32 lbs/ft\(^3\) (480-512 kg/m\(^3\))
   3. Odormix Media shall be UL Class 1 listed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

3.02 MANUFACTURER'S SERVICES

A. A manufacturer's trained specialist, experienced in the installation of odor control systems, and with at least five (5) years of field experience shall be present at the job - site and/or classroom designated by the Owner for a maximum of 1 man-day for the following services:
   1. Inspection of the installed equipment.
   2. Start-up assistance.
   3. Troubleshooting.
   4. Operator training.

END OF SECTION
## APPENDIX A

### ODOR CONTROL SCHEDULE

<table>
<thead>
<tr>
<th>Unit Code</th>
<th>Location</th>
<th>Area Served</th>
<th>Approx. CFM</th>
<th>SP Inches W.G.</th>
<th>Drum Size: (Dia, Ht)</th>
<th>Inlet Size (in)</th>
<th>Horsepower</th>
<th>Volts</th>
<th>Ph.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-700</td>
<td>Solids Bldg</td>
<td>Centrifuge</td>
<td>300</td>
<td>2.5</td>
<td>31&quot;, 48&quot;</td>
<td>6</td>
<td>1.5</td>
<td>115</td>
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<td>F-702</td>
<td>Solids Bldg</td>
<td>Solids Room</td>
<td>500</td>
<td>2.5</td>
<td>36&quot;, 72&quot;</td>
<td>8</td>
<td>1.5</td>
<td>115</td>
<td>1</td>
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<td>F-800</td>
<td>Headworks</td>
<td>Channel</td>
<td>100</td>
<td>2.5</td>
<td>22&quot;, 60&quot;</td>
<td>4</td>
<td>1/2</td>
<td>115</td>
<td>1</td>
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<tr>
<td>F-200</td>
<td>Influent PS</td>
<td></td>
<td>100</td>
<td>2.5</td>
<td>22&quot;, 60&quot;</td>
<td>4</td>
<td>1/2</td>
<td>115</td>
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DIVISION 16

ELECTRICAL

16010 General Electrical Requirements
16110 Conduit, Raceway, and Fittings
16120 Low Voltage Wire and Cable
16124 Signal Cable
16130 Boxes
16140 Wiring Devices
16160 Panelboards
16180 Protective Devices and Switches
16402 Underground Electrical Work
16405 Switchboard
16450 Electrical Grounding
16460 Dry Type Transformers
16500 Lighting
16612 Uninterruptible Power Supply (UPS)
16640 Cathodic Protection – Wastewater Pump Station
16721 Fire Alarm System
16725 Security Management System
16920 Motor Control Center
16924 Adjustable Frequency Drives (AFD)
16955 Control Devices
SECTION 16010
GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work Included:
   1. Provide all required labor, project equipment and materials, tools, construction equipment, safety equipment, transportation, and test equipment, and satisfactorily complete all electrical work shown on the Drawings, included in these Specifications, or required for a complete and fully operating facility. In addition, provide wiring for the equipment that will be provided under other Divisions of these Specifications.
   2. Provide all conduit for the Instrumentation and Controls specified in Division 17. Provide all Instrumentation and Control wire that is specified in Division 16. All other necessary Instrumentation and Controls wire shall be provided under Division 17. See Section 17010, Paragraph 1.01.
   3. Auxiliary Devices: Provide conduit and wire for power and control for all auxiliary devices such as solenoid valves, pressure switches, and instruments that are included as part of a manufacturer's packaged system (i.e., all systems specified in Divisions 11 through 15). Contractor shall be responsible for conduit and wire to these auxiliary devices even if not specifically shown on the Drawings or specified herein.

B. Work Specified in Other Divisions:
   1. Section 11002: Electric Motor Drives - providing electric motors
   2. Division 17: Providing instruments and other equipment specified in Division 17.

C. Work to be Done by Others:
   1. Providing and connecting power company meters and instrument transformers.
   2. Providing telephone company instruments, relays, terminals, and cables.

D. Safety: Conduct operations in accordance with NFPA 70E, Standard for Electrical Safety Requirements for Employee Workspaces.

1.02 SUBMITTALS

A. Shop Drawings:
   1. General: Submit Product Review or Product information shop drawings for materials and equipment as required under each Specification section.
   2. For Product Review submittals, submit single, complete submittal packages for all items specified within the following Specification groups (i.e., no more than one submittal per group of specification sections):
      a. Sections 16100 through 16199.
      b. Sections 16200 through 16299.
      c. Sections 16500 through 16599.
d. Sections 16600 through 16699.
e. Sections 16700 through 16799.
f. Sections 16900 through 16999.

Submit separate, single, complete submittals for all items covered in each Specification section not listed above. Submittal packages shall be organized by Specification section and/or equipment type. Include separators and tabs or other means of identifying each section of the submittal.

B. As-Built Shop Drawings: Revise manufacturer's shop drawings to show any construction changes. Prior to final acceptance, deliver one complete set to the Engineer for his favorable review. After such review, provide copies of all CAD produced drawings on magnetic media satisfactory to the Engineer in AutoCAD DWG format.

C. Manuals:
1. Furnish manuals for equipment where Manuals are specified in the equipment Specifications. Submit manuals in accordance with the requirements of Division 1.
2. In each manual, include equipment descriptions, record shop drawings, operation and maintenance instructions, parts ordering data and ratings for the equipment furnished for this project.

D. Spare Parts: For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.

1.03 QUALITY ASSURANCE

A. Codes: All electrical equipment and materials, including installation and testing, shall conform to all applicable local and state codes as well as the editions of the following applicable codes in effect on the date of issuance of the Contract Documents:
1. National Electrical Code (NEC);
2. National Electrical Safety Code (NESC);
3. Nevada Occupational Safety and Health Act (OSHA) standards;

B. Variances: In instances where two or more codes are at variance, the most restrictive requirements shall apply.

C. Standards: Equipment shall conform to applicable standards of American National Standards Institute (ANSI), Electronics Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), and National Electrical Manufacturers Association (NEMA). The revisions of these standards in effect on the date of issuance of the Contract Documents shall apply.

D. Underwriters Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Safety labeling and listing by other organizations, such as ETL Testing Laboratories, may be substituted.
for UL labeling and listing if acceptable to the authority having code enforcement jurisdiction. Provide service entrance labels for all equipment required by the NEC to have such labels.

E. Contractor's Expense: Obtain and pay for all required bonds, insurance, licenses, permits and inspections, and pay all taxes, fees and utility charges that will be required for the electrical construction work.

F. Series short circuit ratings for protective devices are not allowed.

1.04 DRAWINGS

A. Drawings: The Electrical Drawings are diagrammatic; exact locations of electrical products shall be verified in the field with the Engineer. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict.

1. Locations of equipment, inserts, anchors, motors, panels, pull boxes, manholes, conduits, stub-ups, fittings, lighting fixtures, power and convenience outlets, exterior lighting units and ground wells are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.

2. Review the Drawings and Specification Divisions of other trades and perform the electrical work that will be required for the installations.

3. Should there be a need to deviate from the Electrical Drawings and Specifications, submit written details and reasons for all changes to the Engineer for favorable review.

4. Resolution of conflicting interpretations of the Contract Documents shall conform to Division 1, General Conditions.

B. As-Built Drawings:

1. Maintain a complete and accurate record set of Drawings for the electrical construction work.

2. Record all work that is installed differently than shown on the Drawings.

3. Upon completion of the work, transfer all marked changes to a clean set of full-size Drawings with red ink. Mark the Drawings "AS-BUILT DRAWINGS" and submit them to the Engineer when the electrical work is completed.

4. Locate all underground conduits by accurate field-measured dimensions from walls and corners, etc., of surrounding structures.

1.05 FACTORY TESTS

A. Submit reports of factory tests and adjustments performed by equipment manufacturers to the Engineer prior to field testing and adjustment of the equipment. These reports shall identify the equipment and show dates, results of tests, measured values and final adjustment settings. Provide factory tests and adjustments for equipment where factory tests are specified in the equipment Specifications.
1.06 INSPECTIONS

A. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. Provide the Engineer with sufficient prior notice so that an inspection can be arranged at the factory.

B. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.

C. Favorable review of the equipment at the factory only allows the manufacturer to ship the equipment to the project site. The Contractor shall be responsible for the proper installation and satisfactory startup operation of the equipment to the satisfaction of the manufacturer and the Engineer.

1.07 COORDINATION

A. Coordinate the electrical work with the other trades, code authorities, utilities, and the Owner.

B. Where connections must be made to existing installations, properly schedule all the required work, including the power shutdown periods. Schedule and carry out shutdowns so as to cause the least disruption to operation of the plant and privately owned facilities.

C. When two trades join together in an area, make certain that no electrical work is omitted.

1.08 JOB CONDITIONS

A. Operations:
   1. Keep all power shutdown periods to a minimum.
   2. Carry out shutdowns only after the schedule has been favorably reviewed by the Engineer.

B. Construction Power:
   1. Make all arrangements for the required construction power.
   2. When required, provide all equipment, materials and wiring in accordance with the applicable codes and regulations.
   3. Upon completion of the project, remove all temporary construction power equipment, material and wiring from the site as the property of the Contractor.

C. Storage: Provide adequate storage for all equipment and materials which will become part of the completed facility so that it is protected from weather, dust, water, or construction operations.

1.09 ELECTRICAL AND TELEPHONE SERVICES

A. Provide all the equipment and materials not provided by the utility companies for permanent electrical and telephone services at the locations shown on the
All work shall meet the requirements of the serving utility companies.

B. Coordinate all work with the serving utilities, obtain the required inspections, and notify the respective utility when service is required.

1.10 DAMAGED PRODUCTS

A. Notify the Engineer in writing in the event that any equipment or material is damaged.

B. Obtain prior favorable review by the Engineer before making repairs to damaged products.

1.11 OPTIONAL EQUIPMENT

A. For optional or substituted equipment, refer to Division 1, General Conditions.

1.12 LOCATIONS

A. General: Use equipment, materials and wiring methods suitable for the types of locations in which they are located, as defined in Paragraph B. herein.

B. Definitions of Types of Locations:
1. Dry Locations: All those indoor areas which do not fall within the definitions below for Wet, Damp, Hazardous, or Corrosive Locations and which are not otherwise designated on the Drawings.
2. Wet Locations: All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.
3. Damp Locations: All spaces wholly or partially underground, or having a wall or ceiling forming part of a channel or tank, unless otherwise designated on the Drawings.
4. Hazardous Locations: All areas in which fire or explosion hazards may exist, normally or accidentally, due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings. These areas are shown on the Drawings, together with the Class and Division designations as defined in the NEC, determining the enclosure types and wiring methods required.
5. Corrosive Locations: Areas where chemicals are stored or processed.

PART 2 - PRODUCTS

2.01 STANDARD OF QUALITY

A. Products that are specified by manufacturer, trade name or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Engineer prior to installation.
B. It is the intent of these Specifications and Drawings to secure high quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses, which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.

C. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble-free service. Light-duty, fragile and competitive grade devices of doubtful durability shall not be used.

2.02 NAMEPLATES

A. For each piece of electrical equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings and the model designation.

B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the Engineer upon prior request by the Contractor.

C. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.

2.03 FASTENERS

A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel. Provide stainless steel fasteners in Corrosive Locations. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8-inch.

2.04 PAINTING

A. Equipment: Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish, which has been damaged or is otherwise unsatisfactory, to the satisfaction of the Engineer.
B. Wiring System: Paint all exposed conduits, boxes and fittings to match the color of the surface to which they are affixed. Paint finishes shall include proper surface preparation, prime coat and a final finish coat, and shall conform to Section 09960.

2.05 ENCLOSURES

A. Unless otherwise noted, provide enclosures as follows:
   1. Dry Locations: NEMA Type 1
   2. Wet Locations: NEMA Type 4, 4X or 3R as indicated on the Drawings
   3. Damp Locations: NEMA Type 12
   4. Hazardous Locations (gases): NEMA Type 7
   5. Corrosive Locations: NEMA Type 4X
   5. See additional requirements below in Paragraph 3.08, Metal Panels.

PART 3 - EXECUTION

3.01 REQUIREMENTS

A. All electrical installations shall conform to the codes and standards outlined in this Section.

3.02 WORKMANSHIP

A. Assign a qualified representative who shall supervise the electrical construction work from beginning to completion and final acceptance.

B. Perform all labor using qualified craftsmen, who have had experience on similar projects. Provide first-class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct improperly fit installations at no additional expense to the Owner.

3.03 EXCAVATION AND BACKFILL

A. Provide the excavations for electrical equipment foundations and trenches for conduits as shown on the Drawings.

B. Exercise caution during all excavation work and avoid damage to existing underground pipes. Exercise extreme caution when working near existing electrical conduits and facilities. Field verify the location of all electrical facilities before proceeding with any nearby work.

C. Refer to Division 2, Earthwork, of these Specifications for all excavation and backfilling work.
3.04 CONCRETE

A. Where shown on the Drawings or specified, provide the required concrete installations for conduit encasement and equipment foundations.

B. Refer to Division 3, Concrete, of these Specifications for all concrete work.

3.05 CONDUCTOR IDENTIFICATION

A. Identify all wires and cables in conformance with the requirements of Sections 16120 and 16124. This requirement applies to all equipment provided under this contract, regardless of Division, as well as to all conductors provided or worked on during this contract.

3.06 INSTALLING EQUIPMENT

A. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.

B. Install all floor-mounted equipment on 3-inch-high reinforced concrete pads. The Contractor, suppliers, and fabricators shall take this requirement into consideration when designing, fabricating, and installing panels, motor control centers, and other enclosures so that height above the floor of the operating handles of electrical devices meets the requirements of these Specifications and applicable codes.

3.07 CUTTING, DRILLING, AND WELDING

A. Provide any cutting, drilling, and welding that is required for the electrical construction work.

B. Structural members shall not be cut or drilled, except when favorably reviewed by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry.

C. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel.

D. Perform patch work with the same materials as the surrounding area and finish to match, as specified in Division 3 of these Specifications.

3.08 METAL PANELS

A. Mount all metal panels which are mounted on or abutting concrete walls in damp locations or any outside walls 1/4-inch from the wall, and paint the back sides of the panels with a high build epoxy primer. Film thickness shall be 10 mils minimum.

3.09 PROTECTIVE DEVICE COORDINATION

A. Provide the services of a recognized independent testing laboratory or coordination analysis consultant for the proper system coordination of the protective devices.
furnished on this project. Submit the name and the qualifications of the laboratory or consultant for review by the Engineer; qualifications must include professional registration of proposed personnel as electrical engineers.

B. The protective device on the line side closest to the fault or abnormal conditions shall isolate the problem portion of the system and minimize damage in that portion. The rest of the system shall be maintained in normal service. The coordination shall be in conformance with the recommendations of latest IEEE Standard 242.

C. Submit the analysis that shall include impedance and short circuit calculations, list of any assumptions made in the analysis, the recommended settings of the protective devices, and the system time/current characteristic curves. The submittal shall be made so as to allow time for review and resubmittal, if necessary, before the implementation of final settings and adjustments by the testing laboratory.

3.10 FIELD TESTS

A. Perform tests in accordance with applicable procedures as described in NETA Acceptance Testing Specifications.

B. Give sufficient notice to the Engineer prior to any test to permit witnessing the test.

C. Provide the services of a recognized independent testing laboratory and pay all costs of performing the inspections and tests as specified herein.

D. The testing laboratory shall provide all materials, equipment, labor and technical supervision to perform such tests and inspections. It is the intent of these tests to ensure that all electrical equipment is operational within industry and manufacturer's tolerances and is installed in accordance with the Contract Documents and manufacturer's instructions. The tests and inspections shall determine the suitability for energization.

E. The testing laboratory shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907. Membership in the International Electrical Testing Association (NETA) constitutes proof of meeting such criteria. The testing laboratory shall submit proof of these qualifications to the Engineer for review. Testing laboratory shall be Electrical Testing and Controls, Electro-Test, Power Systems, or equal.

F. The testing laboratory shall have a calibration program, which maintains all applicable test instrumentation within, rated accuracy. The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain. Instruments shall be calibrated in accordance with the following frequency schedule:

1. Field instruments: 6 months maximum
2. Laboratory instruments: 12 months
3. Leased specialty equipment: 12 months

Date calibration labels shall be visible on all test equipment.
G. Where testing pursuant to NETA requirements is required in these specifications, submit a test report which includes the following:

1. Name of project, name of person performing test, and date of test
2. Description of equipment tested
3. Description of test
4. List of test equipment used and calibration date
5. Test results
6. Conclusions and recommendations
7. Appendix, including appropriate test forms

The test report shall be bound and its contents certified. Submit the completed report directly to the Engineer no later than thirty (30) days after completion of the test unless directed otherwise. Number of reports to be submitted for review shall be the same as the number required for shop drawing submittals.

H. Safety practices shall include, but are not limited to, the following requirements:

1. Nevada Occupational Safety and Health Act.
3. Applicable state and local safety operating procedures.

I. All field tests shall be performed with apparatus de-energized except where otherwise specifically required by Section 7 of the latest Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems published by NETA. The testing laboratory shall have a designated safety representative who shall be present on the project and supervise operations with respect to safety. Circuits operating in excess of 600 volts between conductors shall have conductors shorted to ground by a hot-line grounded device approved for the purpose. In all cases, work shall not proceed until the safety representative has determined that it is safe to do so. The testing laboratory shall have available sufficient protective barriers and warning signs to conduct specified test safely.

J. Electrical equipment and materials furnished and installed by the Contractor, and the testing equipment listed below shall be tested in accordance with the "Inspection and Test Procedures" and "System Function Tests" (Section 7) of the latest Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems published by NETA. Tests shall not include any tests listed as optional in the aforementioned NETA Specifications unless specifically noted in respective equipment specifications for this project.

K. Retesting will be required for all unsatisfactory tests after the equipment or system has been repaired. Retest all related equipment and systems if required by the Engineer. Repair and retest equipment and systems, which have been satisfactorily tested but later, fail, until satisfactory performance is obtained.

L. Putting Equipment and Cables into Service: Submittal and favorable review of the specified factory and field tests shall occur before the Contractor is permitted to place the respective equipment or cable into service.

M. Miscellaneous Tests
1. **Insulation Resistance, Continuity, Rotation:** Perform routine insulation resistance, continuity and rotation tests for all distribution and utilization equipment including all motors 1/2 horsepower and larger prior and in addition to tests performed by the testing laboratory specified herein. Supply a suitable and stable source of test power to the test laboratory at each test site. The testing laboratory shall specify requirements. Notify the testing laboratory when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling. All testing shall be performed in the presence of the Engineer. The testing laboratory shall be responsible for implementing all final settings and adjustments on protective devices and tap changes. Any system material or workmanship that is found defective on the basis of acceptance tests shall be reported directly to the Engineer. The testing laboratory shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.

2. **Motor Current:** Measure and record current in each phase for each new motor. Include measurement of the motor terminal voltages and motor currents when the motor is being operated at normal operating loads. For motors that are part of variable frequency drive systems, use true-RMS-reading instruments in making the measurements.

3. **Operational Tests:** Operationally test all circuits to demonstrate that the circuits and equipment have been properly installed, adjusted and are ready for full-time service. Demonstrate the proper functioning of circuits in all modes of operation, including alarm conditions, and demonstrate satisfactory interfacing with the data acquisition and alarm systems.

### 3.11 EQUIPMENT PROTECTION

A. Exercise care at all times after installation of equipment, motor control centers, etc., to keep out foreign matter, dust, dirt, debris, or moisture. Use protective sheetmetal covers, canvas, heat lamps, etc., as needed to ensure equipment protection.

### 3.12 CLEANING EQUIPMENT

A. Thoroughly clean all soiled surfaces of installed equipment and materials.

B. Clean out and vacuum all construction debris from the bottom of all equipment.

C. Provide and touch-up to original condition any factory painting that has been marred or scratched during shipment or installation, using paint furnished by the equipment manufacturer.

### 3.13 CLEANUP

A. Upon completion of the electrical work, remove all surplus materials, rubbish, and debris that accumulated during the construction work. Leave the entire area neat, clean, and acceptable to the Engineer.

**END OF SECTION**
SECTION 16110
CONDUIT, RACEWAYS, AND FITTINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Work specified in other Divisions:
   1. Division 2: Excavation and Backfill of Trenches
   2. Division 3: Concrete Emplacement

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI) Publications:
   1. C80.1 Specification for Zinc Coated Rigid Steel Conduit
   2. C80.3 Specifications for Zinc Coated Electrical Metallic Tubing

B. National Electrical Manufacturers Association (NEMA) Publications:
   1. RN 1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing

C. Underwriters Laboratories (UL) Standards:
   1. 6 Rigid Metal Electrical Conduit
   2. 360 Liquid-Tight Flexible Steel Electrical Conduit
   3. 651 Schedule 40 and 80 Rigid PVC Conduit
   4. 797 Electrical Metallic Tubing
   5. 1479 Fire Tests of Through-Penetration Firestops

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Information category of the General Conditions and the submittal requirements of Section 16010.

1.04 LOCATIONS

A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 CONDUIT, RACEWAYS

A. General:
   1. Rigid steel conduit shall be used in all conduit systems, except where otherwise shown on the Drawings, where flexible conduit is required, or where these
Specifications require, or allow the use of electrical metallic tubing (EMT) or polyvinyl chloride (PVC) conduit.

2. Conduit runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 7 feet or more above finished floors and not subject to mechanical damage or corrosion may be EMT where permitted by the NEC.

3. The minimum size raceway shall be 3/4-inch unless indicated otherwise on the Drawings.

B. Galvanized Rigid Steel Conduit (GRS) shall be hot-dip galvanized after fabrication, conforming to ANSI C80.1 and UL 6. Couplings shall be threaded type. Where PVC coated rigid steel conduit is called for, it shall be hot-dip galvanized, conforming to NEMA RN 1, with factory-applied PVC coating 40 mils thick.

C. Flexible Conduit:
   1. Flexible metal conduit shall be liquid-tight, shall have a moisture- and oil-proof PVC jacket extruded over a galvanized, flexible steel conduit, and shall conform to UL 360.
   2. Flexible conduit for hazardous locations shall be UL listed for the applicable Class, Division, and Group.

C. Rigid Nonmetallic Conduit: Rigid nonmetallic conduit shall be PVC Schedule 40 (PVC-40) conduit approved for underground use and for use with 90°C wires, and shall conform to UL 651.

F. Electrical Metallic Tubing (EMT) shall be galvanized thinwall conduit conforming to UL 797.

2.02 CONDUIT SUPPORTS

A. Supports for individual conduits shall be galvanized malleable iron one-hole type with conduit back spacer.

B. Supports for multiple conduits shall be hot-dip galvanized Unistrut or Superstrut channels, or equal. All associated hardware shall be hot-dip galvanized.

C. All channels, strut, threaded rods, nuts and clamps in corrosive areas shall be of epoxy resin reinforced fiberglass material. Provide Robroy, Superstrut, or equal.

2.03 FITTINGS

A. Fittings for use with rigid steel shall be hot dipped galvanized steel or galvanized cast ferrous metal; access fittings shall have gasketed cast covers and be Crouse-Hinds Condulets, Appleton Uniletis, or equal. Provide threaded-type couplings and connectors; set-screw type and compression-type are not acceptable.

B. Fittings for use with either rigid nonmetallic conduit or duct shall be PVC and have solvent-weld-type conduit connections. If such are not available, then the Specification for PVC coated galvanized rigid steel fittings shall apply.
C. Fittings for flexible conduit shall be Appleton Type ST, O-Z Gedney Series 4Q, or equal.

D. Union couplings for conduits shall be the Erickson type and shall be Appleton Type EC, O-Z Gedney 3-piece Series 4, or equal. Threadless couplings shall not be used.

E. Bushings:
   1. Bushings shall be the insulated type.
   2. Bushings for rigid steel or IMC shall be hot dip galvanized insulated grounding type, 0-Z Gedney Type HBLG, Appleton Type GIB, or equal.

F. Conduit seals shall have zinc electroplate and shall be Crouse-Hinds Type EYS or EZS; Appleton Type EYS, ESU, or EY series; or equal.

G. Fittings for EMT shall be compression type. Connectors shall be insulated throat type. Drive-on, crimp, spring or set screw fittings are not acceptable.

2.04 WIREWAYS AND AUXILIARY GUTTERS

A. General: Wireways shall consist of a prefabricated channel-shaped trough with hinged or removable covers, associated fittings, and supports. Straight sections shall not be longer than 5 feet. Cross-sectional dimensions shall be as indicated on the Drawings. Fittings shall consist of elbows, tees, crosses, and closing plates as required.

B. Interior Locations: All components shall be constructed from sheet steel not less than 16 gauge and coated with a corrosion-resistant gray paint. Covers shall be held closed with screws.

C. Exterior Locations: Wireway and associated fittings shall meet NEMA 3R/12 classifications, with gasketed closing end plates and gasketed hinged covers.

D. Corrosive Locations: In corrosive locations provide enclosure type boxes for use as wireways. Enclosures and associated fittings shall meet NEMA 4X classifications and shall be manufactured from reinforced injection molded fiberglass or formed and welded stainless steel, and shall have gasketed closing plates and hinged and gasketed covers with spring loaded latches.

2.05 SURFACE RACEWAYS

A. Surface metal raceways shall conform to the requirements of ANSI/NFPA 70 (the NEC) Article 386. Minimum cross-sectional area shall equal or exceed that of 1/2-inch conduit.
2.06 CONDUIT SEALANTS

A. Moisture Barrier Types: Sealant shall be a non-toxic, non-shrink, non-hardening, putty type hand applied material providing an effective barrier under submerged conditions.

B. Fire Retardant Types: Fire stop material shall be a reusable, non-toxic, asbestos-free, expanding, putty type material with a 3-hour rating in accordance with UL 1479. Provide products indicated by the manufacturer to be suitable for the type and size of penetration.

2.07 WARNING TAPE

A. Provide electrical warning tape in duct bank as shown on the Drawings. The tape shall be 6 inches wide, red with black lettering stating "CAUTION BURIED ELECTRIC LINE." The tape shall be made of 6-mil polymer with 36,000 psi tensile strength.

PART 3 - EXECUTION

3.01 CONDUIT, RACEWAY AND FITTING INSTALLATION

A. From pull point to pull point, the sum of the angles of all of the bends and offsets shall not exceed 270 degrees.

B. For power, control and signal circuits, provide conduit per Conduit Use Tables below, unless specifically indicated otherwise on the Drawings:

   1. Exception: For raceways leaving a building above grade and then going below grade, provide PVC-coated GRS from a point 3 feet above grade to a point 5 feet from the building wall.

C. At all boxes and equipment, provide insulated type metallic grounding bushings for metallic conduits. Bond together all conduits to provide continuity of the equipment grounding system. Size bonding conductor per code.

D. Provide flexible conduit in lengths of not more than 18 inches at connections to motors, valves and any equipment subject to vibration or relative movement.

E. Conduits embedded in concrete floors on grade shall be installed between grids of reinforcing steel, or shall be encased below the floors, provided the concrete is thickened in a manner satisfactory to the Engineer. Installation of conduit below the bottom of this slab is not acceptable; embedding or encasing is required.

F. Provide galvanized rigid steel factory ells for GRS raceways. Provide GRS for offsets in GRS raceways.

G. Underground Raceways: Slope all underground raceways to provide drainage; for example, slope conduit from equipment located inside a building to the handhole located outside the building. For additional requirements see Section 16402.
H. Conduit Supports: Properly support all conduits as required by the NEC. Run all conduits exposed except where the Drawings indicate that they are to be embedded in the floor slab, walls, or ceiling, or to be installed underground.

1. Exposed Conduits:
   a. Support exposed conduits within 1 foot of any outlet and at intervals not exceeding NEC requirements; wherever possible, group conduits together and support on common supports. Support exposed conduits fastened to the surface of the concrete structure by one-hole clamps, or with channels. Use conduit spacers with one-hole clamps. Coordinate conduit locations with piping, equipment, fixtures, and with structural and architectural elements. Conduits attached to walls or columns shall be as unobtrusive as possible and shall avoid windows. Run all exposed conduits parallel to building lines.
   b. Group together exposed conduits in horizontal runs located away from walls and support on trapeze hangers. Arrange such conduits uniformly and neatly. Trapeze hangers shall consist of channels of adequate size, suspended by means of rods or other suitable means from the ceiling or from pipe hangers. Install such runs so as not to interfere with the operation of valves or any other equipment, and keep at least 6 inches clear of any pipe which may operate at more than 100°F. Treat cut surfaces or damaged ends with corrosion-resistant coatings such as "Devcon Z", prepared by Subox Coatings; "Galvanox Type I", prepared by Pedley-Knowles; or equal. Application shall follow manufacturer's recommendation.

2. Conduits Embedded in Concrete: Provide concrete cover at least equal to that of the reinforcing steel, space at 3 conduit diameters apart except where they cross at angles greater than 45 degrees, and install so as not to reduce the structural integrity of the concrete element.

I. When expansion joints are crossed, whether conduit is embedded or exposed, provide watertight expansion fittings and bonding jumpers. In hazardous locations, provide Crouse-Hinds UNF/UNV, Appleton, or equal. In unclassified locations, provide Crouse-Hinds XD, Appleton, or equal.

J. Spare Raceways: After completing a conduit run between manholes, handholes, or pullboxes, prove the integrity of the conduit run. Use an air compressor to blow in a pull-line, then use the pull-line to pull a mandrel through the entire conduit run. Install a new 3/16-inch nylon, 800 pound test pull-line which has tape measure marking every foot to indicate length. Plug the ends of the conduit, with conduit cap plugs.

K. All penetrations through walls into or out of corrosive locations, as defined in Section 16010 shall be made gas-tight. In concrete walls, pour concrete after the conduit is in place, if possible. If not, core drill concrete or CMU walls, install conduit and caulk around it with non-shrink grout. Install conduit seal in each conduit near the penetration.

L. All conduit penetrations through interior walls and floors shall be sealed with fire retardant type conduit sealant.
M. Conduit Identification: In each manhole, handhole, pullbox, cabinet, motor control center or other equipment enclosure, identify each conduit using the conduit number shown on the Drawings by means of a stamped brass tag affixed with stainless steel wire; where affixing a tag is not feasible, identify conduits by stenciling. Stencil all exposed conduits for identification at least once in each room.

N. Conduit Seals:
   1. Moisture Seals: Provide in accordance with NEC Paragraph 300-5(g).

O. Conduit in finished areas shall be installed concealed.

P. Conduit shall not be supported from T-bar ceiling suspension wires.

Q. Flexible metallic conduit shall have a maximum length of 6 feet. Flexible metallic conduit shall not be considered as a ground conductor. Flexible metallic conduit shall only be installed in exposed or accessible locations.

R. Rigid PVC conduit shall be stored on a flat surface and shielded from the sun.

S. Cut EMT shall be reamed to remove all burrs.

<table>
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<tr>
<th>Circuit Type</th>
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<td>Power &amp; 120 Vac Control</td>
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<tr>
<td>Signal</td>
<td>GRS</td>
<td>PVC-40</td>
<td>PVC Coated GRS</td>
</tr>
</tbody>
</table>

* Provide ground wire sized per NEC requirements for all circuits.

** PVC coated GRS in wet wells, etc., that are both hazardous and corrosive, otherwise, GRS.
Notes:
1. Generally, the Conduit Use Tables apply.
2. Signal circuits are those subject to RF interference or induced current. MSPs, TSPs, telephone cable, coaxial cable, and manufacturer's cables specially designed for low level signals are all presumed to be part of signal circuits.
3. Provide fiberglass conduit where indicated on the Drawings.

3.02 WIREWAY INSTALLATION

A. Straight sections and fittings shall be solidly bolted together to be mechanically rigid and electrically continuous. Dead ends shall be closed. Unused conduit openings shall be plugged.

B. Wireways shall be supported every 5 feet.

C. Wireways and auxiliary gutters shall not contain wiring or control devices and shall not extend over 30 feet in length.

END OF SECTION
SECTION 16120
LOW VOLTAGE WIRE AND CABLE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Related Work Described Elsewhere:
   1. Section 17010: Instrumentation and Controls, General Requirements
   2. Section 17510: Panels

1.02 REFERENCE STANDARDS

A. International Electrical Testing Association (NETA);
   1. ATS Acceptance Testing Specifications

B. Underwriters Laboratories (UL) Standards:
   1. 510 Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Information category of the General Conditions and the submittal requirements of Section 16010.

1.04 LOCATIONS

A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 CONDUCTORS

A. General: All conductors shall be copper. Wire or cable not specifically shown on the Drawings or specified, but required, shall be of the type and size required for the application and in conformance with the applicable code. All insulated conductors shall be identified with printing colored to contrast with the insulation color.

B. Power and Control Conductors, 600 Volts and Below:
   1. Stranded copper wires shall be 600 volt Type THWN, sizes #12 and #10 AWG only.
   2. Stranded copper wire shall be 600 volt Type THWN, Class B stranding, sizes #14 AWG and larger.
   3. Fixture wire shall be 600 volt, silicone rubber insulated, 200°C, UL Type SF-2, with stranded copper conductors.
4. Cords shall be 600 volt, 2-conductor plus ground, Type SO, hard service, of adequate length and with grounding type plug attached, rated in amperes as shown on the Drawings.

2.02 SPLICES AND TERMINATIONS OF CONDUCTORS

A. Splices:
   1. Wire and Cable Splicing Materials and Applications:
      a. For Lighting Systems and Power Outlets: Wire nuts shall be twist-on type insulated connectors utilizing an outer insulating cover and a means for connecting and holding the conductors firmly. They shall be UL listed and suitable for connecting two to four solid copper conductors of #14 or #12 AWG size or two or three #10 AWG solid copper conductors.
      b. All Equipment: Crimp type connectors shall be insulated type, suitable for the size and material of the wires and the number of wires to be spliced and for use with either solid or stranded conductors. They shall be UL listed.
      c. Division 16 Equipment and Power Conductors: Bolted pressure connectors shall be suitable for the size and material of the conductors to be spliced. They shall be UL listed and of the split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor.
      d. All Equipment: Epoxy splice kits shall include epoxy resin, hardener, and mold, and shall be suitable for use in wet locations and hazardous locations.

2. Terminal Cabinets: Provide terminal cabinets per Section 17510. Termination system shall include insulated, crimp-type connectors. Coordinate the lug and boards for correct fit. All terminations shall include marker sleeves.

B. Terminations:
   1. Low Voltage Terminations:
      a. Crimp type terminals shall be UL listed, self-insulating sleeve type, with ring or rectangular type tongue, suitable for the size and material of the wire to be terminated, and for use with either solid or stranded conductors.
      b. Terminal lugs shall be UL listed and of the split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor. Tongues shall have NEMA standard drilling.
      c. Crimp with manufacturer recommended ratchet-type tool with calibrated dies. Hand crimping tools are not acceptable.

C. Tape used for splices and terminations shall be compatible with the insulation and jacket of the cable and shall be of plastic material. Tape shall conform with UL 510.

D. Wire markers shall be heat shrink type (Raychem; T&B; or equal). Wire numbers shall be permanently imprinted on the markers.
PART 3 - EXECUTION

3.01 CONDUCTOR INSTALLATION

A. Provide the following types and sizes of conductors for the uses indicated for 600 volts or less:
   1. Stranded, Sizes #12 and #10 AWG: As shown on the Drawings for circuits for receptacles, switches and light fixtures with screw-type terminals.
   2. Stranded Copper, Size #14 AWG and Larger, Individual Conductors or CC: As shown on the Drawings for the control of motors or other equipment. Size #14 shall not be used for power supplies to any equipment.
   3. Stranded Copper, Sizes #12 AWG and Larger: As shown on the drawings for motors and other power circuits.
   4. Stranded Copper, #6 AWG and Larger: For power feeders, provide copper, unless specifically indicated otherwise on the Drawings or in the circuit schedule.
   5. Fixture Wire: For connections to all fixtures in which the temperature may exceed the rating of branch circuit conductors.

B. Color Coding: Provide color coding for all circuit conductors. Insulation color shall be white for neutrals and green for grounding conductors. An isolated ground conductor shall be identified with an orange tracer in the green body. Ungrounded conductor colors shall be as follows:
   1. 120/208 Volt, 3 Phase: Red, black and blue.
   2. 277/480 Volt, 3 Phase: Yellow, brown and orange.
   3. 120/240 Volt, 1 Phase: Red and black.

C. Color coding shall be in the conductor insulation for all conductors #10 AWG and smaller; for larger conductors, color shall be either in the insulation or in colored plastic tape applied at every location where the conductor is readily accessible (e.g., enclosures, pullboxes, and junction boxes).

D. Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Only soapstone, talc, or UL listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables and exercise care in pulling, to avoid damage to conductors.

E. Cable bending radius shall be per applicable code. Install feeder cables in one continuous length unless splices are favorably reviewed.

F. Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in any flexible conduit or any raceway in which all or any portion of a run consists of non-metallic duct or conduit. For flexible conduit, an external bonding jumper is an acceptable alternative.

G. In panels, bundle incoming wire and cables, No. 6 AWG and smaller, lace at intervals not greater than 6 inches, neatly spread into trees and connect to their
respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Perform lacing with plastic cable ties or linen lacing twine. Where plastic panel wiring duct is provided for cable runs, lacing is not necessary when the cable is properly installed in the duct.

H. For cables crossing hinges, utilize extra flexible stranded wire, make up into groups not exceeding 12, and arrange so that they will be protected from chafing and excess flexing when the hinged member is moved.

3.02 CONDUCTOR SPLICES AND TERMINATIONS

A. Splices: Install all conductors without splices unless necessary for installation, as determined by the Engineer. Splices, when permitted, and terminations shall be in accordance with the splice or termination kit manufacturer's instructions. Splice or terminate wire and cable as follows:
   1. Watertight Splices: Splices in concrete pullboxes, for any type of cable or wire, shall be watertight. Make splices in low voltage cables using epoxy resin splicing kits rated for application up to 600 volts.

B. Terminations:
   1. Terminate stranded #14 wire using crimp type terminals where not terminated in a box lug type terminal. Terminals must be coordinated with type of terminal board where provided.

3.03 CONDUCTOR IDENTIFICATION

A. Except for interior lighting and receptacle circuits, identify each wire or cable at each termination and in each pullbox, junction box, handhole, and manhole using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. Identify other circuits as shown in the circuit schedule or as favorably reviewed by the Engineer.

B. Conductor numbering shall be coordinated with the Interconnection Diagrams specified in Section 17010.

C. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

3.04 FIELD TESTS

A. Insulation Resistance Tests: For all circuits 150 volts to ground or more and for all motor circuits over 1/2 horsepower, test cables per NETA Paragraph 8.3.1. The insulation resistance shall be 20 megohms or more. Submit results for review. See also Section 16010.
B. Phase Rotation: The phase rotation of all circuits shall be clockwise in sequence. The Contractor shall verify that each three-phase service, feeder and branch circuits meet this requirement. A record shall be kept at each circuit tested and, on completion, given to the Engineer for review.

END OF SECTION
SECTION 16124
SIGNAL CABLE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Related Work Described Elsewhere:
   1. Section 17010: Instrumentation and Controls, General Requirements

1.02 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):
   1. B8-99 Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft, Specification for

B. Underwriters Laboratories Incorporated (UL):
   1. 13 Power-Limited Circuit Cables
   2. 83 Thermoplastic-Insulated Wires and Cables

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Information category of Section 01300 and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

2.01 TWISTED SHIELDED PAIRS (TSP)

A. Cable shall conform to UL 13, and UL 83 and shall be type PLTC cable suitable for direct burial. Each TSP shall consist of two #18 AWG, 7-strand copper conductors per ASTM B8-99 with 15 mils PVC insulation. Conductors shall be twisted with 2-inch or shorter lay, with 100% foil shielding and tinned copper drain wires. Each pair shall have a 35-mil-thick outer jacket. Cable shall be rated at 90°C and for operation of 300 volts, as noted on the Drawings. Provide Alpha; Dekoron; Belden; or equal.

2.02 TELEPHONE CABLE

A. Telephone cable shall consist of 4 or 12 pair #22 AWG conductors of solid, soft bare copper as shown on Drawings. Conductors shall have a thermoplastic compound and shall be color coded per telephone industry standards. Insulated conductors shall be twisted into pairs having varying lengths of lay. This cable core shall be covered with a non-hygroscopic core tape and a 0.005-inch copper tape shield. Shield and tape shall be covered with a petrolatum-polyethylene compound
for filling all cable interstices and providing a positive moisture barrier. Filling
compound shall be non-toxic and shall not irritate the skin. Cable shall have an
outer jacket of black, high molecular weight polyethylene jacket resistant to
abrasion, moisture, weather and environmental cracking. Cable shall be suitable
for installation in ducts or direct burial and shall be manufactured to REA
Specification PE-39. Provide Alpha 3900 or 4000 Series; equivalent Brand-REX; or
equal.

PART 3 - EXECUTION

3.01 CABLE INSTALLATION

A. Signal cable shall be installed by personnel who have had a minimum of 3 years
   experience in terminating and splicing twisted shielded conductors, co-axial cables.

B. Adequate care shall be exercised by the installers to prevent cable damage or
   sheath distortion. Bending radius shall not exceed manufacturer's
   recommendations.

C. Cables shall be continuous from initiation to termination without splices except
   where specifically indicated.

D. Cable shielding shall be grounded at the Control Panel (PLC) end only of the cable.
   Bonding shall be to a single ground point only.

E. Heat shrinkable sleeving shall be installed on all cables to insulate shielding at the
   ungrounded cable terminations.

F. Manufacturer's cable pulling tension shall not be exceeded.

3.02 CONDUCTOR SPLICES AND TERMINATIONS

A. Splices: Install all conductors without splices unless necessary for installation, as
determined by the Engineer. Splices, when permitted, and terminations shall be in
accordance with the splice or termination kit manufacturer's instructions. Splice
cables as follows:
   1. Watertight Splices: Splices in concrete pullboxes, for any type of cable or wire,
      shall be watertight. Make splices in low voltage cables using epoxy resin
      splicing kits rated for application up to 600 volts.

B. Terminations:
   1. Crimp-type terminals shall be UL listed, self-insulating, sleeve type with ring or
      rectangular tongue, suitable for size and material of the wire to be terminated
      and for use with either stranded or solid wire. Spade type lugs are acceptable
      with telephone (TC) cable systems only.
   2. Crimp with manufacturer's recommended ratchet-type tool with calibrated
dyes. Hand crimping tools are not acceptable.
3.03 CONDUCTOR IDENTIFICATION

A. Identify each wire or cable at each termination, in each pullbox, and in each handhole using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. Identify other circuits as shown in the circuit schedule or as favorably reviewed by the Engineer. Conductor numbering shall be coordinated with the Interconnection Diagrams specified in Section 17010.

B. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

3.04 FIELD TESTS

A. Insulation Resistance Tests: Perform insulation resistance tests on all circuits. Make these tests before any equipment has been connected. Test the insulation with a 250 Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 20 megohms or more. Submit results for review.

END OF SECTION
PART 1 - GENERAL

SECTION INCLUDES

1.01 provision: Applicable provisions of Section 16010 become part of this Section as if repeated herein.

B. Work Included:
   1. Installation of all necessary outlet boxes for wiring devices, lighting fixtures, and signal equipment as noted on the Drawings.
   2. Installation of junction boxes as required for the consolidation of conduit runs.
   3. Installation of pull boxes as necessary to aid in pulling in conductor.

REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM) Publication:
   1. A123/A123M-02 Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products

B. Federal Specifications (FS):
   1. A-A-50563A Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical, Cast Metal
   2. A-A-59214 Junction Box, Extension, Junction Box Cover, Junction Box (Steel, Cadmium or Zinc Coated)

C. Underwriters Laboratories, Inc. (UL) Publications:
   1. 50 Enclosures for Electrical Equipment
   2. 514A Metallic Outlet Boxes

SUBMITTALS

A. Submit material or equipment data in accordance with the Product Information category of Section 01300 and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

OUTLET, JUNCTION AND PULL BOXES

A. Sheet Metal Boxes: Sheet metal boxes shall conform to UL 50, with a hot-dipped galvanized finish conforming to ASTM A123/A123M-02. Outlet boxes and switch boxes shall be designed for mounting flush wiring devices. Boxes and box extension rings shall be provided with knockouts. Boxes shall be formed in one piece from carbon-steel sheets. Outlet boxes shall not be less than 4 inches square and 1-1/2 inches deep. Ceiling boxes shall withstand a vertical force of 200 pounds for 5 minutes. Wall boxes shall withstand a vertical downward force of 50 pounds.
for 5 minutes. Gangable and through-wall types are not acceptable. Boxes shall conform to FS A-A-59214 and UL 514A.

B. Cast Metal Boxes: Box bodies and cover shall be cast or malleable iron with a minimum wall thickness of 1/8-inch at every point, and not less than 1/4-inch at tapped holes for rigid conduit. Bosses are not acceptable. Mounting lugs shall be provided at the back or bottom corners of the body. Covers shall be secured to the box body with No. 6 or larger brass or bronze flathead screws. Boxes shall be provided with neoprene cover gaskets. Where only cast aluminum is available for certain types of fixture boxes, an epoxy finish shall be provided. Outlet boxes shall be of the FS types. Boxes shall conform to FS A-A-50563A and UL 514.

C. Non-metallic Boxes: Non-metallic boxes shall be hot-compressed fiberglass, one-piece, molded with reinforcing of polyester material, with minimum wall thickness of 1/8-inch.

D. Pull Boxes and Junction Boxes: Except where NEMA 4X fiberglass boxes are called for, all boxes shall be fabricated from carbon steel per UL 50. Boxes shall be welded construction with all seams or joints closed and reinforced. Boxes shall be galvanized after construction. Boxes intended for outdoor use shall be cast metal with threaded hubs and neoprene gasketed covers, or shall be of the fiberglass reinforced polyester type of 1/8-inch minimum thickness. Cover retention shall be by corrosion resistant stainless steel screws.
1. All boxes for wiring operating at 601 volts or higher shall be constructed without hinges and shall be padlockable.
2. All boxes and cabinets shall be securely fastened to building structural members so as to prevent movement in any direction. Boxes shall not be supported by lighting fixtures, suspended ceiling support wires or freely hanging rods.
   a. Covers of boxes and cabinets mounted in horizontal plane (top or bottom) shall either weigh not more than 40 pounds or shall require not more than 40 pounds of force to open or close.
   b. Covers of boxes and cabinets mounted in vertical plane (front, back, sides) shall either weigh not more than 60 pounds or shall require not more than 60 pounds of force to open or close. All covers over 30 pounds shall be furnished with angle support at bottom to carry weight of cover for assembly.
   c. Covers of boxes and cabinets weighing more than 30 pounds shall be provided with lifting handles or some means of grasping other than edges.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Outlet Boxes:
1. Provide fixture outlets with proper fixture connectors.
2. Box mounting height shall be dictated by the wiring device enclosed.
3. Blanking covers shall be installed on all unused openings.
4. Sheet metal boxes shall be used where the conduit system is routed concealed in the walls and ceilings.
5. Cast metal or molded non-metallic surface mounted boxes shall be used in exterior and/or in all wet locations.
6. Bonding jumpers shall be used around all concentric or eccentric knockouts.
7. Boxes shall be securely mounted to the building structure independent of conduits entering or exiting the boxes.

B. Junction Boxes and Pull Boxes:
   1. Boxes shall be installed where required and where indicated on the Drawings.
   2. Boxes shall be readily accessible.
   3. Boxes shall not be installed in finished areas.
   4. Pull boxes shall be provided at least every 150 feet on long straight conduit runs. Spacing shall be reduced by 50 feet for each 90 degree bend. See Section 16110 for maximum bends in conduit systems.
   5. Box dimensions shall be in accordance with size and quantity of conductors and conduits entering and leaving box per NEC Article 314 requirements.
   6. All boxes, both new and existing, for medium voltage systems shall be permanently marked "High Voltage" on all surfaces with red letters which are at least 4 inches high.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Work Included:
   1. Installation, connection and furnishing all single, duplex, GFI and special purpose receptacles complete with wall plates and/or covers as shown on the Drawings.
   2. Installation, connection and furnishing of all single pole, three-way, pilot light and momentary position toggle switches complete with wall plates and or handle operators as shown on the Drawings.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI) Publication:
   1. C73 Plugs and Receptacles
   2. C73a Plugs and Receptacles

B. Federal Specifications (FS):
   1. W-C-596/11D Connector, Receptacle, Electrical, General Purpose, Single
   2. W-S-896/2E Switches, Toggle and Lock, Flush Mounted (AC)

C. National Electrical Manufacturers Association (NEMA) Publications:
   1. WD 1 General Color Requirements for Wiring Devices
   2. WD 6 Wiring Devices - Dimensional Requirements

D. Underwriters Laboratories (UL) Standards:
   1. 20 General-Use Snap Switches
   2. 498 Electrical Attachment Plugs and Receptacles
   3. 514A Metallic Outlet Boxes
   4. 943 Ground Fault Circuit Interrupters

1.03 SUBMITTALS

Submit material or equipment data in accordance with the Product Information category of the General Conditions and the submittal requirements of Section 16010.

1.04 LOCATIONS

Refer to Section 16010, General Electrical Requirements, for definitions of types of locations.
PART 2 - PRODUCTS

2.01 RECEPTACLES

A. General: Receptacles shall be heavy duty, high abuse, grounding type conforming to NEMA configurations, NEMA WD1 and UL 514A Standards.

B. Single and Duplex Receptacles:
   1. Receptacles shall be of back and side wire design utilizing screw type terminals. Receptacles shall be rated 20 ampere, two-pole, 3-wire, 120-volt, NEMA 5-20 configuration, self-grounding. Color shall be brown in industrial areas and ivory or white in office and laboratory areas. Power contacts shall be a T-type design and shall be brass. Ground contacts shall be brass.
   2. Devices shall have a nylon composition face with a nylon or melamine body. Units shall comply with Federal Specification W-C-596/11D and meet UL 498 test requirements. Receptacles shall be Hubbell 5362; Daniel Woodhead 5262DW; or equal.

C. Special Purpose Receptacles: Receptacles shall be of the amperage, voltage and NEMA configuration indicated on the Drawing. Compliance to standards and tests shall be as listed in Item B above.

D. GFI Receptacles:
   1. Device shall be rated 20 ampere, 2-pole, 3-wire, 120 volt, conforming to NEMA WD1.10 configuration. Face shall be nylon composition meeting UL 498 test standards. Unit shall have test and reset push buttons. Reset push button shall have a visible indicator band to indicated tripped condition.
   2. GFCI component shall meet UL 943 standards with a tripping time of 1/40 second at 5 milliamperes current unbalance. Operating range shall extend from 31°F to 158°F. Unit shall have transient voltage protection and shall be ceramic encapsulated for protection against moisture.
   3. Provide Hubbell 5362, Daniel Woodhead, or equal.

E. Corrosion Resistant Receptacles: Units shall comply with standards listed in Item B above, but shall also have tin-nickel plated brass connecting equipment and stainless steel hardware. Receptacle face color shall be yellow to identify the device as having these special qualities. Provide Hubbell Catalog No. 52CM62 and 53CM62; Daniel Woodhead; or equal.

2.02 SWITCHES

A. Line Voltage Types: Switches shall be rated 20 amperes at 120 or 277 Volts ac only. Units shall be flush mounted, self-grounding, quiet operating toggle devices. Handle color shall be brown in industrial areas and white or ivory in office and laboratory areas. Units shall conform to Federal Specifications W-S-896/2E, UL 20, and NEMA WD1 standards. Sierra Electric, Monumental Grade, Catalog No. 5721; Daniel Woodhead 1900 Series; or equal.
B. Low Voltage Types: Switches shall meet all of the requirements listed in Item A above except to be rated at 15 amperes for switching 24 Volts dc. Devices shall be three-position, momentary contact, spring return, center "off" configuration.

2.03 PLATES

A. General: Plates shall be of the style and color to match the wiring devices, and of the required number of gangs. Plates shall conform with NEMA WD1, UL 514A, and ANSI C73. Plates on finished walls shall be non-metallic or stainless steel. Plates on unfinished walls and on fittings shall be of zinc plated steel or cast metal having rounded corners and beveled edges.

B. Non-Metallic: Plates shall be smooth finish with contoured edges and shall be nylon or fiberglass.

C. Stainless Steel: Plates shall be 0.035 inches thick with beveled edges and shall be manufactured from No. 302 alloy having a brushed or satin finish.

D. Galvanized: Plates shall be galvanized sheet steel raised 1/2-inch, with rounded corners.

E. Cast Metal: Plates shall be cast or malleable iron covers with gaskets so as to be moisture resistant or weatherproof.

F. Blank Plates: Cover plates for future telephone or television outlets shall match adjacent device wall plates in appearance.

G. Damp or Wet and Corrosive Locations: Plates shall have weather protective double doors. Material of manufacture shall be die-cast aluminum for metallic plates or nylon for non-metallic plates.

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRING DEVICES

A. Dry Locations: The device shall be installed in flush mounted boxes with washers as required to bring the device mounting strap level with the surface of the finished wall.

B. Damp or Wet Exterior Locations: Install only wiring devices approved for outdoor service in these locations.

C. Mounting Heights: Locations of wall outlets shall be measured from the finished floor to the center of the outlet box. Boxes shall be adjusted so that the front edge of the box shall not be further back from the finished wall plane than 1/4-inch. Boxes shall be adjusted so that they do not project beyond the finished wall. Height above finished floor shall be as follows:
Telephone Outlets - Office Areas  12
Telephone Outlets - Industrial Areas  12
Duplex Receptacles - Office Areas  12
Receptacles - Industrial Areas  46
Toggle Switches  46

D. Damp or Wet Interior Locations: Install only wiring devices approved for outdoor service. Adjust boxes so that front edge will be 1/4-inch beyond the rear edge of the finished wall. Use metal tubing sleeves to bring device mounting straps flush with the front edge of the finished wall.

E. Receptacles:
1. Receptacles shall be grounded by a grounding conductor, not by a yoke or screw contact.
2. Receptacles shall be oriented so that the grounding slot is located at the top of the outlet.
3. Receptacles shall be installed with connections pigtailed (spliced) to the branch circuit wiring so that removal of the receptacle will not lose neutral continuity and branch circuit power will not be lost to other receptacles on the same circuit.

3.02 INSTALLATION OF WALL PLATES

A. General: Plates shall match the style of the device and shall be plumb within 1/16-inch of the vertical or horizontal.

B. Interior Dry Locations: Install plates so that all four edges are in continuous contact with the finished wall surfaces. Plaster filling will not be permitted. Do not use oversize plates or sectional plates.

C. Exterior and/or Wet Locations: Install plates with gaskets on wiring devices in such a manner as to provide a raintight weatherproof installation. Cover type shall match box type.

D. Future Locations: Install blanking cover plates on all unused outlets.

3.03 TESTS

A. Receptacles:
1. Receptacles shall be tested for blade and ground plug tension prior to installation. Do not install any receptacle having less than 16-ounce individual blade retention.
2. After installation of receptacles, circuits shall be energized and each receptacle tested for proper ground continuity, reversed polarity, and/or open neutral condition.
3. GFI receptacles shall be tested with the circuits energized. Devices shall be tested with a portable GFI receptacle tester capable of circulating 7.5 milliamperes of current, when plugged in, between the "hot" line and...
"ground" to produce tripping of the receptacle. Resetting and tripping shall be checked at least twice at each GFI receptacle.

END OF SECTION
SECTION 16160
PANELBOARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Related Work Described Elsewhere:
   1. Section 16450: Electrical Grounding

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI) Publication:
   1. Z55.1 Gray Finishes for Industrial Apparatus and Equipment

B. National Electrical Manufacturers Association (NEMA) Publications:
   1. PB 1 Panelboards
   2. 250 Enclosures for Electrical Equipment (1,000 Volt Maximum)

C. Federal Specifications (FS):

D. Underwriters Laboratories (UL) Standards:
   1. 50 Enclosures for Electrical Equipment
   2. 869A Reference Standard for Service Equipment

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of Section 01300 and the submittal requirements of Section 16010.

B. Shop Drawings: For each panelboard, submit manufacturer's name and data as required:
   1. Panelboard type.
   2. Main bus and terminal connection sizes.
   3. Location of line connections.
   4. Cabinet dimensions.
   5. Gutter space.
   7. Finish data.
   8. Voltage rating.
1.04 LOCATIONS
A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 PANELBOARDS

A. General: All panelboards shall be the automatic circuit breaker type. The number and arrangement of circuits, trip ratings, spares and blank spaces for future circuit breakers shall be as shown on the Drawings. All circuit breakers shall be quick-make, quick-break, thermal magnetic, bolt-on type, and 1, 2 or 3 pole as shown, each with a single operating handle.

1. Each panelboard shall have a field-mounted identifying plastic nameplate giving the panel identification as shown on the Drawings. In addition, each panelboard shall have a manufacturer's nameplate showing the voltage, bus rating, phase, frequency and number of wires.

2. For panelboards used in dry locations, finish of doors and trim shall be ANSI 61 or 49, in accordance with ANSI Z55.1. Boxes of all such panelboards shall be galvanized, field finished to match the fronts.

3. Provide NEMA 1 panelboard enclosure shown on the Drawings.

4. Panelboards and enclosures shall conform to NEMA PB1 and 250, UL 50 and requirements of all relevant codes. Panelboards used as service equipment shall conform to UL 869A.

B. Lighting Panelboards:


2. Lighting panelboards shall have front doors with key latch, common keying and a typed directory card and holder. Panelboard circuits shall be arranged with odd numbers on the left and even numbers on the right.

3. Circuit Breakers: Circuit breakers shall be the molded case type with ratings as shown on the Drawings. Circuit breakers shall have interrupting ratings of 10,000 RMS symmetrical amperes at 120/208 volts.

4. Manufacturer: Panelboards shall be Square D Type NQOD with Type QOB circuit breakers; Pow-R-Line 1; or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Panelboards shall be installed as indicated on the Drawings and in accordance with the manufacturer's instructions.

3.02 MOUNTING HEIGHTS

A. Lighting panelboards shall be mounted with the top of the box 6-feet-6-inches above the floor. Panelboards shall be plumb within 1/8-inch. The highest breaker operating handle shall not be higher than 72 inches above the floor.
3.03 FIELD TESTS

A. Insulation Resistance Tests: Perform insulation resistance tests on circuits to be energized with a line-to-neutral voltage of 120 volts or more. Test the insulation with a 500 Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 20 megohms or more. Submit results for review.

B. Grounding: Panelboard grounding shall conform to Section 16450.

C. Continuity: Panelboard circuits shall be tested for continuity prior to energizing. Continuity tests shall be conducted using a dc device with a bell or buzzer.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Work Included: Provide all necessary labor, tools and material to install circuit protective devices as shown on the Drawings and as described in these Specifications.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI) Publication:
   1. Z55.1 Gray Finishes for Industrial Apparatus and Equipment

B. National Electrical Manufacturers Association (NEMA) Publications:
   1. ICS 3 Industrial Control and Systems: General Requirements
   2. ICS 6 Enclosures for Industrial Controls and Systems
   3. 250 Enclosures for Electrical Equipment (1,000 Volts Maximum)

C. Federal Specifications (FS):
   1. W-C-375 Circuit Breakers, Molded Case, Branch Circuit and Series Service, Series Trip
   2. W-F-1290/GEN Class H Cartridge Fuses

D. Underwriters Laboratories (UL) Standards:
   1. 50 Enclosures for Electrical Equipment
   2. 489 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosure
   4. 698 Industrial Control Equipment for Use in Hazardous (Classified) Locations

E. National Fire Protection Association (NFPA) Publication:
   1. 70 National Electric Code

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of Section 01300 and the submittal requirements of Section 16010.

1.04 LOCATIONS

A. Refer to Section 16010 for definitions of types of locations.
PART 2 - PRODUCTS

2.01 DISCONNECT SWITCHES

A. Disconnect switches shall be heavy-duty safety switches with the voltage ratings, current ratings, and number of poles as indicated by the Drawings. The switches shall be 600 volt type and horsepower rated. Auxiliary contacts shall be provided as indicated on the Drawings. Switches shall be Square D Type HD; Cutler Hammer HUN Series; or equal.

B. Enclosures shall be as follows:
   1. Dry Locations: NEMA Type 1 or 12.
   2. Wet Locations: NEMA Type 4 or 4X.
   3. Corrosive Locations: NEMA Type 4X.

C. Nameplates: Provide an engraved plastic nameplate for each disconnect switch identifying the motorized equipment it controls.

2.02 CONTROL STATIONS

A. Control station shall be of copper-free aluminum finish for use with control devices. Unit shall include a lockout on "STOP" button, neoprene covers for front operated pushbuttons, and a lockout on selector switch covers (locks two- or three-position handle in any position). Receptacle housing shall be copper-free aluminum. Rocker handles, push buttons and guards shall be Type 6/6 nylon. Shaft and shaft bushings shall be stainless steel. Control stations shall be Crouse-Hinds, Series DSD; Westinghouse Type PB-1; or equal.

2.03 MOTOR STARTER

A. Combination motor starter shall include motor short circuit protector, starter, and thermally compensated overload relay. Provide controls as shown on the Drawings. Starter shall be no smaller than Size 1. Units shall be Cutler-Hammer Type A214 or A216 Series; Allen-Bradley Bulletin 512 or 513 Series; or equal.

2.04 REDUCED VOLTAGE MOTOR STARTER

A. Motor starter shall consist of a motor circuit protector and a reduced voltage solid state starter. The combination shall have an interrupting rating of not less than 42,000 amperes symmetrical at 480 volts. Each unit shall have a control terminal board and other components as shown on the Drawings.

B. Motor circuit protector shall be molded case quick-make, quick-break with magnetic trip only. The motor circuit protector shall be rated 600 volts with adjustable trip settings and interrupting rating of not less than 30,000 RMS symmetrical amperes. The motor circuit protector shall have the rating and trip setting as shown on the Drawings and shall be UL listed. Motor circuit protector shall be Cutler-Hammer HMCP, Square D MagGard, or equal.

C. Reduced Voltage Starter
1. General: Unit shall be solid state soft start type with adjustable current features. The starter shall be rated for 50 HP motor in a 40°C ambient temperature environment. Unit shall operate from a 480 volt, 3-phase, 60 Hertz system. Starter shall be equipped with built-in shorting contactor to effectively shutdown the solid state starting components once the controlled motor is up to speed. Unit shall have a 1.15 service factor.

2. Power Module: Shall be a six SCR unit having two SCRs per phase. Units utilizing a single SCR and a diode combination per phase are unacceptable. SCRs shall have 1,500 volt PIV ratings with the three phase module capable of running at 444 amperes at 55°C continuous. The derated 400 HP module shall be capable of 250% overload for 1 minute, or 600% for 20 seconds. The module shall be protected from voltage transients with metal oxide varistors (MOV's) set to clip at 900 volts. Each SCR shall be equipped with over temperature switches which are wired in series to effectively prevent single phase, phase reversal, or overload operation of the power module. RC snubber circuits shall protect against (dv/dt) occurrences.

3. Logic Module: Unit shall be line noise immune, with start/stop circuits providing filters blocking transients of 12 milliseconds or less. Unit shall provide digital sustained hard gate pulse firing of the SCRs to prevent a high rate of current rise (di/dt). Outputs shall be provided for controller over current, SCR failure and end of current limit. Adjustments shall be provided for starting current, 100% to 400%, the same for current limit. The current ramp 2 to 30 seconds. Diagnostic LED lights shall be provided to indicate various failure conditions, and over or under voltage conditions. Control operation shall be effective over a +10% to -15% range.

D. Control power transformers shall be dry type machine tool transformers. These shall be Hevi-Duty SBE Series, Square D Class 9070, or equal. Sizes shall be as required for the inrush and continuous current requirements of the circuits. Primary windings shall be fused in both phases. Secondaries shall be fused and grounded.

E. Pushbuttons, selector switches, indicating lights, control relays, and timing relays shall be as specified in Paragraph 2.06

F. Terminal blocks shall be rated 600 volts and at least 30 amps. These shall be either the box lug type or isolating switch type, as required. Any circuit within the unit that can be energized when the unit power is off shall have isolating switch type terminals. Provide terminals for all external connections as shown on the Drawings, and, in addition, at least 15% spare terminals. Permanently identify each terminal with the same number as the wire being terminated. Terminal blocks shall conform to NEMA ICS4 and shall be Buchanan NQO, Square D Class 9080, or equal.

G. Motor starter shall be complete with black phenolic nameplate identifying the equipment controlled.

H. Manufacturer: Reduced voltage starter shall be Cutler Hammer IT series; Allen-Bradley; or equal.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Install units plumb within 1/8-inch of vertical, and in accordance with manufacturer’s instructions. Make sure that fuse ratings are as shown on the Drawings, and that breaker trip settings are per the Engineer’s instructions.

3.02 MOUNTING HEIGHTS

A. Fusible switches shall be centered 5'-0" above the floor.

3.03 FIELD TESTS

A. Insulation Resistance Tests: Perform insulation resistance tests on circuits to be energized with a line-to-neutral voltage of 120 volts or more. Test the insulation with a 500 Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 20 megohms or more. Submit results for review.

B. Continuity Tests: Perform circuit continuity tests from a low powered dc test source to operate a buzzer or bell. Tests shall be made prior to energizing the protected circuit.

C. Operating Tests: Demonstrate that the protected circuit can be manually controlled by the installed equipment.

END OF SECTION
SECTION 16402
UNDERGROUND ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

2 Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

3 Related Work Described Elsewhere;
   3.1 Section 02301: Earthwork
   3.2 Section 16110: Conduit, Raceways and Fittings
   3.3 Section 16120: Low Voltage Wire and Cable
   3.4 Section 16124: Signal Cable

3.5 REFERENCE STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Federal Specifications (Fed. Spec.):
      b. RR-G-661D Grating, Metal, Bar Type (Floor, except for Naval Vessels)
   2. American Concrete Institute (ACI) Publication:
      a. 318 Building Code Requirements for Reinforced Concrete
   3. American Society of Testing and Materials (ASTM) Publications:
      a. C150-00 Standard Specification for Portland Cement
      b. A615/A615M-03a Standard Specification for Deformed Billet-Steel Bars for Concrete Reinforcement
      c. C33-03 Standard Specification for Concrete Aggregates
   4. American Association of State Highway and Transportation Officials (AASHTO) Publication:
      a. HB-13 Standard Specifications for Highway Bridges
   5. American National Standard Institute (ANSI) Publication:
   6. National Fire Protection Association (NFPA) Publication:
      a. 70 National Electrical Code (NEC)
1.02 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of Section 01300 and the submittal requirements of Section 16010.

B. Manufacturer's Data and Shop Drawings:
   1. Handhole - Include a table of dimensions which shows proposed size of each manhole and handhole
   2. Handhole Frame and Cover
   3. Sealing Material for Precast Handhole Joints

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials and equipment shall conform to the respective specifications and standards and to the specifications herein. Electrical ratings shall be as indicated.

B. Conduit: Provide per Section 16110.

C. Wire and Cable: Provide per Section 16120 and Section 16124.

2.02 HANDHOLES

A. Provide handholes of reinforced precast concrete, or injection molded composite plastic material. Handholes shall include a base, a body, extensions, and a cover. Handholes with a perimeter of 10 feet or more (e.g., 3 feet by 2 feet) shall have both pulling irons and cable racks. All hardware shall be stainless steel, or hot-dip galvanized after fabrication; cable racking hardware, however, shall be non-metallic and corrosion resistant as manufactured by Pacific Utilities Supply (415) 495-4940, or equal. If no handhole size is shown on the Drawings, size units per NEC or provide 12 inches by 24 inches by 18 inches deep, whichever is larger. Structure shall be fabricated in accordance with ACI 318.

B. Aggregate used in pre-cast handholes shall conform to the specifications given in ASTM C33-03.

C. Cement used shall be Type 11, low alkali Portland cement and shall meet ASTM C150-00, Type 11.

D. Reinforcing bars shall be intermediate grade billet steel conforming to ASTM A615/A615M-03a.

E. Design wheel loads for handhole covers and roof structures shall be HS 20-44 as given in AASHTO HB-13.

PART 3 - EXECUTION

3.01 TRENCHING, BACKFILL, AND COMPACTION

Underground Electrical Work 16402 - 2
3.02 WIRE AND CABLE INSTALLATION

A. See Section 16120 and Section 16124.

3.03 UNDERGROUND RACEWAYS WITH CONCRETE ENCASEMENT

A. All underground raceways shall be encased in concrete unless otherwise specified on the Drawings.
   1. Concrete encasement shall be minimum of 3 inches around outer walls of raceways and minimum of 2 inches between raceways. Conduits shall be PVC-40.
   2. Concrete shall be Portland cement type with 4 sacks cement per cubic yard of concrete, maximum coarse aggregate size of 3/8-inches and shall have minimum strength of 2,000 psi after 28 days. Amount of water shall not exceed slump required for placement.
   3. Underground raceways shall slope toward pullboxes, etc., at minimum rate of 3 inches per 100 feet unless indicated otherwise of the Drawings. Raceway entrances in manholes, handholes, etc., shall be by means of bell ends and shall be sealed against entry of silt, debris, rodents, etc., into raceways.
   4. Top of concrete encasement shall be minimum of 24 inches below grade.
   5. Minimum radius of all horizontal bends in underground duct banks shall be 25 feet. Bends shall be formed of factory made sweeps or continuous assembly of bend segments or curved segments, except that polyvinyl chloride conduits may be field formed. Minimum radius of all vertical bends in underground raceways shall be ten times nominal size of conduit. Vertical bends shall be made of rigid steel or permanently coated aluminum conduit.
   6. Underground raceways within roadways shall be run parallel or perpendicular to road centerline.
   7. Pull wires left in underground raceways shall be 1/8-inch nylon rope or 3/16-inch polypropylene.
   8. Terminate conduits in end-bells where duct lines enter handholes. Provide structural support for concrete encased duct banks at the point where they terminate. Separators shall be of precast concrete, high impact polystyrene, steel, or any combination of these. Stagger the joints of the conduits by rows and layers so as to provide a duct line having the maximum strength. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of a duct line is completed, draw a brush through having the diameter of the duct, and having stiff bristles until the conduit is clear of all particles of earth, sand, and gravel; then immediately install conduit plugs.

B. See Section 16110 for additional requirements.
A. Provide handholes complete with all accessories, as indicated. Identify each casting by having the manufacturers name and address cast into an interior face or permanently attached thereto. Stencil manhole number in the neck with 3-inch-high yellow letters.

B. Installation of Cable in Handholes: Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form all cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators at a maximum of 18 inches. Support cable splices in underground structures by racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure. Provide additional cable racks in each existing underground structure through which new cable is run.
SECTION 16405
SWITCHBOARD

PART 1 - GENERAL

1.01 SECTION INCLUDES

1. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

2. Related Work Described Elsewhere:
   a. Section 16110: Conduit, Raceways and Fittings
   b. Section 16120: Low Voltage Wire and Cable

1.02 APPLICABLE STANDARDS

A. American National Standard Institute (ANSI) Publications:
   1. C57.13 Requirements for Instrument Transformers

B. International Electrical Testing Association (NETA) Publications:
   1. ATS Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems

C. National Electrical Manufacturers Association (NEMA) Publication:
   1. PB 2.1 General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards

D. National Fire Protection Association (NFPA) Publication:
   1. 70 National Electrical Code (NEC)

E. Underwriters Laboratories (UL) Publication:
   1. 891 Deadfront Switchboards
   2. 1449 High Performance Suppression System

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.

B. Shop Drawings: Submit shop drawings which shall include: complete layout of equipment and devices; front and end elevations and floor plan to scale with major dimensions; structural details and overall weights; complete nameplate data and ratings of all devices; material, sizes, locations, and short circuit bracing rating of all buses; nameplate schedules; and circuit breaker time-current curves.

C. Regarding the seismic anchorage requirements of GC1-71, submit a sketch or description of the anchorage system.
D. Factory Test Report: Include the results of the applicable production tests as required in NEMA PB2.

E. Manuals: Provide in conformance with Section 16010.

PART 2 - PRODUCTS

2.01 SWITCHBOARD

A. Standards: Design, build and test the switchboard in accordance with applicable portions of NEMA PB 2.1 and UL 891, and comply with the NFPA 70.

B. Switchboard shall be rated as shown on the Drawings.

C. Structure: The switchboard shall be a NEMA 1 completely self-supporting structure of the required number of vertical sections bolted together to form one metal-enclosed switchboard approximately 90 inches high. Sides, top and rear covers shall be code gauge steel, bolted to the switchboard structure. The frame structure members shall be die-formed 12 gauge steel bolted together and reinforced at external corners with rugged gussets both internal and external to the structure members. The switchboard frame shall be suitable for use as floor sills. Structure shall be for indoor use. Switchboard shall be constructed so that when installed on the concrete pad (see Part 3) the unit complies with the NFPA 70 6'-6" rule. Access shall be from the front.

D. Devices: The switchboard shall include all the devices shown on the Drawings. Devices with operating handles or control knobs or switches shall have the handles, knobs or switches externally accessible without opening any inner doors or covers.

E. Buses:
   1. Main buses shall be either copper or tin-plated aluminum, supported with high impact non-tracking insulation material, and braced to withstand mechanical forces exerted during short circuit conditions of 50,000 RMS symmetrical amperes. The continuous current density of the buses shall not exceed 1,000 amperes per square inch of cross section for copper or 750 amperes per square inch for aluminum. Continuous current ratings shall be as shown on the Drawings. Bus arrangement shall be A-B-C (left-to-right, top-to-bottom, front-to-rear) throughout.
   2. Bus bar shall be insulated in main and feeder sections.
   3. Ground bus shall be copper, not less than 1/4-square-inch in cross section. Secure to the vertical section.
   4. Neutral bus shall be copper and not less than 50% of the rating of the main bus. Bus shall be insulated from the structure. Provide removable link between neutral and ground bus.

F. Wiring: Factory install all wiring within the switchboard and neatly cable and secure to supporting surfaces. Provide terminal lugs for all external wiring. Small wire shall be Type SIS.
G. Provision for Future: Arrange horizontal main buses for convenient future extension as shown on the Drawings. Provide vertical buses to the spaces shown on the Drawings for future devices, arranged to accept future mounting bolts and bus connecting straps.

H. Ambient Temperature: Base device ratings on operation in an ambient temperature not exceeding 40°C.

I. Connections: Cable connectors and device lugs shall be compression type and suitable for use with copper or aluminum cables.

J. Hardware: All hardware used on conductors shall have high tensile strength and suitable protective finish.

K. Handling Means: Provide the switchboard with adequate lifting means and make switchboard capable of being rolled or moved into position and bolted directly to the floor without the use of floor sills.

L. Finish: Chemically clean and treat all steel surfaces, providing a bond between paint and metal surfaces to help prevent the entrance of moisture and the formation of rust under the paint film. Finish the switchboard exterior with ANSI 61 light gray paint, not less than 2 mils thick.

M. Provide individually mounted main and group mounted feeder circuit breakers.

N. Main Circuit Breaker
   1. Insulated or molded case type, 3-pole, manually operated, 600 Vac, 100% rated, 50,000 RMS symmetrical amperes interrupting capacity at 480 volts. Frame and trip ratings shall be as shown on the Drawings. It shall have an integral current sensor in each pole and an integral solid state self-powering programmable trip unit with 3 fault indicators. Breaker shall have stored energy operator, 120 Vdc motor-operated charging mechanism, and shunt trip. The trip unit shall provide the following tripping characteristics, all adjustable:
      a. Sensor Rating:
      b. Sensor Setting Range:
      c. Long Time Delay:
      d. Short Time Delay:
   2. Manufacturer: Square D PE with Micrologic Trip; Cutler-Hammer; or equal.

O. Feeder Circuit Breakers:
   1. Insulated or molded case type, 3-pole, manually operated, 600 Vac, 100% rated, 35,000 RMS symmetrical amperes interrupting capacity at 480 volts. Each breaker shall have an integral current sensor in each pole and an integral solid state self-powering programmable trip unit with 3 fault indicators. The trip unit shall provide the following tripping characteristics, all adjustable:
      a. Sensor Rating.
      b. Sensor Setting Range.
      c. Long Time Delay.
      d. Short Time Delay.
e. Instantaneous.
f. Ground Fault Setting.
g. Ground Fault Delay.

2. Manufacturer: Square D Series with Micrologic Trip; Cutler-Hammer Series C; or equal.

P. Current Transformers: Provide three current transformers in accordance with ANSI C57.11, 600 volt, 10 kV BIL, with ANSI metering accuracy class of 0.3 at burden B-0.1 and continuous thermal rating factor of 2.0.

Q. Power Monitor: Provide a microprocessor-based power monitor to measure electrical parameters such current, voltage, kW, power factor, frequency, KWH, and keypad. The power monitor shall include an Ethernet port capable of communication using TCP/IP protocol. Data shall be made available to be displayed on the SCADA system specified in Section 17330. Provide Cutler Hammer IQ DP-4000; Square D; or equal.

R. Utility Metering Sections: Provide pull section for underground service entrance with sealable cover, barrier, and cable terminating facilities, bus or cables from pull section landing lugs to service section, provisions for mounting utility current transformers, all as shown on the Drawings and as required by Sierra Pacific Power Company. Provide a remote meter socket for installation on outside wall.

S. Surge Suppression:
1. The transient voltage sure suppression system (TVSS) shall be designed to protect all AC electrical circuits and connected equipment from destructive, damaging or disruptive effects of lightning induced transients normal utility load switching activities and internal generated transients.
2. The suppression device shall be parallel configured, solid state, voltage clamping components demonstrating threshold suppression characteristics. Clamping components shall be metal oxide varistors. All suppression devices shall be encapsulated and mounted in a NEMA 4 enclosure.
3. The TVSS shall have all normal mode (L-L and L-N) and common mode (L-G and N-G) circuit paths protected with suppression components. Each mode shall be rated for minimum 130/65kA.
4. The TVSS shall be rated for 480/277 V systems.
5. The TVSS shall include a remote alarm form C contact.
6. The TVSS for the facility service entrance shall be installed in accordance with the manufacturer's recommendations.
7. The TVSS manufacturer shall provide a ten-year warranty.
8. The TVSS shall be manufactured by Liebert; Accuvor ACV; or equal.

T. Switchboards shall be listed and labeled as service entrance equipment if the switchboard is used as service entrance.

U. Ground Connections: Provide binding post type lugs for attachment of ground cables to sheet steel enclosures. Lugs shall be of the binding post type, shall accommodate a range of stranded copper cable from #2 AWG to #2/0 AWG, shall have a 1/2 to 13 NC stud size and shall be attached to enclosures using a threaded or tapped boss welded to the sheet steel. These lugs shall be Burndy Type KC.
Anderson Type KS, or equal. Provide bolted pressure connectors for all other ground connections. Provide one lug for each outgoing circuit.

V. Nameplates: Nameplates shall be provided for each control component. The nameplate shall be phenolic, black background with white lettering. All nameplates shall be fastened by stainless steel screws.

W. Switchboard shall be Cutler-Hammer Powerline Series, Square D I-Line Series, or equal.

PART 3 - EXECUTION

3.01 CONDUIT AND WIRE INSTALLATION
A. Install conduit and wire in conformance with Section 16110 and 16120.

3.02 SWITCHBOARD INSTALLATION
A. Mount the switchboard and anchor to a 3-inch concrete pad. Install level and plumb. Doors shall open and close freely and all manually operated device handles and controls shall operate properly. Repair any damage to the enclosure, components or finish to the satisfaction of the Engineer. Clean switchgear inside and out and all nameplates.

B. Lace conductors to resist short circuit forces. Follow manufacturer's recommendations.

3.03 GROUNDING INSTALLATION
A. Ground in accordance with Section 16450.

3.04 FIELD TESTING
A. Test switchboard and circuit breakers in accordance with NETA Publication ATS Sections 8.1, 8.6, 8.10, and 8.11.

3.05 TRAINING
A. Service technician shall instruct operating personnel in the operation, maintenance and adjustment of the system and installation.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Work Included: Furnish all labor, material, equipment, tools and services necessary for the installation, connection and testing of all grounding as specified herein and as shown on the Drawings.

1.02 REFERENCE STANDARD

A. American Society for Testing and Materials (ASTM) Publication:
   1. B228-02 Standard Specification for Concentric-Lay-Stranded Copper Clad Steel Conductors

B. National Fire Protection Association (NFPA):
   1. 70 National Electric Code (NEC)

C. International Electrical Testing Association (NETA) Publication:
   1. ATS Acceptance Testing Specifications for Electrical Equipment for Power Systems

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Information category of Section 01300 and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

2.01 GENERAL

A. The grounding systems shall consist of the ground rods, grounding conductors, ground bus, ground fittings and clamps, and bonding conductors to water piping and structural steel as shown on the Drawings. One system shown provides service and separately derived system grounds. A second system is an electronic ground system to provide for the discharge of static electricity.

2.02 SYSTEM COMPONENTS

A. Ground Rods: Ground rods shall be cone pointed copper clad Grade 40 HS steel rods conforming to ASTM B228-02. The welded copper encased steel rod shall have a conductivity of not less than 27% of pure copper. Rods shall be not less than 3/4-inch in diameter and 10 feet long, unless otherwise indicated. Rods longer
than 10 feet shall be made up of 10-foot units joined together with threaded couplings. The manufacturer's trademark shall be stamped near the top.

B. Ground Conductors: Buried conductors shall be medium-hard drawn bare copper; other conductors shall be soft drawn copper. Sizes over No. 6 AWG shall be stranded. Coat all ground connections except the exothermic welds with electrical joint compound, non-petroleum type, UL listed for copper and aluminum applications.

C. Ground Connections: Connection to ground rods and buried connections shall be by exothermic weld. Lugs for attachment of cables to steel enclosures shall be of the binding post type with a 1/2-13NC stud. Each post shall accommodate cables from #4 AWG to #2/0 AWG.

D. Ground Rod Boxes: Boxes shall be a 9-inch-diameter precast concrete unit with hot-dip galvanized traffic covers. Units shall be 12-inches deep. Covers shall be embossed with the wording "Ground Rod."

E. Ground Bus: Ground bus shall be a high conductivity copper alloy strap measuring 3/16-inch by 3/4-inch and of lengths as shown on the Drawings. Bus shall be predrilled and tapped to accept 8-32 brass machine screws on 12-inch centers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ground all equipment for which a ground connection is required per NEC whether or not the ground connection is specifically shown on the Drawings.

B. Provide a ground rod box for each ground rod so as to permit ready access for the connection and/or removal of any pressure connectors to facilitate testing.

C. Where ground rods must be driven to depths over 8 feet, increase rod diameter used, sufficiently to prevent the rod from bending or being damaged.

D. Bond metallic water piping at its entrance into each building. Ground separately derived electrical system neutrals to the metallic water piping in addition to the system driven ground, per NEC requirements.

E. Provide a ground wire in every conduit carrying a circuit of over 150 volts to ground.

F. Provide UFER grounding electrode as shown on Drawings.

G. Effectively bond structural steel for buildings to the grounding system using exothermic welds.
3.02 TESTING

A. Conduct ground resistance tests using a ground megohmmeter with a scale reading of 25 ohms maximum.

B. Test methods shall conform to NETA Standard ATS using the three electrode method. Conduct tests only after a period of not less than 48 hours of dry weather.

C. Furnish to the Engineer a test report with recorded data of each ground rod location.

END OF SECTION
SECTION 16460

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI) Publications:
   1. 70 National Electrical Code

B. National Electrical Manufacturers Association (NEMA) Publications:
   1. ST 20 Dry-Type Transformers for General Applications
   2. TP-1 Guide for Determining Energy Efficiency for Distribution Transformers

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of Section 01300 and the submittal requirements of Section 16010.

B. Shop Drawings: Submit manufacturer's name and data as required:
   1. Nameplate data:
      a. KVA rating.
      b. Nominal primary voltage.
      c. Tap voltages.
      d. Nominal secondary voltage.
      e. Percent impedance.
      f. Weight.
      g. Physical dimensions and mounting requirements.
   2. Single submittal: A single complete submittal is required for all products covered by this Section.

1.04 FACTORY TESTING

A. Tests on transformers shall include the manufacturer's standard tests, including winding resistance, ratio, polarity, phase relation, no-load loss, impedance, full load losses, and dielectric tests. Certified copies shall show compliance with all referenced standards.

1.05 LOCATIONS

A. Refer to Section 16010 for definitions of types of locations.
PART 2 - PRODUCTS

2.01 DRY TYPE TRANSFORMERS

A. General Purpose: Transformers for supplying lighting and small power loads shall be dry type, general purpose, two winding, 60 Hertz, copper windings, temperature rise not exceeding 80°C under full load in an ambient of 40°C with Class H, 220°C insulation. Capacity ratings and voltages shall be as shown on the Drawings. Transformers shall comply with all applicable provisions of NEMA Standard ST20 and shall have NEMA Standard taps. Transformers shall be indoor type with sound levels 5 dB below NEMA Standard or outdoor type with NEMA Standard sound levels. Terminal compartment shall have a temperature rise not to exceed 35°C. Outdoor units shall be equipped with weather shields. Transformers rated 30 kVA and larger, 3-phase, shall be energy efficient type.

PART 3 - EXECUTION

3.01 TRANSFORMER INSTALLATION

A. Transformers shall be installed as indicated on the Drawings.

B. Transformers shall be connected with flexible, liquid-tight metallic conduit to prevent the transmission of sound through the conduit system. Potted non-ventilated types below 30 KVA shall be installed on resilient vibration-isolating mountings.

C. Transformer grounding shall be sized in accordance with NEC requirements for separately derived systems and shall be connected to the nearest cold water pipe or, if available, structural steel member. Ground rod and connections shall be as detailed in Section 16450. Provide conduit and wire for both the ground rod and cold water pipe or structural steel member connections.

D. Lace secondary conductors to resist short circuit forces. Follow manufacturer's recommendations.

3.02 FIELD TESTS

A. Test per NETA Paragraph 8.2.3. Submit results for review.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Work Included: Provide a lighting system complete, including fixtures, lamps, standards, bases, hangers, reflectors, glassware, lenses, auxiliary equipment, ballasts, sockets, and photoelectric cells.

C. Related Work Described Elsewhere:
   1. Section 03300: Cast-In-Place Concrete

1.02 REFERENCE STANDARDS

A. Federal Regulations: Title 21, Performance Standards for Light Emitting Products CFR 1040

B. Underwriters Laboratories (UL) Standards:
   1. 844 Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

1.03 SUBMITTALS.

A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.

B. Submit photometric curves for each fixture configuration proposed. Substitutions will not be considered unless the photometric distribution curve indicates the proposed fixture is equal to or exceeds the specified luminaire.

C. Submit shop drawings showing proposed methods for mounting interior lighting fixtures that are not attached directly to the ceiling or wall.

D. Regarding the seismic anchorage requirements of GC1-71:
   1. Certification of compliance or written notice of noncompliance, and
   2. A sketch or description of the anchorage system.

1.04 GUARANTEE

Lamps that fail within 90 days after acceptance by the Owner shall be replaced at no cost to the Owner.
PART 2 - PRODUCTS

2.01 FIXTURES

A. Fixtures shall be of the types, wattages and voltages shown on the Drawings, shall be UL classified and labeled for intended use. Fixtures for use in hazardous locations shall be UL listed per UL Standard 844.

B. Luminaire wire, and the current carrying capacity thereof, shall be in accordance with the NEC.

C. Luminaires and lighting equipment shall be delivered to the project site complete, with suspension accessories, aircraft cable, stems, canopies, hickeys, castings, sockets, holders, ballasts, diffusers, louveres, frames, recessing boxes and related items, including supports and braces.

2.02 BALLASTS

A. Solid State Electronic Ballasts: where specifically indicated on the Drawings, provide high frequency electronic Class P ballasts. Input watts shall not exceed 72 with "E" rated 3,700 lumen lamps operated at 25,000 Hertz. Sound rating shall be "A". Crest Factor shall be 1.6. Ballast Factor shall be 0.78. Unit shall be FCC Certified and UL listed. Minimum lamp starting temperature shall be 50°F. An internal MOV shall provide transient protection and a 3-year extended warranty shall be provided.

B. High pressure sodium lamp ballasts shall be the auto-regulator type providing 3% voltage variation to the lamp with 10% line voltage variation. Ballast power factor shall be at least 90%. Ballasts shall bear the UL label.

C. Ballasts in luminaires for exterior use shall provide reliable starting of lamps at 0°F at 90% of the nominal line voltage. All locations, other than totally enclosed rooms, shall be considered exterior.

D. Ballasts producing excessive noise (above 36 dB) or vibration will be rejected and shall be replaced at no expense to the Owner.

2.03 LAMPS

A. General: Lamps shall be new at the time of acceptance and shall be General Electric, Westinghouse, or equal.

B. Type "E" Fluorescent Lamps: where 25,000 Hertz electronic ballasts are specified, 32 watt Type T-8 lamps shall be used having a rated life of 15,000 hours, an initial lumen output of 3,000 and a color temperature of 3,000 Kelvin.

C. High pressure sodium lamps shall have an outer bulb with a diffuse finish and shall be suitable for burning in any position.
2.04 LAMP POSTS AND STANDARDS

A. Lamp posts and standards shall be of the type, configuration, and dimensions shown on the Drawings, and shall be suitable for the indicated lamp mounting height.

B. Furnish complete with anchor bolts, bolt circle template, hand holes, and cover plate.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
1. All fixtures and luminaires shall be clean and lamps shall be operable at the time of acceptance.
2. Install luminaires in accordance with manufacturer's instructions, complete with lamps, ready for operation as indicated.
3. Align, mount, and level the luminaires uniformly.
4. Avoid interference with and provide clearance for equipment. Where an indicated position conflicts with equipment locations, change the location of the luminaire by the minimum distance necessary.
5. Where the Drawings indicate that 4 lamp light fixtures are to be "two level" switched, wire the two inner lamps to one ballast and the two outer lamps to the other ballast.

B. Mounting and Supports:
1. Mounting heights shall be as shown on the Drawings. Unless otherwise shown, mounting height shall be measured to the centerline of the outlet box for a wall-mounted fixture and to the bottom of the fixture for all other types.
2. For suspended luminaires, the mounting heights shall provide clearances between the bottoms of the luminaires and the finished floors as indicated.
3. Luminaire supports shall be anchored to the structural slab or structural members as indicated. Supports shall maintain the luminaire positions after relamping and cleaning.
4. Surface mounted fixtures shall be rigidly bracketed from mounting surfaces. Luminaires installed in rows shall have a non-cumulative dimensional alignment tolerance of 1/16-inch. Nipples carrying wiring between luminaires shall be watertight.
5. Pendant luminaires shall be provided with 7/32-inch aircraft cable to assure a plumb installation and shall have a minimum 25-degree clear swing from horizontal in all directions.

C. Mount fluorescent fixtures level and securely support from the ceiling. Provide earthquake clips for fixtures mounted in suspended ceilings.

D. Pendant Fixture Mounting:
1. In office areas with level ceilings, provide stems and canopies to match fixtures.
2. In office areas with sloping ceilings, provide flexible fixture mounting canopies and stems to match fixtures.
3. In other areas, provide flexible fixture hangers, Crouse-Hinds Type ARB; Appleton Type GS; or equal.

E. Mount lampposts and lighting standards plumb and make free of dents or other damage.

F. Concrete Bases:
1. Templates and anchor bolts shall be obtained before starting any work.
2. Concrete bases shall be constructed in accordance with Section 03300.

END OF SECTION
SECTION 16612
UNINTERRUPTIBLE POWER SUPPLY (UPS)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 are part of this Section as if repeated herein.

B. Related Work Specified in Other Sections:
   1. Division 17: Instrumentation and Control Systems

1.02 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of Section 01300 and the submittal requirements of Section 16010.

B. Shop Drawings: Submit shop drawings complete with a system single line diagram, equipment outline drawings, elementary diagrams, wiring diagrams, battery performance data and nameplate schedules.

C. Submit catalog cuts as required.

D. Spare Parts List: Submit a spare parts list showing recommended parts and quantities as well as complete ordering information for replacement components.

E. Manuals: Provide manuals as specified in Section 16010.

1.03 QUALITY ASSURANCE

A. Comply with the following reference standards:
   1. Underwriter's Laboratories (UL): 1012 Power Supplies

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide a UPS system consisting of input isolating transformer, rectifier, battery charger, static inverter, solid state static transfer switch, manual transfer switch, battery system, and a system monitoring and control panel; all of which shall be housed in a floor standing NEMA 1 enclosure. The UPS shall be a solid-state unit meeting the requirements of UL 1012. Units shall be Best; APCC; or equal.
2.02 DESCRIPTION OF OPERATION

A. The UPS shall be designed to operate as follows:
   1. Normal: The load is continuously supplied by the inverter. The rectifier/battery charger derives power from the normal ac source and supplies dc power to the inverter while simultaneously float charging the battery.
   2. Emergency: Upon failure of the normal ac power, the critical load is supplied by the inverter, which without any switching obtains its power from the storage battery. There shall be no interruption to the critical load upon failure or restoration of the commercial ac source.
   3. Recharge: Upon restoration of the commercial ac source, the rectifier/charger powers the inverter and simultaneously recharges the battery. This shall be an automatic function and shall cause no interruption to the critical load.
   4. Bypass Mode: The static switch shall transfer the load to the normal source without an interruption.

2.03 RATING

A. Input Voltage: 120 volts, 1 phase, 60 Hz.
B. Inverter Output Voltage: 120 volts, 1 phase, 60 Hz ±0.5 Hz.
C. Output Capacity: 1.5 kVA, minimum for 15 minutes, or as shown on the Drawings.
D. Output voltage waveform will be sinusoidal, 5% THD, 3% maximum single harmonic.
E. Audible noise level shall not exceed 50 dB.
F. Protection: The UPS shall have built-in circuit breaker, fuse and thyristor protection against undervoltage, overcurrent, and overvoltage on input and output.
G. Ambient Temperature: Equipment ratings shall be based on operation in an ambient temperature not exceeding 40°C at a site altitude of 100 feet.

2.04 CONTROL PANEL

A. Provide a control panel equipped with the following controls and LED indicators:
   1. Three position control switch for inverter operation (On/Off/Automatic).
   2. Charger On/Off switch.
   3. Indicators for inverter standby, inverter on, line ac failure, battery charger on, high and low battery, high and low ac.

B. Provide an alarm panel which shall have LED indicators for the following alarms:
   1. High/Low float voltage.
   2. Battery discharge.
   4. Overload.
   5. Normal power fail.
   6. Inverter failure.
7. Inverter ac overvoltage.
8. Inverter ac undervoltage.

C. Provide SPDT 10 ampere contacts for composite repeat of the above alarms for remote connection.

D. Provide audible horn on the control panel which is activated upon any UPS alarm.

2.05 BATTERY PACK
A. The battery shall be sealed, maintenance-free lead-acid cells with an expected life of five years. The battery shall be sized to support the inverter at rated capacity for 15 minutes.

2.06 ENCLOSURES
A. The UPS shall be housed in free-standing, dead-front enclosures with a welded steel framework. Doors shall be of 14-gauge steel; framework shall be of 12-gauge steel.

B. Forced-air cooling shall be provided to ensure that all components are operated within their environmental ratings. Blower motors shall be equipped with sealed bearings. All air inlet and exhaust openings shall be protected by perforated or slotted metal guards.

PART 3 - EXECUTION

3.01 FACTORY TEST
A. Subject the UPS to a complete operational test and submit certified test report to the Engineer before equipment is shipped.

3.02 INSTALLATION
A. Installation shall be in conformance with Section 16010.

B. Provide the services of a factory trained service technician to inspect and check out the equipment before energizing.

3.03 FIELD TESTING
A. Provide the services of a factory trained technician to make final adjustments and carry out a full operational test in the presence of and to the satisfaction of the Engineer.
3.04 TRAINING

A. Provide one man-day of time of a factory trained technician to instruct operating personnel in the operation, maintenance and adjustment of the system and installation.

END OF SECTION
SECTION 16640

CATHODIC PROTECTION – WASTEWATER PUMP STATION

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Work Included: Obtain all permits and provide all materials and equipment apparatus, construction, installation, and testing necessary to provide a complete and properly functioning impressed current cathodic protection monitoring and control system for the Cold Springs WRF Diamond Peak Pump Station as specified herein and shown on the Drawings.

1.02 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements.

B. Submit the following:
   1. A complete list of equipment and materials. Include name and manufacturer, catalog number, size, finish, and any other pertinent data necessary to determine conformance with Specifications.
   2. Certification by the cable manufacturer covering conformance of cable insulation to designated Specification.
   3. A certified test report for all anode backfill material including chemical analysis, resistivity, and gradation.
   4. A certified test report showing the chemical analysis of all anodes.
   5. Wiring diagrams for the rectifier, showing all details and components.
   6. A certified test report of the completed installation including pipe to soil potentials, all wire-to-anode connections including connection resistive values and rectifier setting.
   7. Record drawings of the completed installation showing locations facilities and identification of all items of equipment and material.

1.03 QUALITY ASSURANCE

A. General: All work shall be provided by an experienced cathodic protection system installer who shall have a NACE certified Cathodic Protection Specialist supervising the work. The system shall be in accordance with National Association of Corrosion Engineers International (NACE) Standard RP-01-69, 1996 revision, and shall be of sufficient capacity to maintain a structure-to-soil potential of at least –0.85 volts or more electro-negative or equivalent voltage shift potential when measured against a standard copper/copper sulfate reference electrode. The anodes shall be designed for a useful life of at least 40 years.

B. Electrical Service: Electrical service for the cathodic protection system shall be provided by the electrical subcontractor at the electrical panel LA as shown on the Drawings. The cathodic protection installer shall be responsible for furnishing and
installing the necessary wiring, conduits, cables, splice boxes and equipment to the service connection as required by the plans.

C. Special Requirements:
1. Cathodic protection shall be installed on the steel pump vault, accessible and discharge pipeline as shown on the Plans.
2. Soils are gray clayey sand to a depth of approximately 10 feet, and silty sand to a depth of 35 feet. Soil characteristics are:

<table>
<thead>
<tr>
<th>Depth Feet</th>
<th>Resistivity ohm-cm</th>
<th>pH</th>
<th>Soluble Sulfate ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5 – 6</td>
<td>4,300</td>
<td>8.44</td>
<td>&lt;15</td>
</tr>
<tr>
<td>15 – 15.5</td>
<td>4,400</td>
<td>7.88</td>
<td>&lt;15</td>
</tr>
</tbody>
</table>

3. All materials and installation procedures shall be in accordance with applicable NACE International Standards.
4. Standard Specifications:
   a. ANSI C 34.2: Practice and Requirements for Semiconductor Power Rectifiers
   b. ANSI/NEMA 250: Enclosures for Electrical Equipment
   c. ANSI/NFPA 70: National Electric Code
   d. ANSI C 119.1: Sealed Insulated Underground Connector System Rated 600 Volts
   e. ANSI-A-518-89: High Silicon Cast Iron Anodes or equal.
   f. ANSI-D-1248-84: Polyethylene Plastics, Molding and Extrusion Materials
   g. ANSI-C80.1-1977: Specifications for Rigid Steel Conduit, Zinc-Coated
   h. NEMA-1-10-1979: Type 3R and 4X Enclosures
   i. NEMA-TC-2-1983: Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
   j. NACE-RP-01-69 (Rev. 1996): Recommended Practice, Control of External Corrosion of Underground and Submerged Metallic Piping Systems
   k. UL-6-1981: Rigid Metallic Conduit
   l. UL-83-1983: Thermoplastic Insulated Wire
   m. UL-486A-1990: Wire Connectors and Soldering Lugs for use with Copper Conductors
   n. UL-489-1986: Molded Case Circuit Breakers and Circuit Breaker Enclosures
   o. UL-510-1986: Insulating Tape
   p. UL-514A-1983: Outlet Boxes and Fittings

PART 2 – PRODUCTS

2.01 GENERAL

A. All materials shall conform to the requirements set forth herein or as designated on the Drawings, unless otherwise specified. All materials must be new, free from defects, and shall be of the best commercial quality for the purpose specified. All necessary items and accessories not shown on the Drawings or specified herein, but that are required to fully carry out the specified intent of the work, shall be furnished by the Contractor without additional cost to the County.
A. Rectifier shall be the product of a manufacturer currently engaged in the manufacture of cathodic protection equipment and shall conform in all respects to NEMA Standards. The rectifier shall be silicon full-wave bridge, 120/240 VAC, 60-cycle, single-phase, air-cooled for pulse cathodic protection cycles, designed for continuous operation at less than 55°C ambient temperature at elevation not exceeding 10,000 feet and shall include the following features:

1. Rating: 5 amperes and 20 volts.
2. Transformers taps that will permit manual adjustment of output voltage between zero and maximum voltage by a minimum of 20 equal step adjustments.
3. Thermal magnetic circuit breaker, plastic encased, for overload protection of primary and secondary.
4. Thermal cutout device with automatic reset feature for over-ambient temperature protection.
5. Transient protection for AC and DC circuits.
7. Filters to minimize the AC component in the DC output and to reduce interference with radio, telephone, and communication circuits.
8. Separate meters for current and voltage output with 2-7/8-inch scales and 2 percent accuracy.
9. Silver-plated connectors and adjustment bars.
10. Pressure type connectors for DC output cables marked "Structure" and "Anode."
11. Mounting equipment for the rectifier.
12. Protection:
   a. Overload Protection: Shall be provided on the output with a slow blow fuse.
   b. Voltage Surge Protection: Shall be provided with lightning arrestors on the incoming line.
13. Transformer
   a. Transformer shall be isolation type with a grounded electrostatic shield between the primary and secondary windings.
   b. Dielectric strength of all insulating materials shall not be less than 2-kV RMS for one minute when applied between the windings and the transformer coil.
   c. Transformer temperature rise shall not exceed 85°C. Wire insulation, layer insulation and impregnating varnish shall have a temperature rating of not less than 150°C.
   d. Transformer efficiency shall not be less than 95%.
   e. Transformer voltage regulation shall not exceed 3% from full-rated load to 25% of rated load.
   f. The rectifier shall be capable of providing full-rated output at 95% of nominal input voltage and shall not be damaged by line voltages of 110% of nominal input voltage.
14. Rectifier:
   a. Rectifier stack shall be assembled using silicon diodes rated at a minimum of 800 peak inverse volts. Heat sinks shall be sized to prevent diode
junction and case temperatures exceeding 100°C at 45°C ambient temperatures.

b. Rectifier assembly shall be subjected to a dielectric test of 2 kV for one minute applied between each of the electrical terminals and the mounting studs.

15. Instruments:

a. Ammeter and Voltmeter: Provide ammeter and voltmeter for monitoring rectifier output. Meter movement shall be pivot and jewel D'Arsonval type. Taut band meters will not be accepted. Minimum scale length shall be 2-7/8 inches. Meter accuracy shall be ±2% or better. Combination meters are not acceptable.

b. Ammeter Shunt: Ammeter shunt shall be block type mounted on the front panel for easy access. Current and millivolt ratings shall be stamped into the shunt. Shunt accuracy shall be ±1% or better.

16. Acceptable Manufacturers: Universal; CalTech; Good All; or equal.

2.03 IMPRESSED CURRENT ANODES

A. Impressed current anodes shall be 2-21/32-inch outside diameter, 42 inches long, high silicon chromium cast iron, tubular anodes. Each anode shall have a minimum weight of 31 pounds, a minimum surface area of 2.4 square feet and shall be furnished with a cable attached to the end of the cylinder. Composition of the anodes shall conform to the following requirements:

<table>
<thead>
<tr>
<th>Element</th>
<th>Minimum %</th>
<th>Maximum %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon</td>
<td>14.2</td>
<td>14.75</td>
</tr>
<tr>
<td>Carbon</td>
<td>0.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.75</td>
<td>1.5</td>
</tr>
<tr>
<td>Chromium</td>
<td>4.5</td>
<td>6.0</td>
</tr>
<tr>
<td>Iron</td>
<td>Balance</td>
<td>Balance</td>
</tr>
</tbody>
</table>

B. Provide durable sealed connections to each anode. Connections shall be made internally at the end of each anode. Connections shall be made in the factory.

C. Provide double insulated lead wires suitably terminated and encapsulated to the anode. Lead wire insulation shall be modified radiation cross-linked Kynar, polyvinylidene fluoride, with a modified polyolefin outer jacket or equal. Anode lead wires shall be continuous without splices from individual anodes to the junction box.

D. The anode, lead wires and perforated vent pipe shall be enclosed in fluid coke breeze backfill.

E. Minimum life of each anode assembly shall be 40 years at 3 amps.

F. Acceptable Manufacturers: The Duriron Company, Inc.; AnoTec Industries Ltd.; or equal.

G. The cables attached to the anode shall be No. 8, stranded conductors, copper, Type CP, of sufficient length to connect to the anode junction box above ground, and dual-double insulated for 600 volts with high molecular weight polyethylene in
accordance with the requirements of ASTM D1248, Type 1, Class C, Grade 5, and IPCEA NEMA S-61-402. Connection of the cable to the anode shall be accomplished as shown on the Drawings, and pulling strength of the connection shall exceed the tensile strength of the cable. Any damage to the cable insulation or anode will require complete replacement of the cable and anode.

H. Anode Lead Wire Identification: Anode lead wires shall be identified consecutively using identification tags. The identification tags shall be attached to the ends of the anode lead wires inside the anode shunt box. The anodes shall be numbered starting from the bottom to the top of the anode hole.

2.04 ANODE BACKFILL

A. Backfill material for impressed current anodes shall be coke breeze 1/8 – 3/8 inch size with a minimum fixed carbon content of 98 percent by weight and a resistivity of 3 ohm-cm or less when tested with an applied pressure of two pounds per square inch and an average real density of 2.05 to 2.10 g/cc. The material shall conform to the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8-inch</td>
<td>Minimum</td>
</tr>
<tr>
<td>1/8-inch</td>
<td>Maximum</td>
</tr>
</tbody>
</table>

2.05 CABLES

A. Cables for steel structure connection shall be stranded, single conductor, copper insulated for 600 volts use. Sizes shall be as shown on the Drawings. Cables for anode junction box and test stations shall be stranded, single conductor, copper Type UF, sized as shown on the Drawings. Cable for AC power shall be Type TW or THWM and sized as shown on the Drawings.

2.06 SERVICE SWITCH

A. Service switch shall be externally operable, circuit breaker type, heavy duty with NEMA 3R Type 316L stainless steel enclosure and shall be rated 30 amperes, 2 poles.

2.07 EQUIPMENT IDENTIFICATION TAGS

A. The Cathodic protection installer shall furnish and install identification tags on equipment where specified herein. Identification tags shall be laminated white phenolic engraving stock with black core. Lettering shall not be less than 3/16-inch square. The identification tags shall be attached with Type 316 stainless steel pan head screws. Identification tags shall be furnished for rectifier units with identifiers.

2.08 ANODE JUNCTION BOX

A. Anode junction box shall be furnished as indicated on the Drawings and as specified herein.
B. General equipment and construction details for anode junction boxes shall be as tabulated below:

1. Enclosure: NEMA 3R raintight ventilated enclosure constructed of the same material as the rectifier and a minimum of 0.125-inch thick, with louvers on both sides and front, insect screens on all ventilation openings, door shall be attached to junction box, with two 3-point latch.

2. Enclosure Mounting Provisions: Junction box enclosure shall be factory equipped with provisions for rack mounting. The mounting provisions shall be of similar material and finish as the junction box enclosure.

3. Enclosure Finish: The enclosure finish shall be the same as the rectifier finish specified herein.

4. Equipment Mounting Plate: All equipment shall be mounted on a Grade N-1, thermosetting laminate, minimum 1/4-inch thick, conforming with NEMA Standard LI-1.


6. Conduit Hubs: Aluminum-Watertight Conduit Hub, Insulated, EfiCor Series 40-000BAL, size as required by the Drawings.

7. Resistors: Wire wound sliding tap resistors, Ohmite, or equal. Each end connection and the sliding tap of each resistor shall be provided with a flexible, 14 AWG, fine stranded copper wire with insulation rated for 105°C, and with specified terminal lugs. Corrosion-resistant hardware, suitable for a marine environment shall be used for mounting the resistors. Size and quantity of resistors shall be indicated on the Drawings.

8. Terminal Posts: 1/4 - 20 bolts, length as required, each with three hex nuts, two flat washers, and one lock washer all for silicon bronze, "Durium" material as manufactured by Burndy Corp. or equal.

9. Terminal Lugs: Terminal lugs for the various applications shall be as indicated below. Plated terminals may be special order items that require additional delivery time.
   a. Anode or Pipe Lead Wire Terminal Lugs, Burndy Catalog Number KA4CNK, (nickel plated).
   c. Resistor Wire Terminal Lugs, Burndy Hylug, Type YAV Box Ring Tongue Terminals; or equal.

C. Anode junction boxes shall be as manufactured by J.A. Electronics; Stafford; Texas; or equal.

2.09 RECTIFIER CABINET ENCLOSURE

A. The rectifier cabinet enclosure shall be constructed of 12-gauge minimum, Type 316 stainless steel. Dimensions of the cabinet shall be not less than 36" high (H) x 24" wide (W) x 12" (D) deep as manufactured by the Hoffman; Stahlin; or equal. The cabinet shall have a positive latch such as a draw pull latch and shall have a hasp for a padlock. All rectifier electrical components shall be mounted on a steel chassis that may be removed from the cabinet without disturbing or dismantling the cabinet frame. A service disconnect shall be pre-mounted at the factory in the enclosure in such a position as to facilitate installation of the rectifier chassis and...
anode junction box. The rectifier cabinet enclosure will be equipped with a watt meter socket and a viewing window so that the utility company can monitor the power consumption from outside the cabinet without opening the enclosure. Rectifier doors shall be attached to rectifier with 3-point latch and be capable of opening to expose the front and right side of the rectifier.

2.10 SAFETY SWITCHES

A. NEMA heavy-duty fused safety switches in NEMA 3R enclosures shall be provided for protecting and disconnecting power supply leads to cathodic protection rectifier units. Safety switches for 120-volt service shall be 2-pole, 3-wire for 120/208-volt service. The enclosure material and finish shall match that of the corresponding rectifier unit. Each safety switch shall be provided with a means for locking by padlock. Safety switches shall be manufactured by Westinghouse, Square D Company, or equal. Each safety switch current rating and fuse rating shall be in accordance with the requirements of the National Electrical Code for the rectifier served.

2.11 TEST BOARD

A. Test boards for terminating pipeline test leads and reference cell leads inside test stations shall be 1/4-inch thick micarta. The test board with attached bolts, nuts, washers, jumper and shunt shall be shop fabricated. The shunt shall be 0.01 ohm, 8 ampere, Type RS as manufactured by Holloway Shunts, Edna, Texas, or equal. The shunts and jumpers shall be equipped with ring tongue terminals. The ring lugs shall be soldered to the shunts. The shunts and jumpers shall be factory mounted on the terminal boards.

2.12 EXOTHERMIC WELDS

A. All cable connections to steel tank or fittings shall be accomplished by the exothermic process using “Cadweld” by Erico Products, Inc.; “Thermoweld” by Continental Industries, Inc.; or equal. Each cable shall be fitted with a copper sleeve for accomplishing the weld and cartridge sleeves and molds for each weld shall be furnished by the same manufacturer.

2.13 ANODE LEAD WIRE

A. Conductors shall be stranded tinned copper. Size as shown on the Drawing.

B. Primary insulation shall be modified radiation cross-linked Kynar polyvinylidene fluoride.

C. Outer jacket shall be modified polyolefin.

D. Insulation system shall be resistant to chlorine, hydrochloric acid, sulfates, hydrogen sulfide, nascent chlorine, acids, alkalis, and petroleum-based chemicals.

E. Acceptable Suppliers: Matcor, Inc.; Harco, Inc.; or equal.
2.14 OTHER WIRES

A. Negative wires, test wires, sacrificial anode lead wires, and reference electrode wires for buried service shall be stranded tinned copper. Size and type as shown on the Drawings.

B. Insulation shall be Type HMWPE, unless otherwise noted.

C. No outer jacket is required, unless otherwise noted.

D. Insulation shall be resistant to chlorine, hydrochloric acid, sulfates, hydrogen sulfide, nascent chlorine, acids, alkalis, and petroleum-based chemicals.

E. Acceptable Suppliers: Matcor, Inc.; Harco, Inc.; or equal.

2.15 AC WIRE

A. The AC wire used to supply power to the rectifiers shall be three conductor, solid soft drawn copper, sized per the National Electric Code to match the rectifier power requirement. The conductor shall be covered with type THW or THHN insulation conforming to U.L. Standard 83.

2.16 CONDUIT

A. Above Grade Conduit and Fittings: All AC and DC wires installed above grade shall be installed in rigid galvanized steel conduit, flexible liquid-tight steel conduit, or as indicated on the Drawings.
   1. Rigid Stainless Steel Conduit and Fittings: Rigid stainless steel conduit shall conform to U.L. 6 for rigid metallic conduit. All stainless steel conduit fittings shall have threaded connections, and shall conform to U.L. 514. All conduit and fittings shall be U.L. approved. Stainless steel hardware and framing materials shall be used for conduit support. Rigid steel conduit shall continue below grade for minimum of 6 inches.
   2. Flexible Liquid-Tight Steel Conduit and Fittings: Flexible liquid-tight steel conduit and fittings shall conform to U.L. 360, and to Article 351 of the National Electric Code under "Liquidtight Flexible Metal Conduit", and shall be U.L. approved. Flexible conduit shall only be used for short runs between individual components of the above ground electrical equipment. A separate ground wire shall be installed when one is not built into the conduit core. All flexible conduits including fittings shall have a PVC jacket.

B. Below Grade Conduit and Fittings: All below grade D.C. conduit shall be PVC. All below grade A.C. conduit shall be galvanized steel with a PVC jacket, conforming to requirements of Paragraph 2.22A of this Section. Rigid polyvinyl chloride (PVC) conduit and fittings shall be Schedule 40, manufactured to NEMA TC-2 and WC-1094 Specifications, and shall be UL approved.

2.17 WIRE COLOR CODE

A. Wires shall be color coded to indicate function in accordance with the following:
1. Provide wire identification labels as shown in the following table.

<table>
<thead>
<tr>
<th>Wire Identification Label Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire Connection</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Structure</td>
</tr>
<tr>
<td>Anodes</td>
</tr>
<tr>
<td>Bonds</td>
</tr>
</tbody>
</table>

2.18 ELECTRICAL TAPE

A. Taping materials shall be as listed below, or equal:
   1. Varnished Cambric Tape: 3M Company Scotch 2520.
   2. Rubber Tape: 3M Company Scotch 130C.
   3. Vinyl Tape: 3M Company Scotch Super 33+

2.19 "C" TYPE CRIMP CONNECTORS

A. "C" type crimp connectors shall be Burndy Type YC-C Copper Crimpit compression connectors, as manufactured by the Burndy Corporation, U.S. Electrical Group, Manchester, New Hampshire, or equal.

2.20 PIPE COATING REPAIR MATERIALS AT CABLE CONNECTIONS

A. Materials used to repair the pipe coating at lead wire connections shall be Tapecoat TC Omniprime primer, Tapecoat Moldable Sealant, and Tapecoat H50 Gray cold applied tape or equal. Tapes shall be 2 inches wide. Tapecoat products shall be as manufactured by the Tapecoat Company, Evanston, Illinois, or equal.

2.21 SAFETY SWITCHES

A. NEMA heavy-duty fused safety switches in NEMA 12 enclosures shall be provided for protecting and disconnecting power supply leads to cathodic protection rectifier units. Safety switches for 120-volt service shall be 2-pole, 3-wire for 120/208-volt service. The enclosure material and finish shall match that of the corresponding rectifier unit. Each safety switch shall be provided with a means for locking by padlock. Safety switches shall be manufactured by Westinghouse; Square D Company; or equal. Each safety switch current rating and fuse rating shall be in accordance with the requirements of the National Electric Code for the rectifier served.

2.22 INSULATING FLANGED JOINTS

A. Each insulating flange set shall consist of a full-face gasket, a full-length sleeve for each flange bolt, two insulating washers and two stainless steel washers for each stainless steel bolt. The gasket shall be 1/8-inch-thick, neoprene faced phenolic, Advance Type E; Central Plastics; or equal.
PART 3 – EXECUTION

3.01 GENERAL


3.02 ANODE GROUND BED

A. Anode bed must be drilled and completed in compliance with all state, County, and local requirements. Installation shall also comply with NACE RP-05-72 where no conflicts exist with state, County and local regulations.

B. Anode Drilling:
1. Driller Qualifications: Anodes shall be installed by a qualified installation Contractor who has a minimum of two years experience in the installation of deep anodes. Drilling Contractor shall have a valid Nevada well drilling license.
2. Drilling Permits: The Contractor is required to obtain and submit all applications for drilling permits required by local (County) and state agencies.
3. Drilling Location: The anode bed shall be installed at the locations designated on the Drawings. The Contractor is responsible for verifying that there will be no interference with buried utilities or structures at the site.
4. Size and Depth: The anode bed shall be drilled as close to straight and plumb as possible.
5. Drilling: The anodes shall be drilled as close to straight and plumb as possible.
   a. Anode Lead Wires: The anode lead wires shall be directly buried from the top of the anode to the anode junction box as shown on the Drawings. No nicks, cuts, or damage of any kind to the anode lead wire insulation is allowed. If the insulation is damaged, the Contractor must submit a method of repair. Any anode lead wire repair method must be approved and inspected by the Cathodic Protection Specialist. Anode lead wire lengths shall be determined by the Contractor such that the splice-free requirement is met.
   b. Anode Lead Wire Identification: All anode lead wires shall be identified with a corresponding anode number by identification tags fixed to the free end of the lead wire. Care shall be taken to maintain anode lead wire identities. The anodes shall be numbered using the deepest anode as the number one anode. Identification tags shall be repositioned if excess lead wire length is trimmed.

3.03 RECTIFIER

A. Mounting: The rectifier shall be mounted and connected to the power supply and grounded as shown on the Drawings. The cable connected to the pipe shall be connected to the negative output terminal of the rectifier, and cables connected to the anodes shall be connected to the positive terminal of the rectifier.
B. Cabinet: The rectifier chassis shall be mounted in the rectifier cabinet. A service disconnect switch shall be mounted by the Contractor.

C. Installation: Cathodic protection rectifier unit shall be installed as indicated on the Drawings and as specified herein. Installation shall include connection of the rectifier negative DC output terminal to the structure and connection of the rectifier positive DC output terminal to the anode ground bed. In addition, the AC input power supply shall be furnished and installed from the power source to the rectifier. Initial energization of the rectifier and testing of the cathodic protection system shall be as specified herein.

1. A safety switch shall be installed as part of the rectifier assembly. The arrangement of the assembly shall be as indicated on the Drawings. The support framework for the safety switch shall be furnished, fabricated, and installed by the Contractor. All hardware and mounting rack steel shall be hot-dipped galvanized.

3.04 ANODE JUNCTION BOX

A. The cathodic protection installer shall install an anode junction box as indicated on the Drawings and as specified herein. All wires to be terminated in the anode junction box shall be cut off leaving approximately 18 inches of slack and neatly bundled at the junction box installation site. Each numbered anode wire shall be attached to the shunt compression terminal with the corresponding number.

1. The anode lead wires shall be routed from the anodes to the anode junction box. The anode lead wires shall be terminated in the anode junction box as shown on the Drawings and identified by the same number used to identify the anode.

2. The support framework for the anode junction boxes shall be furnished, fabricated and installed by the cathodic protection installer. All hardware and mounting rack steel shall be hot-dipped galvanized.

3.05 CABLES

A. Cables buried in the ground shall be laid straight without kinks and shall have a minimum cover of 18 inches. Each cable run shall be continuous in length and free of joints or splices. Care shall be used during installation to avoid punctures, cuts and similar damage to insulation. Any damage to insulation will require replacement of the entire cable length. Pull boxes and splice boxes shall be installed wherever shown and where otherwise required to facilitate installation of conductors and to comply with code requirements.

1. Wire and conduit routing shall be as shown on the Drawings. Where required for ease of pulling, and as necessary to meet code requirements, the cathodic protection installer shall install junction or pull boxes, even though not shown on the Drawings. Bends and offsets shall be avoided where possible but, where necessary, shall be made with a hickey or conduit bending machine. Turns shall consist of cast-iron fittings or symmetrical bends.

2. If conduits enter sheet steel boxes or cabinets, they shall have sealing locknuts on the exterior and standard locknuts on the interior of the device, and shall have insulation over the conduit end. Surface-mounted cast boxes shall have threaded hubs. Joints shall be made with standard couplings or specified
unions. Running threads shall not be used in lieu of conduit nipples, nor shall excessive thread be used on any conduit. Ends of all conduit shall be cut square, reamed and threaded with straight threads. Conduits shall be sloped slightly to drain to boxes. Flexible conduit (liquid tight) shall not be used as a general purpose raceway, but shall be used only in locations requiring flexibility, or where shown on the Drawings.

3. The cathodic protection installer shall exercise the necessary precautions to prevent the lodging of dirt, concrete or trash in the conduit, fittings and boxes during installation. Conduits are to be cleaned with a mandrel and compressed air, if necessary, and prelubricated using a non-metallic pull line before attempting to pull cable. Lubricant shall be of the type approved by the cable manufacturer for the conduit used.

4. Metallic conduit, cabinets, and equipment shall be grounded in accordance with the latest edition of the codes listed. Conduit shall be grounded directly or through equipment frames and ground busses to the grounding system. Grounding conductors shall not be smaller than that required by applicable codes and ordinances.

5. Flexible conduits shall be liquid tight, with a moisture and oil proof PVC jacket extruded over a galvanized steel flexible core.

B. Above Grade Wire and Conduit: All above ground cabling shall be installed in rigid galvanized steel conduit. One positive header cable of the size specified shall be installed from the compression terminal in the anode junction box to the positive terminal of the rectifier as shown on the Drawings.

C. Below Grade Wire and Conduit: All buried AC wire and conduit shall be installed at a minimum depth of 30 inches, or as shown on the Drawings. Trench backfill shall be clean sand as shown on the Drawings. Backfill shall be placed in loose layers not exceeding a thickness of 8 inches. Jetting will not be allowed.

1. All wiring attached to structures shall be of sufficient length to reach the appropriate rectifier or shunt box without splicing. Plastic warning tape shall be placed in the trench backfill a maximum of 6 inches above the conduit.

2. Underground AC conduit shall be PVC coated galvanized rigid steel schedule 40. Conduit bends installed for underground service entrance use shall be wide radius bends. Contractor shall bury AC electrical conduits 30 inches minimum.

D. Negative Cable Connections to Structure: Rectifier negative cathode/structure drain and test cables shall be attached to the pipe surface using an exothermic welding process as shown on the Drawings. The existing pipe coating shall be removed with a file to expose bare metal before attaching the cables. The connection shall be recoated using 3M epoxy melt sticks, 3M Scotchkote electrical sealing compound or equal.

E. Conductors: Conductors shall be copper of the AWG (American Wire Gauge) noted on the Drawings. Branch circuit AC wiring shall be type THW or THHN unless otherwise specified. AC Conductors No. 12 AWG or smaller in power circuits shall be solid.

1. Conductors No. 10 AWG or larger shall be stranded. Stranded conductors shall be terminated in pressure connectors, crimp lugs, or weld connections.
2. Equipment grounding conductors shall be green in color, Type THW or THHN unless otherwise indicated on the Drawings.

3. Power conductor insulation shall be rated 600-volts AC minimum, U.L. listed, OSHA (Occupational Safety and Health Administration) acceptable.

F. Grounding: Grounding shall comply with applicable code and ordinances as a minimum requirement, but shall not be less than shown on the Drawings.

1. The Contractor shall measure the ground rod resistance to ground. If the ground electrode does not have resistance to ground of 25 ohms or less, it shall be augmented by one additional electrode of the same type and specifications.

2. The resistance tests shall be performed in the presence of Cathodic Protection Specialist.

3. Where a grounding system includes more than one ground rod or ribbon, the ground rods shall be a minimum of 10 feet apart, and remain in the pipeline right of way, permitted area and/or permanent easement area, unless otherwise permitted by the Cathodic Protection Specialist.

4. Grounding electrode conductors and bonding conductors shall be buried 18 inches minimum.

5. Ground rods shall be 3/4-inch-diameter minimum, 10 feet long, and shall be copper weld type, copper clad steel. Driving heads shall be used to protect the end of the rod.

6. An exothermic welding process, or compression ground tap, shall be used to connect grounding electrode conductors to ground rods. Each grounding electrode conductor or bonding conductor that connects at a ground rod shall be No. 6 AWG minimum.

7. Connections between grounding conductors and equipment shall be made with solderless pressure type connectors of silicon bronze, as manufactured by Anderson; Royal; Burndy, or equal.

8. Lugs for attachment of ground cables to sheet steel enclosures shown on the Drawings shall be of the binding post type and shall be attached to enclosures using a threaded or tapped boss welded to the sheet steel.

3.06 CABLE TO STRUCTURE CONNECTIONS

A. Cable to structure connections shall be installed in the manner and at the locations shown on the Drawings. Coating materials shall be removed from the surface over an area just sufficient to make the connection. The metal pipe surface shall be cleaned to white metal by grinding or filing prior to welding the conductor. Use of resin-impregnated wheel for the purpose of grinding will not be permitted. The conductor shall be welded to the pipe by the exothermic process with a copper sleeve fitted over the conductor and only sufficient insulation shall be removed from the conductor to allow placing in welding mold. After the weld has cooled, all slag shall be removed and the weld shall be tested with a sharp hammer blow to assure proper metallurgical bond. All defective welds shall be removed and replaced. All exposed metal surfaces shall be covered with a minimum thickness of 1/2-inch of insulating material.
3.07 ELECTRICAL SERVICE

A. The Contractor shall furnish and install electric power at 120/240-volt, single-phase, 60 Hz to the safety switches and to the cathodic protection rectifier unit switch and breakers as shown on the Drawings, as specified herein and in accordance with PG&E requirements and standards.

3.08 INSULATING FLANGED JOINTS

A. All insulating components of the insulating flanged gasket set shall be cleaned of all dirt, grease, oil, and other foreign materials immediately prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation. After flange bolts have been tightened, each insulating washer shall be inspected for cracks or other damage. All damaged insulating washers shall be replaced. After assembly, resistance between each bolt and flange shall be measured with an approved insulation checker, minimum resistance shall be 50,000 ohms.

3.09 GROUNDING

A. Ground connections shall be made by using bolted compression connectors for all wire to wire or wire to rod connections.

B. Grounding conductors that are run on the surface of the pole shall be protected by wood molding or plastic molding of equal mechanical strength extending from the ground line throughout communication spaces.

PART 4 – ENERGIZING AND TESTING

4.01 GENERAL

A. After installation of all of the cathodic protection system, the system shall be tested and energized by the Contractor’s Cathodic Protection Specialist in the presence of the County’s Engineer or Construction Manager.

1. The County shall be notified a minimum of five (5) days before the commencement of the tests. Upon completion of the tests, a detailed report shall be submitted by the Cathodic Protection Specialist describing any deficiencies detected and recommending corrective action. Any and all deficiencies relating to these plans and specifications shall be corrected by the Contractor and retested prior to final acceptance. Any deficiencies requiring facilities and equipment not as shown or specified shall be defined and submitted with estimated costs for a change order to the contract. Costs for retesting and making corrections shall be paid by the Contractor.

4.02 TESTING

A. Metallic pipe sections and fittings shall be subject to electrical continuity tests.

B. Deep well anode installation shall be monitored by the Cathodic Protection Specialist as provided in this specification.
C. Grounds Test: Grounds shall not be connected until they have been tested for ground resistance value. Provide a portable ground testing meter to test the ground resistance. The directions provided by the equipment manufacturer for proper use of the equipment shall be followed. Two copies of the directions shall be furnished for the use of the Cathodic Protection Specialist to the County’s Construction Manager.

D. Testing to verify acceptable installation and performance of the cathodic protection system and associated equipment and materials shall be performed by the Cathodic Protection Specialist witnessed by the County’s Engineer or Construction Manager.

E. The Cathodic protection installer shall ensure that all necessary safety precautions are taken, and shall provide all necessary equipment, materials, and labor for the performance of tests. If defects are discovered, the cathodic protection installer shall perform such additional tests as are required to establish the nature of the defects at no cost to the County.

F. If tests indicate that defects exist in materials, equipment, or installations that are the sole responsibility of the cathodic protection installer, these defects shall be immediately corrected. Tests and repairs shall continue until the materials, equipment, and installations are in accordance with the specification requirements. Corrective action shall include the restoration of all other construction and facilities disturbed by the repair work at no cost to the County.

G. Required test equipment shall include the following:
   1. 8-inch saturated copper-copper sulfate solution portable reference electrode, M.C. Miller Model RE7, available from the M.C. Miller Company, Inc., Ringwood, New Jersey; or Cathodic Protection Services Company, Houston, Texas; or equal. The reference electrode copper rod shall have been cleaned and the reference electrode shall have been filled with a fresh copper-sulfate and distilled water saturated solution within 30 days of testing time.
   2. Miscellaneous flexible test leads as required.
   3. High input impedance DC voltmeter with millivolt scale and built-in ohmmeter, Fluke Model 87 hand held multimeter available from John Fluke Manufacturing Company, Everett, Washington; or equal.
   4. 6-volt lantern battery or 12-volt automotive battery.

H. Procedures for testing the cathodic protection system and associated equipment and materials shall be as described in the articles that follow. The CONTRACTOR shall record test data for each test performed and submit the data as specified herein.

I. Except as specified otherwise herein, acceptance tests may be conducted in any sequence selected by the cathodic protection installer so long as they produce results definitely confirming that the installation conforms to the specifications in
4.03 TESTING PROCEDURES

A. Impressed Current Cathodic Protection System Tests: The impressed current cathodic protection system testing shall include initial testing of baseline ("native") pipe to soil potentials then energization of the cathodic protection rectifier and anode ground bed, pipe-to-soil "instant off" potential testing for protection of underground piping, cathodic protection interference testing, and pipe DC voltage drop tests. Installation of the rectifier, all anodes, and all electrical connections to the underground piping systems shall be complete before testing. In addition, all of the field test stations and all of the underground reference electrodes shall be completely installed and terminated prior to commencement of the tests. The following test procedures shall be performed in the sequence listed:

1. Verify that the cathodic protection rectifier for the underground piping under test is not energized and has no measurable DC current output.

2. At the rectifier, make the following preliminary checks and adjustments:
   a. Verify that the positive DC output is connected to the anode ground bed.
   b. Verify that the negative DC output is connected to the pipe.
   c. Set the rectifier voltage and current adjustments to their lowest setting.
   d. Switch the rectifier on and measure the current output.
   e. Operate the system for period of time to polarize the pipe as directed by the Cathodic Protection Specialist.

3. Switch the rectifier off and disconnect the negative return cable from the negative DC output of the rectifier. Connect the specified current interrupter between the disconnected cables and the negative DC output of the rectifier. Set the current interrupter for 10 seconds on, 3 seconds off.

4. With the current interrupter cycling, switch the rectifier on, and measure and record pipe-to-soil potentials with the rectifier on and again approximately 1 second after the rectifier current is interrupted at each location described in this step. These "instant off" pipe-to-soil potential measurements shall be made using the specified voltmeter, flexible test leads, portable reference electrode and the permanently installed underground reference electrodes installed by the cathodic protection installer. The polarity of each measurement should be negative if the meter is connected as indicated below:

5. Readjust rectifier outputs as required to achieve a minimum -0.85 volt "instant off" potential or greater than 0.1 volt shift at each location described in Step 4 above.

6. Repeat Steps 4 and 5 as directed by the Cathodic Protection Specialist.

7. Perform stray current interference testing in areas close to the anode ground bed installation, and as directed by the Cathodic Protection Specialist and reviewed by the Engineer or Construction Manager. The stray current interference testing will essentially consist of pipe-to-soil potential measurements, performed while the rectifier output is cycled off and on with the specified current interrupter.

8. Readjust the rectifier output and repeat Steps 5, 6, and 7 above as required and as directed by the Cathodic Protection Specialist. When testing is complete, temporarily de-energize the rectifier, disconnect the current.
interrupter, restore cable connections to the rectifier and re-energize the rectifier.

9. After the rectifier outputs have stabilized following performance of Step 8, measure and record the rectifier settings and final DC output current and voltage.

10. A resistance test at each insulating flange joint, using an insulation tester. This test will be witnessed by the Engineer.

11. Ground Rod Test: Ground rod shall not be connected until it has been tested for ground resistance value. Provide a portable ground testing meter to test the ground resistance. The directions provide by the equipment manufacturer for proper use of the equipment shall be followed. One copy of the directions shall be furnished for the use of the Engineer.

4.04 SYSTEM TESTING

A. Energizing: After installation of the cathodic protection facilities, including power service to the rectifier, baseline (native) pipe to soil potential measurements will initially be performed, then the system shall be energized, tested and adjusted by the cathodic protection installer and witnessed by the Cathodic Protection Specialist to assure conformance with the Specifications. Upon completion of tests, a detailed report shall be submitted by the Cathodic Protection Specialist describing any deficiencies detected. Any and all deficiencies shall be corrected by the cathodic protection installer and shall be re-tested by the Cathodic Protection Specialist prior to final acceptance. Costs incurred for testing and re-testing shall be the responsibility of the cathodic protection installer at no additional expense to the County.

B. County’s Presence: The Contractor shall inform the County five days in advance of planned testing and energizing the cathodic protection system. All tests and the energizing the system shall be conducted in the presence of the County’s Engineer or Construction Manager.

4.05 FOLLOW-UP TESTING AND ADJUSTMENT

A. In a period within three to six months of initial installation testing and energizing the cathodic protection system, the cathodic protection installer shall retest the system by conducting structure to soil potential tests at a minimum of three locations. Any adjustment of the anode currents, rectifier, or other components of the system shall be done at that time by the cathodic protection installer. The cathodic protection installer shall notify the County so that the County’s Engineer or Construction Manager can witness the retesting and system adjustment.

4.06 REPORTS

A. All record drawings and data indicating the location of installed equipment and materials shall be submitted to the County’s Engineer or Construction Manager within 15 calendar days after completion of the installation. All test reports and supporting documentation shall be submitted to the County’s Engineer or Construction Manager within 15 calendar days following the tests.
B. Drawings and data shall include the following items:
   1. Drawings showing the location of the test station complete with a description of piping connected.
   2. Records of all anode installation details.
   3. Records of all anode installations.

C. Certified Reports by the Contractor's Cathodic Protection Specialist or Construction Manager shall include:
   1. The final "instant off" pipe system potential measurements including native pipe to soil potential measurements.
   2. The final rectifier settings and DC output current and voltage.
   3. All final current outputs of individual anodes.
   4. Final AC potential measurements.
   5. Final structure DC voltage drop measurements.
   6. Insulating flange resistance test results.
   7. Grounding rod resistance test results.

END OF SECTION
SECTION 16721
FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Work Included: Furnish smoke detectors, auxiliary relays, and annunciators to provide a complete fire alarm detection system.

1.02 RELATED WORK DESCRIBED ELSEWHERE

A. Section 15800: Heating, Ventilating and Cooling

1.03 REFERENCE STANDARDS

A. American National Standards Institute (ANSI) Publication:

B. National Fire Protection Association (NFPA) Publications:
   1. 70 National Electrical Code
   2. 72A Local Protective Signaling Systems
   3. 72D Proprietary Signaling Systems
   4. 72E Automatic Fire Detectors

1.04 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.

B. Shop Drawings: Shop drawings shall include wiring diagrams, elementary diagrams and complete descriptions of components.

C. As-Built Diagrams and Manuals: Upon completion of work and prior to final testing and inspection, furnish as-built drawings showing the exact sequence of all initiating devices as they were installed in the circuits.

PART 2 - PRODUCTS

2.01 GENERAL

A. All equipment shall be listed by the State Fire Marshal, UL listed, FM listed, and tested by a nationally recognized fire test laboratory.
2.02 COMPONENTS

A. Manual Pull Station: Stations shall be non-coded, dual-action type. Station shall be red in color and fabricated from high impact LEXAN. The station shall provide mechanical indication of operation until reset with the proper key. Station operating lever shall be recessed to prevent accidental operation of the station. The station shall be surface mounted in a red backbox. Unit shall contain one set of normally open contacts. Station shall be ADT Catalog 5050 Series, equivalent Pyrotronics, or equal.

B. Smoke Detector: Unit shall contain solid state electronic circuitry including a pulsed light emitting diode and a light sensing photodiode. Unit shall also contain a 135°F fusible back-up heat detecting element. Solid state electronics shall be RF and transient protected. Detector shall alarm on 2% smoke obscurity but shall ignore invisible products of combustion. Unit shall operate on 24 Vdc. A supervisory red indicating LED shall provide indication of both normal and alarm conditions. Detector shall be ADT, equivalent Simplex, or equal. Smoke detector shall include a dry contact for connection to the alarm system.

C. Fire Alarm Control Panel: Unit shall be a dual zone solid state electronic control unit enclosed in a red surface mounting enclosure having space for rechargeable standby battery power. The solid state circuitry shall operate on 24 Vdc and shall consist of the following:
1. Two class B supervised detection zones.
3. System power supply which operates from 120 volts, single phase, 60 Hertz. The 24-volt output shall be rated at 3 amperes and shall function as a charger for the 2.5-ampere hour 12-volt batteries. Two batteries connected in series shall provide 24 Vdc power to the system. Battery capacity shall have sufficient power to provide 60 hours of normal operation and 5 minutes of alarm power at the end of that period of time.
4. Provision for a trouble signal for a ground fault, a system short, an open line, removal of a detector, or loss of primary power.
5. Capability to handle up to 20 detecting sensors. The control panel shall be UL listed and shall meet NFPA 72A and 72°C requirements.
6. Unit shall be ADT Catalog 4519-013, equivalent Pyrotronics, or equal, having dimensions approximately 14 inches by 3 inches by 13 inches.

D. End of Line Device: Unit shall consist of a 6,000-ohm resistor mounted on the back of an ABS white plastic cover plate. Included shall be a standard single gang surface mounting box. Unit shall be ADT Catalog 5420-053, equivalent Pyrotronics, or equal.

E. Auxiliary Shut Down Relay: Relay shall be a miniature plug-in sealed enclosure unit with a 24 Vdc operating coil. Relay shall be equipped with four normally open contacts rated 5 amperes at 120 volts. The unit shall be complete with a surface mounting 11-pin octal socket mounted in a NEMA 1 enclosure with a hinged cover. Unit shall be ADT Catalog 3150, equivalent Pyrotronics, or equal.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall not begin until the State Fire Marshal Listing for all equipment and plans and specifications have been approved by the Fire Marshal's office.

B. Installation of wiring and equipment shall conform to Article 760 of NFPA 70 and Article 210 of NFPA Standard No. 72.

C. All wiring shall be in conduit. Terminations in control panels shall be made on terminal strips with a separate point for each conductor.

D. Mount all end of line resistor boxes where they will be readily accessible at all times and at 54 inches above the finished floor.

E. Install no automatic detection equipment on its ceiling mounting plate until the associated room has been painted and cleaned. A minimum of 2% or two (whichever is larger) automatic detection elements shall be given to the Owner as spares.

3.02 TESTING

A. A factory trained representative of the manufacturer shall supervise final testing of the complete system. This test of each component of the total system shall be made in the presence of the Engineer and in the presence of the enforcing fire agency. Upon completion, the Owner's maintenance staff shall be instructed in the testing and operation of the system by the manufacturer's representative.

B. Any equipment proving defective shall be immediately replaced with new equipment at no additional cost to the Owner.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. The work to be performed by the security management system contractor includes furnishing all labor, materials, tools, equipment, programming, software, and documentation required for a complete and working microprocessor based programmable Security Management System (SMS) as described herein and as shown on the plans.
2. The work also includes integration of the existing Fire and Security Alarm Systems (as appropriate), keyless entry control system, addition of new security detectors and new Closed Circuit Television (CCTV) System specified herein. The security management system contractor will evaluate the existing fire and alarm controllers to determine the integration needs.
3. The system shall include, but not be limited to: designated operator workstation hardware and software, keyless entry control system, alarm control panel, keypads, motion detectors (interior and exterior), exterior CCTV pan tilt zoom, digital video recorder, conduit, wire, cable, connectors, and accessories required to provide a complete operational system. The security management system contractor is required to provide all labor, supplies, and coordination necessary to run signal wires to and from all security devices.
4. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Design Documents.
5. This document defines and describes the performance and conceptual design requirements for a complete SMS. Final system design shall be by the security management system contractor and submitted for approval.

B. Related Sections: Refer to other Division 16 Sections for the following:
- Section 08330 – Overhead Doors
- Section 08700 – Finish Hardware
  1. Section 16010 – General Electrical Requirements
  2. Section 16110 – Conduits, Raceways, Boxes, and Fittings

1.2 QUALITY ASSURANCE

A. The SMS equipment supplied shall be a standard labeled product of the equipment supplier, bearing the manufacturer's name and having the manufacturer's exclusive model numbers. The security management system contractor must be of established reputation and experience and regularly engaged in the access control/alarm business.
   1. The security management system contractor shall certify that the products proposed under this Contract have been in continuous and successful use for not less than one year prior to the date of opening Bids.
2. The current security industry standard of practice for design and installation must be used. No substitutions of components, power supplies, installation details, or panel designs shall be permitted without approval of responsible engineer or his/her designee. The system must be bid to the proposed standard described below in STANDARD OF INSTALLATION.

3. All security power and signal wire and runs, including conduit raceways, from all security field devices to the equipment panels, power supplies, and other head end control equipment shall be included in this proposal. Terminations to panels, low voltage power supplies, and security components shall be provided by the security management system contractor.

4. 120 VAC power sources and terminations shall be as shown on the Drawings.

5. Security management system contractor supplied network equipment will be compatible with the Owner's network environment.

6. The security management system contractor shall provide the information requested in Specification Section 16725.

B. Or Approved Equivalent: In this Specification section, there are references to specific pieces of equipment. It shall be understood that "or approved equivalent" will be considered in each situation, but only as allowed in Section 2.4 SUBSTITUTIONS.

1.3 SUBMITTALS

A. All submittals shall conform to the requirements of Section 01330 (Shop Drawing, Product Data, and Samples).

B. All Submittals shall indicate system components, product data for system components, size of components, component finishes, and all component locations. Include dimensioned plans and elevations showing minimum clearances and installed features and devices. Include list of materials and complete description data indicating UL listing for all network components.

C. Submit manufacturer's installation instructions.

D. Submit wiring diagrams from manufacturer differentiating between factor and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Indicate components for both field and factory wiring.

E. Submit final security system design sequence of operation description covering including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.

F. Submit operation, maintenance, and repair data for inclusion in Operating and Maintenance Manual specified in Section 01830. Include data for each type product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the Site. Provide the names, addresses, and telephone numbers of service organizations that carry stock or repair parts for the system to be furnished.
G. Product certification signed by the manufacturer of the SMS components certifying that their products comply with indicated requirements.

H. Submit records of field tests of system.

I. Security management system contractor is to submit acceptance tests upon completion of the system that confirm the system is installed and functioning as desired.

J. Submit a list of every network node address.

K. Submit a list of every device connected to a network node that is provided for purposes of alarm initiation, status monitoring, supervised notification appliance circuits, and auxiliary control.

L. Submit a listing of the manufacturer's representatives responsible for installation coordination and service.

M. Submit calculations for battery capacity for both alarms and supervisory modes.

N. The Security management system contractor shall submit a point-by-point statement of compliance with EQUIPMENT and SOFTWARE requirements.

O. The statement of compliance shall consist of a list of all numbered/lettered paragraphs within these Sections.

P. Where the proposed system complies fully with the numbered paragraphs as written, such shall be indicated by placing the word “comply” opposite the paragraph number.

Q. Where the proposed system does not comply with the paragraph as written, but the Security management system contractor feels it will accomplish the intent of the paragraph in a manner different from that described, a full description of the intent perceived by the Security management system contractor shall be provided as well as a full description of how its proposal will meet its design intent.

R. Where a full description is not provided, it shall be deemed that the proposed system does not comply with the paragraph in question.

S. Any submission, which does not include a point-by-point statement of compliance, as described herein, shall be deemed non-responsive.

T. Documentation in support of substitute equipment shall qualify all parameters with tangible values in the response notations or on the manufacturer's original data sheets and shall not include vague statements such as “limitless” or “virtually limitless".
1.4 CONTENT OF SUBMITTALS

A. The Security management system contractor introduction shall provide the following information within the bid submittal:
   1. Primary business experience.
   2. Length of time in business, 5 years minimum.
   3. Length of time doing business under the same name, 5 years minimum.
   4. Ownership.
   5. Licensing.
   7. Pertinent telephone numbers.

B. A primary contact person for solicitation purposes along with phone number, fax number, and e-mail address.

1.5 TECHNICAL PROPOSAL

The technical section of the proposal shall be specific and complete in all respects. It shall demonstrate a thorough understanding of the Standard of Installation (Part 2 of this Section). This technical proposal shall be submitted as part of the bid submittal.

A. The technical proposal shall include a sample D-size drawing of a Security Control Panel installation. This drawing must incorporate detailed call outs. At least one call out shall lead from each device location icon. All icons shall be described in a Legend Table on each drawing. Each call out shall incorporate the following: device #, device description, cable routing, door detail, and cable code.

B. A separate call out shall exist for each low voltage cable run and shall define the routing of each individual cable run. Each cable run may consist of any number of wires and shall be described in a Cable Definitions Table.

C. The Cable Definitions table shall list the necessary wires and conductors to be included in each cable run. The table shall be split up into a header labeled with the name of the table, and four columns. The columns shall each have a label at the top: Code, Type, Wire, and Manufacturer. Code shall refer to the Cable Code in the call out. Type shall refer to an abbreviated description of what the individual wires will be used for. Wire shall define the wire that will be used to make up this cable run. The Manufacturer column shall give part number.

D. The technical proposal shall include a sample 8-door Security Control Panel drawing. The drawing shall include an accurate line drawing of all Security Control Panel boards, LAN communication devices, fuses, isolation relays, power distribution terminals, data distribution terminals, and the appropriate conductors between them. Each conductor shall be labeled.
1.6 EXCEPTIONS AND DEVIATIONS

A. The Technical Proposal shall specifically itemize any exceptions or deviations from the minimum requirements set forth in Section 1.5 of Specification 16725. Deviations and exceptions will be handled in the same manner described in Section 2.4 SUBSTITUTIONS.

1.7 PRICING

The cost for any software licenses necessary for use by the Owner during the first three years from date of initial installations by the Owner shall be incorporated into the bid price.

PART 2 –PRODUCTS

2.1 STANDARD OF INSTALLATION:

A. The current security industry standard of practice for the design and installation of security systems must be used. No substitutions of components, power supplies, installation details or panel designs will be permitted without prior approval of the responsible engineer or his/her designee. The system must be bid to the proposed standard described below. Any variation from this standard of installation will be considered non-responsive. All equipment must be UL listed.

2.2 SECURITY ALARM SYSTEM

A. Arm/disarm functions of the security alarm control panel shall be performed on a dynamically programmable basis to allow defined day/time schedules or via the operation of security alarm system keypad(s).

B. The Security management system contractor shall coordinate with the Owner's phone provider to assure that one (1) phone line is run to the location of the security control panel. The Security management system contractor shall coordinate with the Owner's phone provider to assure the installation of one (1) labeled phone jack at the location of the security control panel.

2.3 CCTV SYSTEM WITH DVR

A. The CCTV system shall be fully integrated with the security alarm system.

B. All wire for power, video, and data run from the CCTV head end equipment to the outdoors cameras shall be outdoor rated.

C. Outdoor PTZ cameras shall be powered by appropriately rated power supplies.
2.4 SUBSTITUTION

A. Substitutions of products proposed to be equal to those specified herein will be considered only when the following requirements have been met:

B. A complete list of such substituted products, with Drawings, data sheets and UPS battery calculation charts for four (4) hours of standby time on all network functions.

C. Substitute equipment and its capabilities must be a standard part of that systems current product line and must meet or exceed the capabilities of the equipment specified. Security management system contractors are cautioned to conform to this Specification so that the system provided will provide future options for the Owner with regard to the systems use.

D. A security management system contractor intending to use equivalent substitute products shall submit two price quotations; one based on the use of products specified herein; the other shall based on the use of the equivalent substitute products.

E. Provide a reference using the proposed substitute equipment/software. The reference list shall include a one-paragraph narrative of the site’s system, as well as site name, address, phone number and contact name with title of that site person. The site included must have been completed and on line for a minimum of 3 months. The list shall only include systems installed by the security management system contractor.

F. If during the submittal process, there are any specification requirements in Specification 16725 that the security management system contractor cannot meet for any reason, then the responsible engineer or his/her designee will determine whether to: a) require different equipment be used that does meet the specification, b) accept the non-compliance as non-sustentative for this application, or c) develop another solution that allows the Owner to obtain a properly functioning system within the contract price.

2.5 MANUFACTURERS

A. The SMS specified is that of a generic Security Control Panel that meets the performance requirements set forth in this Section. Catalog and model numbers are intended to establish the type and quality of equipment and system design as well as exact operating features required. Alternatives that meet the performance requirements and the qualification requirements of Specification 16725 may be considered, but must be determined to be equivalent or superior by the responsible engineer or his/her designee than the specified component.

B. The Security Alarm System manufacturer specified is that of DMP for the security control panel.

C. The CCTV system specified is that of Pelco for the PTZ domes, a power supply compatible with the proposed cameras, and Integral Technologies for the Digital Video Recorder (DVR).
PART 3 – SYSTEM

3.1 MONITORING SYSTEM

A. Information Management
   1. This system will consist of one, multi-level password protected workstation connected to network. The security alarm system and CCTV system will be integrated in order to provide communication between both systems. If proprietary code is used, a copy must be provided to the Owner.
   2. The SYSTEM must be designed to perform a wide variety of functions. These SYSTEM functions are categorized into primary "system operating features" that shall include:
      a. Digital Video Recorder: The SYSTEM shall include a seamlessly integrated digital video management module. It shall support real time linkage of digital video clips to their associated alarms from the access control and alarm monitoring system. System Administrators shall configure video segments by specifying pre- and post-alarm time marks, then link those defined video segments to specific alarms. Each camera shall be configured to have its own unique set of pre- and post-alarm time marks. The SYSTEM shall allow for the central administration, monitoring, and archiving of digital video and the associated cameras. The DVR shall support digital cameras from various manufacturers.

3.2 SYSTEMS FUNCTIONS

A. The Owner requires the ability to monitor the site via CCTV. The SYSTEM shall be administered by one PC on network. Security management system contractor is to provide appropriate equipment and software necessary to fit this scenario. This shall be done with the minimum number of software licenses as practical.

B. The SYSTEM shall provide multiple levels of controlled operator access. The controlled operator access levels will include, but are not limited to, Administrator, Supervisor, Operator, and View Only.

C. The workstation shall be a Dell Poweredge 2600 or equivalent computer with minimum configuration consisting of: Pentium 4 Processor 3.0 GHz, 120/220V 330 Watts, 512 MB SDRAM, 512 KB cache, 24X CD ROM, 18 GB 10K RPM SCSI hard drive, 10/100 Ethernet communication, 17" SVGA Monitor (must support 1024 x 768), 8 MB Video Card, 56K modem, 20/40 GB DDS4 SCSI tape backup, (2) serial ports, (1) parallel port, keyboard, mouse and surge suppression strip.

3.3 SECURITY ALARM SYSTEM

A. The security alarm system consists of three layers of protection:
   1. Outdoor Motion Detectors: these units consist of a combination of stereo Doppler microwave sensors with dual element passive infrared sensors. These units to be strategically located on the buildings to provide capture zones and activate outdoor lighting where designated on drawings. See plans for approximate locations.
2. Perimeter Building Protection: this consists of door contacts to be installed on all new exterior doors and on designated overhead and roll-up style doors. Existing doors that have door contacts shall be integrated into the system using the existing door contacts. See plans for approximate locations.

3. Interior Building Protection: this consists of interior motion detectors located in the buildings. These motion detectors will be dual technology microwave/passive infrared to provide maximum stability. See plans for approximate locations.

B. The security alarm system will be integrated with the CCTV system so that an alarm event will trigger the DVR to call up cameras to programmed presets, record and store video pre-alarm, and continue to record the alarm activity until reset.

C. Arm/disarm functions of the security control panel shall be performed on a dynamically programmable basis by means of defined day/time schedules or via the operation of security alarm system keypad(s).

3.4 CCTV SYSTEM WITH DIGITAL VIDEO RECORDER (DVR)

A. The CCTV system and DVR shall be integrated with the SMS to provide the video recording and storage of security alarms. PTZ cameras will be programmed by the Security management system contractor to execute pre-set positions during these activities.

3.5 INTEGRATION REQUIREMENTS

A. The SMS shall integrate multiple building functions including alarm management, intrusion detection, keyless access, and CCTV System.

3.6 CLOSED-CIRCUIT TELEVISION (CCTV)

A. The CCTV system DVR shall integrate with the security alarm system via software added to the security workstation described in 3.2.C. Each workstation shall provide controls to enable the user to perform the following CCTV functions directly from the security PC graphic user interface workstation, mouse, and keyboard.

1. Pan-tilt-zoom control.
2. Select camera to view
3. Record video from any camera
4. Define system events that will switch any camera to a pre-selected position, including zoom and focus.
5. Define and execute camera pre-set positions.
6. Define and execute a preset sequence of operations based on operator command or an input anywhere in the SMS.
7. Automatically reposition pan-tilt-zoom cameras within line of sight to focus on any security device which has been activated including, but not limited to; keypads, door dry contacts, motion detectors, card readers (future), etc.

B. The CCTV system shall provide full function control of PTZ cameras, limited in number only by the number channels on the DVR.
C. There shall be the capability for configuring additional security workstations to control any video camera within the system including pan, tilt, and zoom, from the keyboard and mouse.

D. Control of the video cameras to be accomplished from software loaded on the designated security workstation.

PART 4 – SCOPE OF WORK

4.1 SECURITY ALARM SYSTEM

A. The Security management system contractor shall deliver a turnkey security alarm system to the Owner. Any existing security system shall remain functional until it is integrated into the new security system.

B. Any cable required for a fully functioning system meeting this section is to be provided and installed by the security management system contractor. The security management system contractor must coordinate all conduit or wire mold raceway installations that support the security management system with the electrical contractor.

C. The turnkey system shall include, but is not limited to the following: provide and install peripheral devices such as door contacts, overhead door contacts, interior motion detectors, outdoor motion detectors, alarm control panel, keypads, and power connection to the current industry standard of the security system installation.

D. The security management system contractor shall provide one (1) DMP XR200 alarm control panel with optional 462 N network interface. All alarm points to interface programmable and supervised alarm inputs on this control panel. The control panel has a built-in digital communicator for sending alarm signals to the central station.

E. The security management system contractor shall provide two (2) DMP Model 793 Alpha Numeric keypads for security system operations. These keypads are to be located at the positions shown on the drawings.

F. Security management system contractor to supply and install Sentrol 1078W recessed steel dry contacts on all exterior doors as shown on plans.

G. The overhead door contacts shall be track mounted Sentrol 2317A industrial extra wide gap.

H. The interior motion detector shall be Detection Systems DS860 dual technology microwave/passive infrared.

I. The outdoor motion detectors shall be the Protech Model SDI-76XL (50' x 50') or SDI-77XL-A (90' x 50').
4.2 CCTV SYSTEM WITH DVR

A. The security management system contractor shall deliver a turnkey CCTV system with DVR to the Owner.

B. The security management system contractor shall provide all cables and material required for a fully functioning system meeting these specifications. The Security management system contractor must coordinate all conduit or wire mold raceway installations that support the security management system with the electrical contractor.

C. The turnkey system shall include, but is not limited to: providing peripheral devices such as PTZ cameras, DVR, and power supplies to the standard of installation described in Part 2.1.

D. Security management system contractor shall provide digital video recorder (DVR) equipment as follows:
   1. One (1) Integral DVX-16000 with sixteen (16) minimum 30 fps video channels.
   2. Not used.
   3. The system shall also include: 3U, 19-inch rack mount digital video recorder, 16 video channels with 120GB of hard drive (supports up to nine 120CGB hard drives), Windows 2000 Professional operating system, Net meeting, 10/100 Ethernet, CD-R/W drive, and rack mount rail kit. The extended storage chassis will allow for a total of four (4) 120GB hard drive units to eventually be installed.
   4. The one Integral DVR shall have capacity for 16 cameras.

E. The Security management system contractor shall provide one (1) Integral DVX-16000 Video Client Software Licenses for two (2) designated workstations and expandable to more as needed in the future. This software will control the PTZ cameras. The Security management system contractor shall load this software onto the designated CCTV workstations.

F. Security management system contractor shall provide all cameras shown on drawings (refer to camera list at the end of this section).

G. The PTZ cameras shall be Pelco color PTZ cameras with white housing, 23x zoom, day/night, wide dynamic range with I/O board mounting base. Camera shall be enclosed in a weatherized clear housing that includes a condensation elimination system. PTZ camera functionality and operability shall be compatible with the selected DVR.

H. The Security management system contractor shall provide mounts complete with all accessories for all cameras; refer to camera list at the end of this section for mounting type. Mounts shall be Pelco types: RHOTR over the roof parapet mounts with ROTRF floor adaptor, and ROENDC end cap assembly for all roof mounted cameras.

I. The Security management system contractor shall provide one remote outdoor rated camera power supply for each outdoor camera. This power supply shall be located within the manufacturers recommended distance.
J. The Security management system contractor shall provide one (1) camera control unit power supply in the equipment storage room of the Operations building and one (1) camera control unit power supply located in the MCC and Pipe Gallery as shown on the plans.

4.3 KEYLESS ENTRY SYSTEM FOR SLIDING GATE

A. The Keyless entry system shall be a Viking Electronics Model K-1700-3-EWP or equivalent and shall include the following features:
   1. 14 louvered, stainless steel faceplate with stainless steel speaker/mic screen, heavy duty metal keypad and "Call" button
   2. Faceplate gasket, sealed keypad, mylar speaker with rubber gasket and conformal coated circuit board
   3. Built-in electronic ringer
   4. Yellow "in use" indicator LED
   5. Volume adjustments for microphone, speaker and ringer
   6. Disconnects on busy, return to dial tone, CPC, silence time out and maximum call time out
   7. Selectable auto-answer feature
   8. Extended operating temperature range -26°C to 54°C (-15°F to 130°F)
   9. Zinc plated steel rough-in box with (2) 3/4" conduit knockouts
   10. Surface mount box available (VE-6x7)
   11. Telephone line powered 20V DC/25mA minimum (28mA minimum with JP1 removed)
   12. Entry controller shall be Viking Electronics Model C-4000 or equivalent.

PART 5 – COMPLETION

5.1 DELIVERABLES

A. Upon completion of the project the Security management system contractor will turn over the following:
   1. Closeout Manuals – Comply with Section 01830.
      a. Submit two (2) copies of closeout manuals for each system: Access Control, Security Alarm System, and CCTV System.
      b. Prepare data in the form of instructional manuals for use by the Owner. Use 8½” by 11” manual format in 3-ring binder that includes all of the four systems.
      c. Include index, indexed tabs, and title for the manual.
   2. Manuals shall include:
      a. Manufacturer’s specifications for all devices and components.
      b. Operation Data: Operating instructions.
      c. Maintenance Data: Maintenance and repair procedures.
      d. All necessary local permits, inspections, and completion notices.
   3. Record Drawings – comply with Section 10820.
      a. Provide a D sized drawing of the layout of security devices.
      b. Provide CAD or CAD compatible electronic copies of all drawings.
c. Post a detailed wiring diagram inside each equipment enclosure showing exact physical details of the individual panel construction and accurate labeling of every wire termination.

d. The drawing shall include an accurate line drawing of all Security Control Panel boards, LAN communication devices, fuses, isolation relays, power distribution terminals, data distribution terminals, and the appropriate conductors between them. Each conductor shall be labeled.

e. Post a detailed floor plan diagram with the equipment locations shown in relation to the building's details.

f. The floor plan record drawings must incorporate detailed call outs. At least one call out shall lead from each device location icon. All icons shall be described in a Legend Table on each drawing. Each call out shall incorporate the following: device number, device description, cable routing, door detail, and cable code.

g. A separate call-out shall exist for each low voltage cable run and shall define the routing of each individual cable run. Each cable run may consist of any number of wires and shall be described in a Cable Definitions Table.

h. The Cable Definitions table shall list the necessary wires and conductors to be included in each cable run. The table shall be split up into a header labeled with the name of the table, and four columns. The columns shall each have a label at the top: Code, Type, Wire, and Manufacturer. Code shall refer to the Cable Code in the call out. Type shall refer to an abbreviated description of what the individual wires will be used for. Wire shall define the wire that will be used to make up this cable run. The Manufacturer column shall give part number.

i. Drawings must include control diagrams, flow diagrams and system relationships.

5.2 MAINTENANCE SERVICE

A. Furnish 1-year parts and labor warranty including 24-hour emergency service from date of substantial completion.

B. Guarantee shall not cover any damage to material or equipment caused by accident, misuse, unauthorized modifications or repair by Owner, or purposeful destruction.

5.3 DEMONSTRATION AND ACCEPTANCE TEST

A. Demonstrate normal modes of operation, and required response to each.

B. During Acceptance Test, Security management system contractor shall demonstrate all equipment and system features to Owner. Security management system contractor shall promptly correct all deficiencies.
PART 6 - EXECUTION

6.1 INSTALLATION

A. Complete wiring and rigid conduit where required shall be supplied between all equipment in accordance with Part 1 of this section.

B. Installation of the SMS shall be in strict compliance with manufacturer's recommendations. The system shall be installed in dedicated conduit throughout, and wired per the manufacturer's recommendation and wiring diagrams provided in the submittals.

C. The security management system contractor shall furnish all conduits, mounting brackets, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation except for power supply to the security devices that are specified as being provided by others. Conduit sizes for security system signal wire shall be sized for 40% fill. Multi-Guard multicell raceways may be submitted as an alternative if UL listed and approved for direct underground installation.

D. All equipment shall be firmly attached to non load-bearing walls.

E. Each wire shall be identified at both ends with the wire designation corresponding to the wire numbers shown on the wiring diagrams.

F. All exposed wiring within the cabinets, consoles, and terminals shall be formed neatly with wires grouped in bundles using non-metallic, flame-resistant wiring cleats or wire ties.

G. All ferrous metal work shall be painted, in accordance with the manufacturer's standards.

H. All riser diagrams, plan view and point-to-point wiring diagrams for the Security Systems shall be generated and supplied by the security management system contractor.

I. All penetration of floor slabs and firewalls shall be fire stopped in accordance with all local fire codes.

J. End of Line Resistors shall be furnished and installed on all equipment and peripheral circuits as required, and shall be installed as directed by the security management system contractor.

K. The Security management system contractor shall provide one (1) UPS with sufficient volt-ampere capacity to power, for a minimum of four (4) hours, the following equipment: PC workstation, security alarm panel, keyless access control system, CCTV power supplies, and DVR. UPS units shall be capable of generating a failure signal that shall wired to the Security Control Panel system.
6.2 CABLE, WIRING, AND CONDUITS

A. Conduit and Conductors: Complete wiring and rigid conduit shall be supplied between all equipment in accordance with Part 1 of this Section. Unless otherwise specified within the Installation Manual of the specific equipment being used, all field wiring shall be minimum No. 18 (solid) low capacitance twisted, shielded cable (unless otherwise noted) in dedicated conduits. Conduits shall not be filled over 40 percent of their maximum capacity.

B. All field devices shall be mounted in or upon UL listed electrical junction boxes. Runs between devices shall be continuous and unbroken. Any required splices in field wiring shall be made in UL listed electrical junction boxes. The installation shall comply fully with all local, state and national Codes.

C. Maximum length of RJ-59U coax cable run shall be 700 feet.

D. The Security management system contractor shall provide all underground conduit system shown on plans. As soon as the contract is awarded, the Security management system contractor shall verify that the underground conduits shown on the drawings can carry the required cable. If not, the Security management system contractor shall add the necessary conduits without additional cost to the Owner.

E. The Security management system contractor shall coordinate with other trades, the final location of underground conduits and manholes.

F. Refer to specification Division 16, Section 16050 and 16110 for conduits installation material and methods.

G. The Security management system contractor shall coordinate necessary exterior conduits from SMS to camera and exterior intrusion detection devices, gate entry island card reader and gate motor.

H. The Security management system contractor shall coordinate necessary interior conduit if needed from the SMS to the keypads and from SMS to interior intrusion detection devices.

6.3 THEORY OF OPERATION/FINAL SYSTEM ACCEPTANCE

Three alarm zones will be created in the security management system (SMS). Zone one will be the Operations Building. Zone two will be the solids processing building and Zone three will be the remainder of the site.

A. Site
   1. The site security will be monitored using a combination of intrusion alarms, PTZ cameras and DVRs. These cameras identified in the following Camera List provide visual monitoring capabilities. They are interfaced with the security alarm system to position themselves to record activities when specific combinations of events occur. The cameras are interfaced with a digital video recorder (DVR) to provide event recording capabilities. Exterior motion detectors MD1, MD2, MD5, MD6, MD7, and/or MD8 are used to provide
Operations

2. Two (2) PTZ cameras are proposed in the security system. The "home" or normal viewing direction of PTZ2 is towards the entry gate. Additional exterior motion detectors MD5, MD6, MD7, and MD8 are provided at the locations shown- to cover the areas not currently viewed.

3. The normal viewing direction of PTZ1 is towards the west side of the site and the oxidation ditch #1 area. Additional exterior motion detection can direct PTZ1 to cover other areas not currently viewed by the camera. In the event of motion detection from MD1 and MD5, PTZ1 will reposition itself to monitor the activity that triggered the motion detector. In the event of motion detection or intrusion detection of door 01 and/or door 13, PTZ1 will reposition to the preset that will allow monitoring of the north side of the operations building. In the event of motion detection or intrusion detection of door 21 and/or door 24, PTZ1 will reposition to the preset that will allow monitoring of the south side of the solids processing building. The DVR will be activated to record the event including the pre-alarm video. In the event of motion and intrusion detection an alarm will be sent to the SCADA system and the previously agreed upon response protocol will be followed. The DVR will be activated to record the event including the pre-alarm video. In the event of motion and intrusion detection, an automated call will be made from the SMS to the alarm monitoring service and the previously agreed upon response protocol will be followed.

4. Door contacts are added to the emergency generator equipment panels to provide an alarm signal in the event the panels are opened or removed without authorization. This will provide an alarm signal to the Security Management System (SMS).

B. Operations Building

1. Exterior doors 01, 03, 04, 05 and 12 are monitored for intrusion except for the outer vestibule door 13. This door will be locked after hours. To allow authorized entry into the building, the alarm system must be deactivated. After entry into the operations building vestibule, the alarm system is deactivated by entering the appropriate code into the alarm panel/keypad. The system must be manually reactivated upon leaving the building. Intrusion detection of the building is provided by a combination of interior motion detection, door contacts, exterior motion detectors, and external monitoring by cameras.

2. The security control panel #1 is installed in the equipment storage room 101 as shown on the drawings.

3. Motion detected by MD2, MD3, MD4, MD5 and/or MD6 will activate lights above these doors and at the headworks and send an alarm to the SCADA system through the security control panel.

C. Solids Processing Building

1. Exterior doors 21, 24, 26, and 27 have dry contacts monitoring for intrusion. To allow authorized entry into the building, the alarm system must be deactivated. After entry via the door 21, the alarm system is deactivated by entering the appropriate code into the alarm panel/keypad located on the adjacent wall. This code must be entered within a pre-et time (e.g. 20 seconds) or the alarm system will activate. The system must be manually reactivated upon leaving.
the building. Exterior intrusion detection is an additional delay (e.g. 3 minutes) to allow egress from the premises before the system is totally armed. Intrusion detection of the building is provided by a combination of door contacts and exterior motion detection integrated with the camera's functionality.

2. The camera control panel for PTZ1 is installed on the southwest corner of the Solids Processing Building, outside of room 201 as shown on the drawings.

3. Security control panel #2 is located on the north side of the building. Security devices for this building and the MCC and Pipe Gallery and aerobic digester will terminate in this panel.

D. Final Acceptance Testing
1. Each individual system point (hardware) and operation (software) shall be tested and documented on a point-by-point basis for its complete and proper operation. These procedures shall be bound, tabbed and indexed identifying each segment of testing. Procedures for testing the entire SMS shall be provided by the security management system contractor to the Owner for their approval 21 days prior to testing.

2. The SMS will be accepted only after a satisfactory test of the entire system has been accomplished by a factory-trained technician in the presence of the Owner. This test shall include verification of the integration of the Intercom system, CCTV system, and Fire Alarm System to the SMS.

3. The security management system contractor shall submit three complete sets of record drawings and all mentioned documents of this specification to the Owner. A computer file of the compiled Data Transfer Files for the installed system shall be provided. The approved testing report shall be provided, signed by the attending parties, to the Owner.

6.4 ON-SITE SERVICES

A. The security management system contractor management system contractor shall meet with the Owner to establish access levels for personnel to accommodate weekend, holiday and evening schedules. The security management system contractor shall provide on-site services of an Authorized, factory trained technical representative to terminate all field panel connections and fully test all devices and components of the system during installation phase. The system shall be demonstrated to the Owner to perform all the functions as specified.

6.5 TRAINING

A. Comply with Section 01830. The security management system contractor shall provide comprehensive training on the operation, proper use, testing and routine maintenance of the installed system to the Owner or Owner's Representative. Provide a minimum 24 hours of training and classroom instruction. This shall be provided at the facility. Training will be required for up to eight customer employees

B. Training materials shall consist of the following:
1. Formal course outline and agenda
2. Complete set of user's manuals and technical manuals for each student
3. Hands-on practice with on-line equipment.
6.6 WARRANTIES

A. The system shall be warranted for a period of 1 year from date of acceptance. Written notification shall be sent to the Owner stating the date this warranty period has started and termination.

B. The equipment manufacturer shall make available to the Owner a maintenance contract proposal to provide a minimum of two inspections and test per year.

DOOR LIST

<table>
<thead>
<tr>
<th>Door Number</th>
<th>Card Access</th>
<th>Type of Alarm</th>
<th>Type</th>
<th>Request to Exit</th>
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<tbody>
<tr>
<td>01</td>
<td>No</td>
<td>Door Contacts</td>
<td>Exterior</td>
<td>No</td>
</tr>
<tr>
<td>03</td>
<td>No</td>
<td>Door Contacts</td>
<td>Overhead</td>
<td>No</td>
</tr>
<tr>
<td>04</td>
<td>No</td>
<td>Door Contacts</td>
<td>Exterior</td>
<td>No</td>
</tr>
<tr>
<td>05</td>
<td>No</td>
<td>Door Contacts</td>
<td>Exterior</td>
<td>No</td>
</tr>
<tr>
<td>12</td>
<td>No</td>
<td>Door Contacts</td>
<td>Interior</td>
<td>No</td>
</tr>
<tr>
<td>21</td>
<td>No</td>
<td>Door Contacts</td>
<td>Exterior</td>
<td>No</td>
</tr>
<tr>
<td>22</td>
<td>No</td>
<td>Door Contacts</td>
<td>Exterior</td>
<td>No</td>
</tr>
<tr>
<td>24</td>
<td>No</td>
<td>Door Contacts</td>
<td>Exterior</td>
<td>No</td>
</tr>
<tr>
<td>26</td>
<td>No</td>
<td>Door Contacts</td>
<td>Exterior</td>
<td>No</td>
</tr>
<tr>
<td>27</td>
<td>No</td>
<td>Door Contacts</td>
<td>Overhead</td>
<td>No</td>
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CAMERA LIST

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<tr>
<th>Camera Number</th>
<th>Location</th>
<th>Power Supply Panel</th>
<th>Mounting</th>
<th>Camera Type</th>
<th>Location</th>
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<tbody>
<tr>
<td>PTZ1</td>
<td>Outside</td>
<td>CCP-1</td>
<td>Parapet/Roof</td>
<td>PTZ(a)</td>
<td>Solids Processing Building</td>
</tr>
<tr>
<td>PTZ2</td>
<td>Outside</td>
<td>CCP-2</td>
<td>Parapet/Roof</td>
<td>PTZ</td>
<td>MCC and Piping Gallery</td>
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</table>

Note:
(a) PTZ = Pan-Tilt-Zoom.
# MOTION DETECTOR LIST

<table>
<thead>
<tr>
<th>Motion Detector Number</th>
<th>Location</th>
<th>Activation</th>
<th>Mounting</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD1</td>
<td>Exterior</td>
<td>PTZ1 Camera/Alarm</td>
<td>Camera Mount Soffitt</td>
<td>Solids Processing Building</td>
</tr>
<tr>
<td>MD2</td>
<td>Exterior</td>
<td>PTZ1 Camera Lighting/Alarm</td>
<td>Wall</td>
<td>Solids Processing Building South entry door</td>
</tr>
<tr>
<td>MD3</td>
<td>Exterior</td>
<td>Lighting/Alarm</td>
<td>Soffitt</td>
<td>Operations Building North East</td>
</tr>
<tr>
<td>MD4</td>
<td>Exterior</td>
<td>Lighting/Alarm</td>
<td>Wall</td>
<td>Operations Building South</td>
</tr>
<tr>
<td>MD5</td>
<td>Exterior</td>
<td>PTZ2 Camera/Alarm</td>
<td>Wall</td>
<td>Operations Building Main entry door North</td>
</tr>
<tr>
<td>MD6</td>
<td>Exterior</td>
<td>PTZ2 Camera Light/Alarm</td>
<td>Light pole</td>
<td>Headworks</td>
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<tr>
<td>MD7</td>
<td>Exterior</td>
<td>PTZ2 Camera Light/Alarm</td>
<td>Camera Mount Soffitt</td>
<td>MCC and Pipe Gallery Northeast Corner</td>
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<tr>
<td>MD8</td>
<td>Exterior</td>
<td>PTZ2 Camera Light/Alarm</td>
<td>Wall</td>
<td>Aerobic Digester#3 South Wall</td>
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<td>MD9</td>
<td>Spare</td>
<td>PTZ2 Camera Light/Alarm</td>
<td>Spare</td>
<td>Spare</td>
</tr>
<tr>
<td>MD10</td>
<td>Interior</td>
<td>Alarm</td>
<td>Wall</td>
<td>Operations Building Breakroom</td>
</tr>
<tr>
<td>MD11</td>
<td>Interior</td>
<td>Alarm</td>
<td>Wall</td>
<td>Laboratory</td>
</tr>
<tr>
<td>MD12</td>
<td>Interior</td>
<td>Alarm</td>
<td>Wall</td>
<td>Control Room</td>
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END OF SECTION

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FINAL
January 2004
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SECTION 16920
MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Work Included: Provide a motor control center, complete, at each location shown on the Drawings.

C. Related Work Described Elsewhere:
   1. Section 16160: Panelboards
   2. Section 16460: Dry Type Transformers

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA) Publications:
   1. ICS 1 Industrial Control and Systems: General Requirements
   2. ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
   3. ICS 4 Industrial Control and Systems: Terminal Blocks
   4. ICS 6 Industrial Control and Systems: Enclosures

B. International Electrical Testing Association (NETA) Publication:
   1. ATS Acceptance Testing Specifications for Electrical Power and Distribution Equipment and Systems

C. Underwriters Laboratories (UL) Publication:
   1. UL 845 Motor Control Centers

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.

B. Shop Drawings: Submit shop drawings as specified under "Submittals" in Section 16010 and include the following: a wiring diagram and an elementary control diagram for each unit; an overall connection diagram for each motor control center; a dimensioned outline drawing to scale showing space for conduits, etc.; complete identification of all electrical components in each control center and their interconnections within the motor control center; all connections to external equipment and controls; bus material and ratings; wire marking scheme; and method of installation to resist seismic forces. Where unit arrangement or wiring deviates in any way from that shown on the Drawings, provide a complete record and explanation of such deviations.
C. Regarding the seismic anchorage requirements of GC1-71, submit:
   1. Certification of compliance or written notice of noncompliance.
   2. A sketch or description of the anchorage system.

D. Arrange submissions in a logical manner and use the device abbreviation identifications and equipment names as shown on the Drawings, in order to expedite and facilitate review by the Engineer.

E. Spare Parts List: Submit a spare parts list showing recommended parts and quantities as well as complete ordering information for replacement components. Provide instruction books for special control devices and special equipment installed in each control center. Submit these to the Engineer prior to installation of the equipment.

F. Manuals: Provide manuals as specified in Section 16010.

PART 2 - PRODUCTS

2.01 MOTOR CONTROL CENTERS

A. General: Each motor control center shall be a free-standing, completely metal enclosed, dead front, dead rear, grouped motor control center arranged as shown on the Drawings. The motor control centers shall be suitable for use on a 480Y/277-volt, 3-phase, 4-wire radial system grounded at the supply, with a short circuit capacity of up to 42,000 amperes without a neutral conductor in the motor control center. The motor control center shall conform to all applicable requirements of current NEMA Standards ICS 1 and ICS 2 and be UL listed. Each MCC section shall bear the UL label. Equipment shall be assembled into standardized drawout units. The motor control center shall be NEMA Class II, Type B construction.

B. Structure and Arrangement:
   1. The motor control centers shall consist of NEMA 1 vertical free-standing sections, each at least 20 inches wide, 20 inches deep and 90 inches high, and containing not more than six space units. A space unit shall be the space required for a Size 1 combination starter together with associated control transformer. The motor control center shall be suitable for floor mounting against a wall. Provide a horizontal wireway 6 inches high at the bottom of the motor control center, and a vertical wireway 4 inches wide in each 20-inch-wide structure. Coordinate horizontal wireway dimensions with that of the housekeeping concrete pad (see Part 3) to ensure conformance with the NEC 6'6" rule (NEC 380-8).
   2. Each cubicle shall have an individual door with concealed hinges. Doors shall be part of the structure, shall be readily interchangeable, and shall be interlocked so that the unit power is off before the door can be opened; provide door hinges on the side of the cubicle which ensures compliance with the 30-inch rule in NEC Paragraph 110-16(a). In addition, each unit shall be padlockable in the off position and in the tilted-out disconnected position.
   3. All components shall be within individual control cubicles, except as noted. Control components shall be as specified in Section 16955.
4. "Future" spaces shall be cubicles arranged for future addition of the door and unit of the size indicated on the Drawings. The vertical bus shall extend to but not be exposed within "future" spaces.

5. Arrangement and grouping of cubicles shall be substantially as shown on the Drawings. Avoid deviations from the arrangement shown, if possible; otherwise, submit changes to the Engineer for review. Provide for future extension of each motor control center as shown on the Drawings. The number of vertical free-standing sections shown on the Drawings is the minimum required. If additional sections are needed to house all equipment, including relays and timers, indicated to be located within the motor control center:
   a. Provide such sections at no additional cost to the Owner, and
   b. Provide a sufficient number of additional sections such that the total number of future spaces is at least the number shown on the Drawings or 15% of the total motor control center size, whichever is smaller.

C. Buses:
   1. Each motor control section shall have a main 3-phase, 3 wire, horizontal insulated bus rated as shown on the Drawings. Each vertical section shall have a rigid vertical insulated bus rated not less than 300 amperes and extending to all space units; the bus in vertical sections containing either main lugs or main breakers shall have the same ratings as the horizontal bus. Brace buses for 42,000 amperes symmetrical.
   2. Provide each motor control center with a ground bus not smaller than 1/4-square inch in cross sectional area, copper equivalent, extending to all sections. Provide a solderless connector for copper cable at each end of each ground bus, sized for the grounding conductor shown on the Drawings. All solderless connectors shall be NEMA Standard.
   3. All phase and ground buses shall be of copper with silverplated joints and connections, or shall be of aluminum completely tin-plated. If aluminum buses are used, take special precautions at all joints to offset the effects of creep of the aluminum and to minimize effects of contact between dissimilar metals. All terminal lugs shall be suitable for copper conductors.

D. Wiring:
   1. All wiring entirely within each motor control center shall be completely factory installed and shall be thermoplastic machine tool wiring rated 600 volts.
   2. Provide a control terminal block with identified terminals in each cubicle for external control wiring associated with that cubicle. Terminal blocks, in cubicles and on doors, shall be as specified elsewhere herein under Motor Control Units.
   3. Connections of wiring from devices on fixed surfaces to door-mounted devices shall have hinge loops of extra flexible wires securely fastened at each end to permit opening and closing the door without "working" the terminations.
   4. Each control or feeder unit in the motor control sections shall be connected to the vertical bus by means of self-aligning, free-floating, silverplated copper alloy, plug-in pressure stab units. All components shall be mounted on a removable pan secured by quick opening fasteners and aligned by means of guide rails. Units shall be interchangeable.
E. Motor Control Units:
1. General: Each unit shall consist of a motor circuit protector and a magnetic starter. The combination shall have an interrupting rating of not less than 42,000 amperes symmetrical at 480 volts. Each unit shall have a control terminal board and other components as shown on the Drawings.
2. Motor circuit protector shall be molded case quick-make, quick-break with magnetic trip only. The motor circuit protector shall be rated 600 volts with adjustable trip settings and interrupting rating of not less than 14,000 RMS symmetrical amperes. The motor circuit protector shall have the rating and trip setting as shown on the Drawings and shall be UL listed. Motor circuit protector shall be Cutler-Hammer HMCP, Square D MagGard, or equal.
3. Starter shall be magnetic air-break type complying with NEMA Standards, no smaller than Size 1, each with three ambient compensated type overload elements with externally operable manual reset. Overload relays shall have a field adjustable trip of 85% to 115% of heater rating. Size the overload heaters to protect the motor actually installed. For submersible motors, provide fast-acting overload relays if required by the motor manufacturer. Provide two spare auxiliary contacts, one normally open and one normally closed.
4. Control power transformers shall be dry type machine tool transformers. These shall be Hevi-Duty SBE Series, Square D Class 9070, or equal. Sizes shall be as required for the inrush and continuous current requirements of the circuits. Primary windings shall be fused in both phases. Secondaries shall be fused and grounded.
5. Pushbuttons, selector switches, indicating lights, control relays, elapsed time meters, and timing relays shall be as specified in Section 16955.
6. Terminal blocks shall be rated 600 volts and at least 30 amps. These shall be either the box lug type or isolating switch type, as required. Any circuit within the unit which can be energized when the unit power is off shall have isolating switch type terminals. Provide terminals for all external connections as shown on the Drawings, and, in addition, at least 15% spare terminals. Permanently identify each terminal with the same number as the wire being terminated. Terminal blocks shall conform to NEMA ICS4 and shall be Buchanan NQO, Square D Class 9080, or equal.

F. Main and feeder circuit breakers shall be thermal magnetic and of the size shown on the Drawings. Interrupting rating shall be at least 22,000 amperes symmetrical at 480 volts.
1. Where indicated on the Drawings, provide key interlocks for the main and tie circuit breakers for each pair of motor control centers. Interlocking shall be such that either both main circuit breakers or one main and the tie may be closed at any one time.

G. Surge Protection: Provide each motor control center with one 3-phase, 600 volt, 0.5 mfd sloping capacitor and one 3-phase rotating machine lightning arrester rated for 750 volts phase-to-phase, connected to the main bus assembly.

H. Lighting Transformer and Panelboard:
1. When indicated on the Drawings, provide a lighting transformer and panelboard built into the motor control center.
2. Lighting transformer shall be as specified in Section 16460.
3. Lighting panelboard shall be as specified in Section 16160, except that the boxes need not be hot-dip galvanized.

I. Nameplates and Identification:
   1. Provide each motor control center with manufacturer's nameplate which indicates voltage, phases, number of wires, frequency, and bus ratings.
   2. Provide each motor control center with an identifying nameplate inscribed as shown on the Drawings.
   3. On each cubicle door in each control center, provide an identifying nameplate inscribed as shown on the Drawings.
   4. In those cases where integral legend plates cannot be used, install additional special nameplates on doors to identify selector switches, pushbuttons or other devices, as required by the Drawings or as specified herein. All integral legend plates shall be large size and shall be uniform for all control centers.
   5. Identify all internal wiring using a system consistent with the terminal identification system. Each wire at each terminal shall have attached to it permanent means of identification made of moisture resistant non-fading material.

J. Finish: Paint finish shall be ANSI 61.

K. Manufacturer:
   1. The motor control centers shall be standard catalog equipment modified as shown on the Drawings or specified herein as normally manufactured by the specified manufacturer.
   2. The motor control centers shall be as manufactured by Cutler-Hammer Square D, Allen Bradley, or equal. All shall be factory assembled, except for shipping splits.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install each motor control center level and plumb, and secure to a 3-inch-high housekeeping concrete pad in conformance with the favorably reviewed seismic mounting method. Doors shall swing freely and close tightly.

B. Carefully repair any damage to the structure, components or finish to the satisfaction of the Engineer. Clean all nameplates.

C. Exercise care at all times after installation of motor control centers to keep foreign matter, dust, dirt, debris, and moisture out of the control center.

D. Lace incoming and outgoing power conductors to resist short circuit forces. Follow manufacturer's instructions.

3.02 FIELD TEST

A. Test the motor control centers per NETA Paragraph 7.16.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Work Included: Provide an AFD controller for each of those motors so shown on the Drawings.

C. Related Work Specified Elsewhere:
   1. Section 11002: Electric Motor Drives
   2. Section 16920: Motor Control Centers
   2. Section 16955: Control Devices

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA) Publications:
   1. ICS 1 Industrial Control and Systems: General Requirements
   2. ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
   3. ICS 3 Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC
   4. ICS 3.1 Industrial Control and Systems: Handling, Storage, and Installation Guide for AC General-Purpose Medium Voltage Contactors and Class E Controllers, 50 and 60 Hertz
   5. ICS 4 Industrial Control and Systems: Terminal Blocks
   6. ICS 6 Industrial Control and Systems: Enclosures

B. American National Standards Institute (ANSI) Publication:
   1. C37.90 Relays and Relay Systems Associated with Electric Power Apparatus

C. Institute of Electrical and Electronic Engineers (IEEE) Publication:
   1 519 Harmonic Control and Reactive Compensation of Static Power Converters

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.

B. Submit shop drawings, including: complete elementary (ladder) diagrams; comprehensive interconnection diagrams for AFD, motor, external control devices and controllers, and other related devices; drawings showing physical arrangement
of components; front elevation to scale with overall dimensions, conduit entrance spaces and weights; and Bill of Materials.

C. Submit written descriptions explaining ladder diagram operation, system operation and analog signal processing.

D. Submit comprehensive interconnection diagrams for AFD, motor, wet well level controller, and other related devices.

E. Within 45 days following Notice to Proceed:
   1. Submit a report documenting the results of computer or factory based voltage distortion and commutation notch area simulations. Obtain all data needed for the report. Contact equipment manufacturers and utility Company to obtain impedance and fault duty data. Obtain other data from the field as necessary. The simulations shall model the effects of full load AFD operation on the line side of the AFD line reactor during both utility and standby generator operation. Simulations shall demonstrate compliance with IEEE 519 for general systems.
   2. If simulations show that compliance with IEEE 519 cannot be achieved with the equipment shown on the Drawings, include in the report the manufacturer's recommended design modifications needed to ensure compliance with IEEE 519. Include additional simulation data for the recommended system demonstrating compliance. Simulation shall include specific filtering or impedance modifications necessary. Perform and submit a report on the results of a power factor analysis and document any special switching requirements necessary to eliminate filter induced leading power factors.
   3. Submit sketches of the revised single line diagram and a revised scale drawing of the equipment room layout. Room layout shall show location and mounting requirements for filters, reactors, or other devices required. All additional equipment shall meet the seismic anchorage requirements as described in Paragraph F of this Section.
   4. Simulation report, analysis, and design shall be included in the Contractor's bid price.
   5. Additional filters, reactors, enclosures, conduit, wire, and all other components necessary for a fully functioning system complying with IEEE 519 for general systems shall be included in the Contractor's bid price.

F. Regarding the seismic anchorage requirements of GC1-71, submit a sketch or description of the anchorage system.

G. Submit certified factory test report before equipment is shipped.

H. Manuals: Provide in conformance with Section 16010.

I. Submit certification that AFD, motor, and driven load are compatible throughout the specified speed range.

J. Submit list of manufacturer's recommended spare parts.

K. Submit certified statement from the manufacturer accepting responsibility for providing a fully functioning installation as specified herein.
L. Submit certified test reports of the AFD field tests.

1.04 COORDINATION

A. Motor: Obtain and review the appropriate data for the driven motor and load over the required speed range, for a complete system analysis. Verify that equipment is mutually compatible and free of resonance over the complete operating range. Coordinate the assignment of any critical frequencies with the motor supplier. Prepare the certificate required under Submittals paragraph in this Section, the certificate shall specifically state whether the AFD equipment is rated for variable torque or constant torque applications.

B. Instrumentation and Controls: Review and coordinate requirements with the instrumentation and controls work of Division 17. Provide all necessary interfacing to produce a complete, fully operational system.

PART 2 - PRODUCTS

2.01 SYSTEM

A. General: Provide integrated, all solid state adjustable frequency drives (AFD) complete with incoming line reactors. Provide all additional components necessary to meet IEEE 519 as described below. System shall comply with NEMA ICS 1, 3, 4, 3.1, 4, and 6.

B. Manufacturers: Products of the following manufacturers are acceptable, subject to conformance with these Specifications:
   2. Allen-Bradley 1336 Plus II.
   3. Or equal.

C. Operation: Accomplish speed control by adjusting the output frequency according to the desired reference speed. Adjust ac voltage and frequency simultaneously to provide the constant volts/Hertz necessary to operate the motor at the desired speed. The AFD must use pulse width modulation (PWM) technology.

D. Rating:
   1. Line Voltage: 460 volts, -5% continuous, -10% momentary, +10%, 3 phase.
   2. Line Frequency: 60 Hz, 2 Hz
   3. Ambient Temperature: 5°C to 40°C
   4. Altitude: Up to 6,000 feet above sea level.
   5. Service Factor: 1.15
   6. Power Factor: Above 0.92 at full speed and rated load.

E. Performance:
   1. Efficiency: Above 95% at 100% full speed, above 93% at 70% full speed, both for centrifugal pump loads.
   2. AFD Inrush Current: As required to start motor.
3. Duty Cycle: 6 starts per hour.
4. Speed Range: 34% to 100% full speed, with adjustable minimum and maximum speeds.

F. Features:
1. Provisions to accept the following control signals for automatic and manual operation:
   a. Run signal from a single remote contact closure.
   b. A 4-20 mA dc signal for speed control. The AFD shall provide linear speed control of the motor from minimum speed to maximum speed as the adjustable speed input signal varies from its minimum to maximum. Input impedance shall be 250 ohms resistive.
   c. 4-20 mA signal for speed indication.
2. Selector switch for automatic, manual or off.
3. Potentiometer for manual speed control.
4. Motor speed indicator calibrated in percent of full speed.
5. Incoming line circuit breaker.
6. All components necessary to ensure compliance with IEEE 519 for general systems: 5% voltage distortion factor and 22,800 voltmicroseconds commutation notch area. It is the intent of this Specification to achieve a system that operates within the guidelines of IEEE 519 for general systems when operated from the utility and when operated from the standby generator.
7. 120 volt control circuitry.
8. Adjustable time delay for delaying motor drive restart after power failure; timer range shall be 0 to 120 seconds, with initial settings differing by 10 seconds for each drive; provide module which causes multiple attempts to restart.
9. Provision for automatic emergency shutdown in any mode, actuated by the following:
   a. Motor thermal protection (see Section 11002).
   b. Any additional abnormal conditions as shown on the Drawings. Provide for manual restart.
10. Auxiliary contacts for remote indication of "Run", "Ready", "Motor Fail" and "AFD Fail."
11. AFD able to withstand harmonic distortion and notching a defined in IEEE-519 for dedicated system (10% voltage distortion factor and 36,500 volt microseconds commutation watch area).
12. AFD operable with motor disconnected, in order to test AFD.
13. Linearity and repeatability accuracy of 3 phase output of 1% of analog input control signal regardless of input power voltage fluctuations between 437 and 505 volts.
14. Independent acceleration and deceleration controls, adjustable from 2 to 30 Hz per second.

G. Protection: Protect against the following conditions:
1. Reverse phase sequence and single phasing of input power.
2. Input power failure.
3. Input transient voltages, including peak suppression and snubbers, in accordance with ANSI C37.90.
4. Radio and television interference.
5. Output overcurrent.
6. Input overcurrent (see Item 2.01F.5 above).
7. Motor overtemperature.
8. Cabinet overtemperature.
9. Undervoltage: AFD shall automatically shut down if input voltage falls below 414 volts with automatic restart upon return to a stable 437 volts or more.

H. Construction (part of Motor Control Center, Section 16920):
1. Enclosure, housing controller modules and components shall be free-standing, floor-mounted or wall mounted as shown on the Drawings, NEMA ICS Type 1, and fabricated from steel, 12-gauge minimum. The enclosure shall be dead front and dead back construction with all modules, components, load, line, and control terminations fully front accessible. The enclosure shall be completely self-ventilated and have provision for top and bottom entry of wiring and conduits. The controller enclosure shall have gasketed doors mounted on semi-concealed hinges, with lockable door latches.
   a. Door-mount the following devices:
      1) Power On indicating light.
      3) On-Off switch.
      4) Manual Speed potentiometer.
      5) Speed Indicator calibrated in percent of full speed.
      6) Motor Run indicating light.
      7) Motor Overtemperature indicating light.
      8) Controller Failure indicating light.
      9) External operating handle for the incoming line circuit breaker.
     10) Cabinet overheat indicating light.
     11) Elapsed time meter.
   c. Provide finish as specified in Section 16920. Provide control components as specified in Section 16955.
   d. Components: Mount components on circuit cards or modules which can be adjusted or replaced in the field without the use of special tools.

I. Factory Test:
1. Subject AFD motor control to a complete simulated operational test. Drive a calibrated load at various speeds over the specified speed range to determine AFD efficiency.
2. Submit certified test report to the Engineer before equipment is shipped.

J. Spare Parts: Furnish two sets of spare power fuses for each size and type of fuse used; furnish a minimum of five fuses of each size and type of control circuit fuse.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be in conformance with Section 16010 and 16920.

B. Provide the services of a factory trained service technician to inspect and check out each system before energizing.
3.02 FIELD TESTING

A. Provide the services of a factory trained service technician to make final adjustments to equipment and carry out a full operational test in the presence of the Engineer.

B. Replace any failed or damaged parts at no cost to Owner.

C. Following installation and manufacturer's field test, perform a field test under utility and standby operating conditions. Operate the drive from no load to full load and perform a spectrum analysis to verify that the waveform on the line side of the line reactors and filters is in compliance with IEEE 519 for general systems. Submit a complete certified test report for review by the Engineer. If compliance has not been attained, provide additional equipment as specified herein and perform the test again.

3.03 TRAINING

A. Service technician shall instruct operating personnel in the operation, maintenance and adjustment of the system and installation.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

B. Work Included: Furnish and install all control devices complete, including, as applicable, enclosures, engraved escutcheons or nameplates, gaskets, lenses, lamps and mounting provisions.

C. Related Work Specified Elsewhere:
   1. Section 16920: Motor Control Center
   2. Section 16924: Adjustable Frequency Drives
   3. Section 17510: Panels

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA) Publications:
   1. ICS1 Industrial Control and Systems: General Requirements
   2. ICS2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
   3. ICS6 Industrial Control and Systems: Enclosures

1.03 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

2.01 GENERAL

A. All control devices shall conform to applicable provisions of NEMA Standards ICS1 and ICS2.

2.02 CONTROL AND TIMER RELAYS

A. General: Relays shall be provided as necessary to perform switching functions required of control panels and other control circuits. Relays shall be of the following types (abbreviations in parentheses correspond to labels on the Drawings):
   1. Relays (CR):
      a. Provide machine tool relays for the following applications:
         1) All relays driving 120 Vac motor starters up to and including Size 3.
2) All relays driving non-motor loads up to 6 amps (or 720 VA).
b. Provide machine tool type relays with convertible contacts rated 10 amperes continuous with NEMA Rating Designation A600 for ac applications and N600 for dc applications. Coils shall be designed for continuous duty and shall have the voltage rating indicated on the Drawings.
c. Relays shall be the magnetically held type unless designated otherwise on the Drawings. For each relay provide one spare Form C contact over and above the number indicated on the Drawings. In addition, for latching relays, provide coil clearing contacts as necessary.
d. Manufacturer: Square D, Class 8501, Type X; General Electric CR120B; or equal.

2. General control (GR) relays (plug-in):
   a. Provide plug-in style 2-, 3-, or 4-pole enclosed relays with integral neon or LED indicators for the following applications:
      1) Relay logic (relays driving other relays, including machine tool relays) operating at voltages up to 120 Vac.
      2) Control power switching.
      3) All relays driving non-motor loads up to 2 amps (240 VA) at 120 Vac.
   b. Provide relay sockets rated for 10 amp, 240 Vac with screw-type barriered terminals.
   c. Manufacturer: Square D, Class 8501, Type R; Allen-Bradley Bulletin 700; or equal.

3. Timing relays (TR): Relay shall be solid-state with multi-range programmable settings. The relays shall include a calibrated front dial and LED indicator and shall be complete with socket. Relays shall be "on delay" or "off delay" type as indicated on the Drawings. Provide additional form C contacts over and above the number indicated on the Drawings. Relay contacts shall be rated 10 amp, 120 Vac. Relays shall be ATC Type 328; Idec Type RTEL; or equal.

4. General requirements:
   a. Provide relays rated for 1 million operations at 10 amp, 120 Vac, at power factor of 0.2.
   b. Where timing relays or control relays require additional contacts, provide auxiliary control relays, properly sized for the application as described previously in this Section.

2.03 CONTROL PANEL ACCESSORIES

A. Relays, timers and other internally mounted equipment shall be of the types specified in other sections of these Specifications.

B. Panel face mounted equipment shall be of the types specified in other sections of these Specifications.

C. Standards: All control devices shall conform to applicable provisions of NEMA Standards ICS 1 and ICS 2.

D. Pushbuttons, Selector Switches and Pilot Lights:
   1. Shall be heavy-duty oiltight units; each unit shall have an engraved escutcheon plate unless nameplates are indicated on the Drawings or are necessary because of length of identification. Pushbuttons and selector switches shall
have contacts rated 10 amperes continuous, Rating Designation A600 in conformance with NEMA ICS 2.

2. Pushbuttons used as emergency stop devices shall have a padlockable means for maintaining an open circuit. Indicating lights shall be push-to-test transformer type with lenses of the colors shown on the Drawings.

E. Multiposition control switches shall have rotary action, round knurled handle and the number of positions and stages shown on the Drawings. They shall be suitable for panel mounting. Each position shall have a positive detent. Contacts shall have a continuous current rating of 10 amperes at 300 Vac. Switches shall have integral indicator.

F. Colors and Descriptions:
1. Indicating Lamps: Unless otherwise noted on the Drawings, the following color code and inscriptions shall be followed for the lenses of all indicating lights.

<table>
<thead>
<tr>
<th>Indicating Lamp Inscription</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON/START</td>
<td>Red</td>
</tr>
<tr>
<td>OFF/STOP</td>
<td>Green</td>
</tr>
<tr>
<td>CLOSED</td>
<td>Green</td>
</tr>
<tr>
<td>LOW</td>
<td>Amber</td>
</tr>
<tr>
<td>FAIL</td>
<td>Amber</td>
</tr>
<tr>
<td>HIGH</td>
<td>Amber</td>
</tr>
<tr>
<td>OPEN</td>
<td>Red</td>
</tr>
<tr>
<td>POWER ON</td>
<td>White</td>
</tr>
</tbody>
</table>

2. Lettering shall be black on white and amber lenses. Lettering shall be white on red and green lenses.
3. Pushbuttons: Follow color coding for indicating lamp above.
4. All unused or noninscribed buttons shall be black. Lettering shall be black on white and yellow buttons. Lettering shall be white on black, red and green buttons.

G. Panel Lights and Receptacles: Panels shall be internally lighted by fluorescent lamps, provided with guards and a toggle switch located convenient to each access door. One duplex GFI type receptacle shall be provided in each panel section. The lights and receptacles shall be wired to outgoing terminal blocks for 120 volt, 60 Hertz, single-phase supply.

H. Nameplates: Unless specified otherwise in the Drawings, nameplates shall be black lamacoid with minimum 3/16-inch-high white letters for major area titles, 5/32-inch for component titles, and 1/8-inch for subtitles, and shall be fastened with a permanent but dissolvable adhesive or by screws.

2.04 CONTROL STATIONS

A. Provide control stations complying with NEMA ICS 6 for manual control functions as follows and as shown on the Drawings: start-stop pushbutton, hand-off-auto,
forward-reverse-jog-stop, etc. Control stations shall include selector switches, pushbuttons, and indicators as specified in this Section.

B. Enclosures shall be as follows:
   1. Dry Locations: NEMA Type 12
   2. Wet Locations: NEMA Type 4 or 4X

C. Nameplates: Provide an engraved plastic nameplate for each control station and escutcheons or nameplates for devices mounted thereon.

D. Provide pushbuttons, selector switches, indicators, etc., as shown on the Drawings and as required. Provide control devices with NEMA ratings matching that of the control station.

E. Manufacturer: Provide Allen-Bradley; Cutler-Hammer; Crouse-Hinds; or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Identify all control devices with engraved plastic nameplates or escutcheons, as applicable. Install control devices as recommended by the manufacturer.

END OF SECTION
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>17010</td>
<td>Instrumentation and Controls, General Requirements</td>
</tr>
<tr>
<td>17010A</td>
<td>Instrument Schedule</td>
</tr>
<tr>
<td>17110</td>
<td>Analytical Instruments</td>
</tr>
<tr>
<td>17120</td>
<td>Flow Measurement</td>
</tr>
<tr>
<td>17140</td>
<td>Level Measurement</td>
</tr>
<tr>
<td>17150</td>
<td>Pressure Measurement</td>
</tr>
<tr>
<td>17200</td>
<td>Panel Mounted - Misc. Field Instrumentation</td>
</tr>
<tr>
<td>17330</td>
<td>Programmable Logic Controller</td>
</tr>
<tr>
<td>17330A</td>
<td>PLC Control Strategies</td>
</tr>
<tr>
<td>17330B</td>
<td>PLC Input/Output</td>
</tr>
<tr>
<td>17510</td>
<td>Panels</td>
</tr>
</tbody>
</table>
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work Included:
   1. Provide all tools, equipment, materials, and supplies and be responsible for all labor required to complete the installation, startup and operational testing of a complete and operable Instrumentation and Control (I&C) System as indicated on the Drawings and as specified herein.
   2. Provide all the necessary equipment components and interconnections along with the services of manufacturers' engineering representatives necessary to ensure that the Owner receives a completely integrated and operational I&C system as herein specified.
   3. Provide all terminations for wiring at field-mounted instruments, equipment enclosures, alarm and status contacts.
   4. Provide all Instrumentation and Control wire required for a fully functioning Instrumentation and Controls System as shown on the Drawings except for wire specifically specified in Division 16. See Section 16010, Paragraph 1.01.

B. Work Specified in Other Divisions:
   1. Process piping, installation of inline instrumentation, air compressors, main air supply headers, and other mechanical work and equipment as specified in Divisions 11, 13, or 15.
   2. Instruments and controls that are not directly used for process control, i.e., those provided as part of a package system.
   3. Division 16 work, including all instrumentation and controls conduit, and only that wire specified in Division 16. Refer to Division 16 Specifications for specific requirements for wire, conduit, grounding, and other electrical equipment.
   4. Final control elements as specified in Section 15050.
   5. General mechanical requirements as specified in Section 11001.

1.02 REFERENCE STANDARDS

A. American National Standard Institute (ANSI) Publications:
   1. Y14.15a Drafting Practice
   2. C62.1 Surge Arresters

B. Instrumentation Society of America (ISA) Publications:
   1. S5.4 Instrument Loop Diagrams
   2. S20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves

C. American Society for Testing and Materials (ASTM) Publication:
   1. A276-03 Standard Specification for Stainless Steel Bars and Shapes
1.03 I&C SUBCONTRACTOR QUALIFICATIONS

A. An I&C Subcontractor shall be an electrical contractor who has demonstrated experience in purchasing, calibrating, fabricating, installing and testing the Instrumentation and Control (I&C) products listed in this Specification Section. Normally, the I&C Subcontractor is a systems house regularly engaged in the business of panel fabrication, control component procurement, programmable logic controller and personal computer (PC) application in the process control industry.

B. The I&C Subcontractor has been regularly engaged for a period greater than five years in performing all aspects of the type of work specified in this Section and shown on the Drawings and must be qualified as specified below.

C. The I&C Subcontractor shall submit 1) proof in the form of names and references of jobs over the past five years where this work was accomplished, 2) present samples and an explanation of representative work performed, 3) submit the name and qualifications (resumes) of the proposed employees of the firm who would be responsible for the day-to-day work, and 4) an explanation of how the I&C Subcontractor will carry out and implement the responsibilities described in the following section.

1.04 I&C SUBCONTRACTOR SYSTEM RESPONSIBILITIES

A. General: The I&C equipment as specified in this Division shall be considered an integrated system. Entire system installation including calibration, verification, startup, operation testing, and training shall be performed by qualified personnel, possessing all the necessary skills and equipment, and who have had experience performing similar installations. Instrumentation and control systems drawings are diagrammatic only; it is the responsibility of the Contractor to obtain technical data, determine performance requirements, develop instrumentation detail installation designs, and coordinate the selection of specified equipment with Contractor supplied equipment to meet the design conditions stated.

B. Certain primary elements, final control elements, etc., which are installed in the process lines are specified under other Divisions of these Specifications; however, the installation of these elements shall be under the supervision of the I&C subcontractor to the extent recognized by previous labor agreements.

C. System Responsibilities:
   1. Instrumentation and control system drawings are diagrammatic only. Ensure that all components of the instrumentation system, including primary measuring, indicating, transmitting, receiving, recording, totalizing, controlling, and alarming devices and all appurtenances are completely compatible and shall function as outlined and shall furnish and install such additional equipment, accessories, etc., as are necessary to meet these objectives at no additional cost to the Owner.
   2. Compatibility: See that all components of the instrumentation system, including equipment specified under other Divisions, are completely compatible and function properly as a system. Provide such additional equipment,
accessories, etc., as are necessary to meet these objectives at no additional cost to the Owner.

3. Coordination: For control components, devices, and systems specified in Divisions 11, 13, 15, 16, and 17, or shown on the Drawings.
   a. Provide technical advice to mechanical and electrical subcontractors as necessary regarding their installation of instruments.
   b. Verify the correctness of installation of all instruments.
   c. Verify that the proper type, size, and number of control wires with their conduits are provided.
   d. Verify that the proper type, size, and number of pneumatic tubes with their conduits are provided.
   e. Verify that proper electric power circuits provided for all components and systems.
   f. Resolve all manufacturer's installation discrepancies between requirements and the detail requirements of the Drawings and Specifications.
   g. Supervise final signal connections, both electric and pneumatic, to all process instrumentation and control equipment.
   h. Adjust, startup, and test all process instrumentation and control equipment.
   i. Provide specified documentation and training.

4. Performance: While the Drawings provide sufficient information to establish the form and function of the systems and their relationships, the responsibility for system integration and performance rests solely with the Contractor. The Engineer provides technical instruction and guidance where needed.

5. Site and Instrument Inspection: Inspect site for conformance to Drawings, paying special attention to space allocation and dimensions shown or required on Drawings. Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing.

1.05 SUBMITTALS

A. Refer to Division 1 for required method of preparation and transmittal, and conform to requirements herein.

B. Shop Drawings: Submit shop drawings (diagrams) for review in complete bound sets indexed by Specification number, with exterior tabs marked by subject. Submit manufacturer's catalog cuts for each item for which shop drawings are not required. Manufacturer's catalog cuts, specifications or data sheets shall be clearly marked to delineate the options or styles to be furnished. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Drawings shall be complete with device tag numbers, wire numbers and terminal board numbers. Submit fabrication details, nameplate legends, and control panel internal wiring and piping schematic drawings. Submit panel graphic drawings where applicable. Include material lists and/or bills of material.

1. Loop Diagrams:
   a. Submit Instrument Loop Diagrams per ISA S5.4 as depicted in Sketch 17010-1 to provide necessary detail for connection of analog instrument and control system components including those components specified in other sections of these Specifications.
b. Provide with the Instrument Loop Diagrams all instrument model numbers, ranges, set points, sizes, process fluids, specification reference numbers, and all other information listed as "desirable and optional items of information" per ISA S5.4.

2. Interconnection Diagrams:
   a. Submit point-to-point type interconnection diagrams conforming to ANSI Y14.15a as depicted in Sketch 17010-2. Include each conduit run, with wirefill noted for each run. Include electric panel and circuit numbers for all sources of 120 Vac power. Show conduit and wiring interconnections between each control panel, instrument, multiplexer or telemetry unit, motor control center, motor combination starter, valve actuator, and other field-mounted device. Include all equipment and appurtenances provided in this contract regardless of the Division in which it is specified.
   b. Add to all diagrams the instrument model numbers, instrument ranges, setpoints, sizes, process fluids, specification reference numbers and other information listed as "desirable and optional items of information per ISA S5.4."

3. Elementary Diagrams: Submit an elementary diagram (also known as a schematic diagram - see Sketch 17010-3) for control, protection, and monitoring circuits. Elementary diagrams are not required for lighting, communications and those systems clearly defined on the single line diagram. Show all interconnections between power sources, apparatus, and device elements of a particular system or equipment, and all interlocks with other systems in a manner, which fully indicates circuit function and operation. Refer to the Drawings for functional and operational requirements.

C. Specification Forms:
   1. Submit completed Specification Forms per ISA S20, including those instrumentation and control components directly related to process control, but specified in other Divisions of these Specifications.
   2. Include on each form the assigned tag numbers, manufacturer's part numbers, and device data. More than one tag numbered item may be included on a sheet.

D. As-Built Drawings: Submit a revised set of shop drawings that incorporates all change orders and modifications made during performance of the work. In addition to updated loop diagrams, interconnect diagrams and elementary diagrams, submit equipment and device wiring diagrams (see Sketch 17010-4) and other drawings as necessary to depict the "as-built" condition of equipment. Include all installed field and panel conduit and piping/tubing runs and routing, tray systems, supports, mounting details, interconnection diagrams with cable, wire, tube and termination numbers. Coordinate all drawings with the conductor identification requirements in Sections 16120 and 16124. Submit a copy of CAD produced drawings on magnetic media in AutoCAD DWG format.

E. Operation and Maintenance Manuals: Furnish Operation and Maintenance Manuals, including Instruction Manuals and Part Lists, for equipment provided under Division 17 as required by Division 1. Obtain data from manufacturers, and
format and bind as specified. Obtain distribution method instructions from the Owner or his representative.

1. Schedule: Deliver at least two (2) copies of manuals in 3-ring binders (8-1/2 by 11-inch format) not later than the equipment shipment date.

2. Contents: Include in manuals not less than the following information, as applicable, for each instrument, equipment, subsystem and/or control loop:
   a. General, introduction and overall description, purpose, functions, simplified theory of operations, etc.
   b. Specifications (including equipment specification data sheet as described above under Shop Drawings), sufficiently detailed for reordering exact duplicates of the original items.
   c. Installation instructions, procedures, sequences, tolerances, and precautions.
   d. Operational procedures.
   e. Shutdown procedures.
   f. Maintenance, calibration, and repair instructions.
   g. Parts list and spare parts recommendations.
   h. Calibration curves, rating tables, and any other data showing the relationship of the variable inputs and the calibrated output of all measuring devices and controlled equipment.
   i. Software programs (PLC Ladder Logic, HMI Scripts, etc.).
   j. HMI screens (DWG.PIC).

3. Format:
   a. Use drawings and pictorials to illustrate the text to the extent necessary to insure a clear, concise presentation. If manuals have been written to cover a family of similar instruments or equipment, strike out inapplicable information in a neat fashion or emphasize applicable portion by heavily weighted arrows, circles or boxes; whichever provides the clearest and neatest presentation.
   b. Group manuals by system control panels, including field instrumentation connected or associated with the panel. Where identical instruments are used in more than one control loop or subsystem, include only one instruction manual, per panel grouping; however, an index by tag number for all instruments shall identify its location in that manual.
   c. Provide control loop and/or subsystem operational descriptions to identify the function of each instrument and its relation to the other instruments in the loop.

4. Binding: Bind each manual in a cover which indicates the panel or process area to which it applies, manufacturer’s name, local address and telephone number, and year of purchase. Punch and bind manuals in standard three ring binders and include system name and subcontractor’s name on binding.

F. Accessory and Maintenance Materials: Submit data for the following items:

1. Special Tools and Accessories: Special tools, instruments, and accessories for maintaining instruments and equipment requiring periodic repair and adjustment as specified elsewhere herein. Also, furnish special lifting and handling devices for equipment requiring such devices.

2. Maintenance Materials and Spare Parts: Submit a list of manufacturer recommended spare parts for each item specified. Refer to other sections of these Specifications.

FINAL
January 2004
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G. Test Reports: Submit the following test reports as described herein:
1. Instrument Calibration Data Sheets (para. 2.13)
2. Factory Testing of Control Panels (para. 2.14)
3. Instrument Verification Report (para. 3.07.B)
4. Final Operational Testing (para. 3.07.C)

H. Demonstration and Final Operation Test Plan and Results: Submit a document that outlines all procedures to be used in final operational testing of instrument and control systems. Include a description of each system, the scope of testing, test methods and materials, testing instruments and recorders, a list of functional parameters to be recorded on each item, and Shop Drawings showing temporary bypasses, jumpers, and devices.

1.06 QUALITY ASSURANCE

A. Standard of Quality: The Contractor shall provide equipment of the types and sizes specified which has been demonstrated to operate successfully. Provide equipment which is new and of recent proven design.

1.07 INSPECTIONS

A. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. Provide the Engineer with sufficient prior notice so that an inspection can be arranged at the factory.

B. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.

C. Favorable review of the equipment at the factory only allows the manufacturer to ship the equipment to the project site. The Contractor shall be responsible for the proper installation and satisfactory startup operation of the equipment to the satisfaction of the manufacturer and the Engineer.

1.08 DRAWINGS

A. Drawings: The Instrumentation Drawings are diagrammatic; exact locations of instrumentation products shall be determined in the field by the Engineer. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict.

1. Locations of equipment, inserts, anchors, motors, panels, pull boxes, manholes, conduits, stub-ups, fittings, power and convenience outlets, and ground wells are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.

2. Review the Drawings and Specification Divisions of other trades and perform the instrumentation work that will be required for the installations.
3. Should there be a need to deviate from the Instrumentation Drawings and Specifications, submit written details and reasons for all changes to the Engineer for favorable review.

4. Resolution of varying interpretations of the Contract Documents shall conform to Division 0, General Conditions.

5. The Drawings provide details of installation and supersede the manufacturer’s recommendation where a conflict exists.

1.09 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Box, crate, or otherwise enclose and protect instruments and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element, which could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain prior favorable review by the Engineer before making repairs to damaged products.

1.10 INSTRUMENT SCHEDULE

A. The appended Schedule lists all pertinent information about instruments identified for the contract. The Schedule is a comprehensive listing of devices but shall not be construed as a Bill of Materials or as a complete listing. Upon request, a copy of the database can be provided.

PART 2 - PRODUCTS

2.01 MATERIALS AND STANDARD SPECIFICATIONS

A. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as ANSI, ASTM, ISA, and SAMA. The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the plant. All instruments in the plant of the same type shall be made by the same manufacturer.

2.02 NAMEPLATES

A. For each piece of equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings and the model designation.

B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the Engineer upon prior request by the Contractor.

C. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function.
These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.

D. Provide CAUTION or SAFETY nameplates to alert operators of special conditions that may result in faulty equipment operations. Devices containing batteries that must be replaced periodically must be clearly identified. Nameplates are not required if the device senses and displays a low battery warning.

2.03 NAME TAGS

A. All instrumentation and equipment items or systems shall be identified by name tags. Field equipment shall be tagged with the assigned instrumentation tag number listed in the Instrument Schedule.

B. Name tags shall be stainless steel with engraved or stamped black characters of 3/16-inch minimum height. Tags shall be attached to equipment with a tag holder and stainless steel band with a worm screw clamping device. Use 20-gauge stainless steel wire where banding is impractical. For field panels or large equipment cases use stainless steel screws; however, such permanent attachment shall not be on an ordinarily replaceable part.

2.04 FIELD-MOUNTED EQUIPMENT

A. All instrument and control equipment mounted outside of protective structures shall be equipped with suitable surge arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Protective devices used on 120 Vac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of ANSI C62.1.

2.05 EQUIPMENT OPERATING CONDITIONS

A. All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:

1. Electrical Power: 120 Vac ±10%, 60 Hz, unregulated, except where specifically stated otherwise on the Drawings or in the Specifications, or when two-wire, loop-powered devices are specified.
3. Field Instruments:
   a. Outdoor Areas:
      Ambient Temperature: +20°F to +120°F
      Ambient Relative Humidity: 5% to 100%
      Weather: Rain and sleet.
   b. Indoor Unheated Areas:
      Ambient Temperature: +40°F to +120°F
      Ambient Relative Humidity: 5% to 95%, non-condensing
   c. Indoor Environmentally Controlled Areas:
      Ambient Temperature: +60°F to +104°F
      Ambient Relative Humidity: 10% to 90%, non-condensing
2.06 EQUIPMENT LOCATIONS

A. Provide equipment and materials suitable for the types of locations in which they are located as defined under Division 16. All equipment specified for field mounting shall be weatherproof and splash proof as a minimum. If electrical or electronic components are contained within the equipment, they shall be housed in NEMA 3R gasketed cases, and NEMA 4X in corrosive locations unless noted otherwise on the Drawings.

2.07 ANALOG SIGNAL INDICATED UNITS

A. For all instruments with local or remote indicators, provide indicators scaled in actual engineering units, i.e., gallons per minute, feet, psi, etc., rather than 0 to 100%, unless noted otherwise on the Drawings or the Instrument Schedule.

2.08 SIGNAL TRANSMISSION

A. Analog: Signal transmission between electric or electronic instruments shall be 4-20 mA and shall operate at 24 Vdc. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating. Where practical, milliampere signals from the field shall be converted to a voltage signal at the external terminals of each panel, and all instruments within a panel shall be parallel wired.

B. Nonstandard transmission systems such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted in the Instrument Schedule or shown on the Drawings. When transmitters with nonstandard outputs do occur, their output shall be converted to 4-20 mA prior to transmission.

C. Discrete: All alarm and status signals shall be 120 Vac unless specified otherwise on the Instrument Schedule. Proprietary data highway or serial bit transmissions such as RS232C shall be allowed to the extent shown on the Drawings.

2.09 PANEL/RACK/ENCLOSURE BAY POWER SUPPLIES

A. Provide each main rack and/or enclosure bay with a separate isolation transformer to prevent ground loops between the instrument and electrical power grounds. These transformers may be nonshielded control power type.

B. For each two-wire transmitter, provide a 24 Vdc regulated 50 mA power supply with 120 Vac input. Output voltage may be 24 Vdc ±5% manufacturing tolerance at no load, but shall hold within 1% from no load to full load at 120 Vac ± 10% input. Line-to-load regulation shall be within 0.1% from no-load to full load. Ripple shall be less than 15 mV peak-to-peak.

C. Manufacturer: Provide Model AP9046 instrument loop power supply as manufactured by Action Instruments with plug-in mounting base, equivalent capacity Lambda power supply with terminal blocks for external connections, or equal.
2.10 PAINTING

A. Factory paint all instruments and equipment except where installed in pipelines. Where instrument panels are installed adjacent to electrical control panels provided under Division 16, provide instrument panels of identical color to that of electrical control panels. Paint as required in Division 9 for structural supports, brackets, etc. Repair damaged factory paint to satisfaction of the Engineer. Feathering, priming and painting shall produce a reasonable match to the surrounding paint work.

2.11 FASTENERS

A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel. Provide stainless steel fasteners in corrosive locations. Use capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8-inch.

2.12 TUBING, PIPE, FITTINGS AND SUPPORTS

A. General: Instrument tubing listed below is required for all instruments and control valves. Select the appropriate tubing materials to satisfy service conditions except where specifically shown on Installation Detail Drawing.

1. Copper Tubing: Soft-annealed copper tubing shall be 1/4-inch O.D. x 0.030-inch wall, 3/8-inch O.D. x 0.032-inch wall, or 1/2-inch O.D. x 0.032-inch wall as shown on the Drawings. Copper tubing shall be seamless copper, Type DHP, bright annealed after coiling, dehydrated and sealed in 50-foot aluminum coils, per ASTM B75. Use for instrument or valve connections only.

2. Copper Tubing: Hard-drawn copper tubing shall be in accordance with ASTM B88. Sizes shall be 3/8-inch standard: 3/8-inch O.D. x 0.030-inch wall; 1/2-inch standard: 1/2-inch O.D. x 0.035-inch wall; or 5/8-inch standard: 5/8-inch O.D. x 0.040-inch wall in 20-foot straight lengths with plastic capped ends. Use for header or branch service only.

3. Stainless Steel: Stainless tubing shall be Type 304 seamless, cold drawn and annealed per ASTM A269. Sizes shall be 1/4-inch O.D. x 0.045-inch wall, 3/8-inch O.D. x 0.035-inch wall or 1/2-inch O.D. x 0.035-inch wall. Use for instrument or valve connections.

4. Pneumatic Tubing: Pneumatic tubing for panel internals shall be 1/4 or 3/8-inch O.D. rigidwall, clear polyethylene, 250 psi rating. Tubing shall be supported in plastic duct or conduit where appropriate. Use for enclosed or indoor instrument or valve connections.

5. Fittings:
   a. Copper Tube: Solder joint fittings shall be seamless wrought copper per ASTM B75. Compression fittings shall be Brass equal to Imperial or Swagelok.
   b. Stainless Steel Tube: Weld joint fittings shall be Type 304 stainless. Compression fittings shall be Type 316 stainless steel equal to Imperial or Swagelok.
   c. Supports for Tubing: Supports located in areas exposed to the weather or corrosive atmosphere shall be Type 304 stainless steel Unistrut or equal or
made of steel conforming to ASTM A276-03. Supports not exposed to the weather or corrosive atmosphere shall be carbon steel painted.

d. Weld joint fittings shall be permitted for header and branch service only. Instrument and valve connections shall be compression-type only. Use unions on as necessary to simplify instrument removal.

6. Valves:
   a. Pipe, Pipe Fittings and Valves: Main-line piping material and root valves for instrumentation shall be as specified in Section 15050.
   b. Instrument valves shall be 1/4-inch, 3/8-inch or 1/2-inch from Whitey or Hoke to match tubing material and size.

2.13 INSTRUMENT CALIBRATION

A. Each analog field instrument shall be calibrated at 0% and 100% of span and calibration checked at 0%, 25%, 50%, 75% and 100% of span for compliance with linearity and hysteresis accuracy. Use a test instrument to simulate inputs and read outputs that are at least 10 times greater than the specified accuracy of the instrument being calibrated. Such test instruments have accuracies traceable to the National Institute of Standards and Technology (NIST). Digital instruments shall be calibrated over 10 pts for accuracy, linearity and hysteresis.

B. Submit a written report to the Engineer on each instrument. This report shall include a laboratory calibration sheet or the manufacturer's standards calibration sheet on each instrument and calibration reading as finally adjusted within tolerances.

C. The Contractor may, at his option, choose to perform calibration on an instrument by acquiring the services of an independent test lab, or by obtaining the required test instruments and performing the calibration.

2.14 FACTORY TESTING OF CONTROL PANELS

A. All fabricated equipment shall be tested before it leaves the factory. At the factory verify wiring continuity and equipment operation by simulating input and output.

B. Factory testing of control panels/devices/equipment shall be accomplished. Refer to individual Specification sections for tests requiring favorable review.

C. Upon completion of factory testing, submit a report certifying the control panels/devices/equipment are operable and meet the Specifications.

PART 3 - EXECUTION

3.01 MOUNTINGS

A. Mount and install equipment as indicated. Mount field instruments on pipe mounts or other similar means in accordance with suppliers' recommendation. Where mounted in control panels, mount according to requirements of that section.
B. Equipment specified for field mounting shall be suitable for direct pipe mounting or surface mounting, surface-mounted indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than 3 feet 6 inches nor higher than 6 feet above walkways, platforms, catwalks, and the like.

C. Note that applicable specifications require detail drawings showing seismic sway bracing design and anchorage requirements for their equipment. Seismic zone requirements are specified in Division 1.

D. All devices shall be accessible to operators for servicing, operating, reading, etc. Provide permanent platforms to assure devices are continuously accessible.

3.02 PROCESS CONNECTIONS

A. Provide instrument impulse tubing (see Part 2) to meet the intended process service and ambient environmental condition for corrosion resistance, etc. Install impulse tubing with a continuous slope according to service to promote self draining or venting back to the process. Terminate connection to process lines or vessels in a service rated roof valve, provided under other Divisions, that will permit closing off the impulse line or removal of the element without requiring shut down of the process. Include blowdown of drip legs and valves for terminations of impulse lines at the instruments.

B. Process vessels, line penetrations, and root valves shall be furnished and installed under other Divisions of these Specifications. Instrument tubing and valve manifolds are installed as part of this Specification.

3.03 FIELD WIRING

A. Ring out signal wiring prior to termination and perform surge withstand tests where required (see Section 16010, Part 3 for methods). Verify wire number and terminations are satisfactory as designated on the Loop and Interconnect Diagrams. Verify all terminations are tight and shields are uniformly grounded at one location.

3.04 ELECTROMAGNETIC INTERFERENCE (EMI)

A. Construction shall proceed in a manner which minimizes the introduction of noise (RFI/EMI) into the I&C System.

B. Cross signal wires and wires carrying ac power or control signals at right angles.

C. Separate signal wires from wires carrying ac power or switched ac/dc control signals within control panels, terminal cabinets, telemetry equipment, multiplexer cabinets, and data loggers as much as possible. Provide the following minimum separations within such equipment unless indicated otherwise on the Drawings:
### 3.05 SIGNAL GROUNDING

**A.** Proper grounding of equipment and systems in this Division is critical if computer and associated networks and peripherals are involved. The Drawings and Division 16, Section 16450, specify safety grounding for all equipment in this Division.

**B.** A single-point grounding system for instrument signals is required for all instrument panels. This instrument single point grounding system does not use building steel or conduit systems for its ground path.

1. Ground all signal shields, signal grounds, and power supplies at an isolated signal bus within each instrument panel, rack, or enclosure. See Section 17510 for isolated bus requirements. The shields at the far ends of these signal cables must be disconnected (floated) from any ground to prevent ground loops.
2. Do not connect the rack or enclosure frames to the signal grounding buses.
3. Connect each isolated signal ground bus within each panel using a stranded, insulated copper wire of size 6 AWG or larger directly to a system ground rod installed per the Drawings.

**C.** If more than one instrument panel or rack is installed side-by-side, locate an isolated system grounding plate in one of the panels (see Section 17510 for requirements).

1. Connect all the isolated signal buses in such instrument panel or rack radially to the system ground plate using a stranded, insulated copper wire of size 8 AWG or larger.
2. Do not use conduit, cable raceways or building steel to distribute the grounding connections; use dedicated wires as specified above. Install a single conduit containing a #2 AWG insulated ground wire from the insulated grounding plate directly to a system ground rod installed per the Drawings. See Division 16 for conduit requirements.

### 3.06 PREPARATION

**A.** Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.

**B.** Panels shall be protected during construction to prevent damage to front panel devices and prevent dust accumulation in the intervals. Other protective measures (lamp, strip heaters, etc.) shall be included as weather conditions dictate.
3.07 FIELD TESTING

A. General: The purpose of the field testing is to verify instruments are calibrated and operationally performing their intended function. Provide the services of factory trained and experienced engineers to perform verification and operational testing as prescribed below. Since the initial calibration of instruments may not satisfy the final operation of system, perform recalibration or adjust setpoints as required to satisfy the performance requirements of the system. Notify the Engineer and Owner in writing a minimum of 48 hours prior to the proposed date for commencing final operational testing and acceptance.

B. System Verification Testing: Verify that each instrument shown on the Instrument Schedule is operating and calibrated as specified in the Instrument Schedule by simulating inputs at the primary element in each system loop and verify performance at loop output devices (i.e. recorder, indicator, alarm, etc., except controllers). Simulate inputs at 0%, 25%, 50%, 75%, and 100% of span or with on-off inputs, as applicable. During system verification:
1. Make initial or provisional settings on levels, alarms, etc. listed in the Instrument Schedule.
2. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point.
3. Cause malfunctions to sound alarms or switch to standby to check system operation.
4. Check all loop instruments thoroughly for correct operation.
5. Immediately correct all defects and malfunctions disclosed by tests.
6. Submit a report certifying completion of verification of each instrument system. This report shall include a data sheet on each instrument tested that indicates instrument tolerances, instrument calibration verification, data and initial settings made to devices.

C. Final Operational Testing: Upon completion of instrument verification, test all systems under process conditions in the presence of the Owner or designated representative. System testing shall be accomplished in accordance with the approved Test Plan in Section 17330. The test for each portion thereof shall be witnessed, documented and signed off upon completion by the Engineer. The intent of this test is to demonstrate and certify the operational interrelationship of plant instrumentation and control systems. This testing shall include, but not be limited to:
1. Making final adjustments to levels, alarms, etc.
2. Checking all alarms, failure interlocks, and operational interlocks.
3. Verifying all PLC input and outputs are fully functional.
4. Immediately correcting all defects and malfunctions and retesting.

D. Submit the witnessed test results and a transmittal letter indicating that all required systems have been tested satisfactorily and the systems meet all the functional requirements of their applicable specifications.
3.08 INSTRUCTION OF OWNER'S PERSONNEL

A. Provide the services of a factory trained and field experienced instrumentation engineer to conduct group training of up to five of the Owner's designated personnel in the operation of each instrument system. This training shall be for the time period of five working days and shall be performed during the operational testing period. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the Operation and Maintenance Manuals furnished under these Specifications.

END OF SECTION
SKETCH 17010-1: LOOP DIAGRAM

NOTES:
1. PV-301 FULLY OPEN @ 3 PSIG, FULLY CLOSED @ 15 PSIG.
2. STAND MOUNT PER INSTRUMENT STANDARD XXXX NEAR, BUT NOT ON THE CONTROL VALVE.
3. PE-301 CONSISTS OF 20 DIAMETERS UPSTREAM AND 5 DIAMETERS DOWNSTREAM.

REFERENCE DRAWINGS:
P & I D XXX SHEET 1
INSTRUMENT INSTALLATION DETAILS XXX
CONTROL BOARD SPECIFICATION XXX

FRESH FEED TO
UNIT NO. 3

Instrumentation and Controls
General Requirements

FINAL
January 2004
037012.10
Kennedy/Jenks Consultants 2004
NOTES

1. SHOW TERMINAL NUMBERS FROM SHOP DRAWINGS.

2. SHOW WIRE NUMBERS PER CONTRACT DRAWINGS OR AS DESIGNATED BY THE PANEL SUPPLIER. ON AS-BUILT DRAWINGS, INDICATE FIELD WIRE NUMBER ASSIGNMENTS AS USED BY THE ELECTRICAL SUBCONTRACTOR.

3. SHOW CROSS REFERENCES TO THE FAVORABLY REVIEWED SHOP DRAWINGS.

4. SHOW CONDUIT NUMBERS AND CABLE NUMBERS IN THE PULL BOXES AND IN THE EQUIPMENT WHERE THE CONDUITS AND CABLES TERMINATE.

5. SHOW CROSS REFERENCES TO THE REVISED SHOP DRAWINGS.

6. SHOW CONDUIT NUMBERS AND CABLE NUMBERS IN THE PULL BOXES AND IN THE EQUIPMENT WHERE THE CONDUITS AND CABLES TERMINATE.

RELAY PANEL AT PUMP CONTROL PANEL

FOR INTERNAL WIRING SEE DWG ___ (SEE NOTE 3)

120 VAC CONTROL POWER FROM LP-16

TO ANNUNCIATOR PANEL AT MCB

TO MCB

TO LEVEL PROBES

202 POWER LEADS TO MOTOR

203 TO CONTROL STATION BY MOTOR

HANDHOLE, PULL BOX OR JUNCTION TERMINAL CABLE ___ (SEE NOTE 4)

MULTICONDUCTOR CABLE NO. ___

SKETCH 17010-2
INTERCONNECTION DIAGRAM

LOW SUCTION LEVEL PROBE LS-101
AT WATER TANK

PUMP P-1 STARTER
IN MCC ___ (SEE NOTE 3)

(SEE NOTE 2) 12 13

MULTICONDUCTOR CABLE NO. ___

SKETCH 17010-2
INTERCONNECTION DIAGRAM

037012.10
January 2004 FINAL

17010 Instrumentation and Controls
General Requirements
120 VAC FROM PANELBOARD

"POWER ON"

SEE NOTE 1

PROBE RELAY

SEE NOTE 2

120 VAC FROM PUMPBOARD

SEE NOTE 3

PS-1 SET TO CLOSE AT 56 PSI.

SEE NOTE 4

TO ANNUN. PANEL AT MCB

SEE NOTE 5

PUMP P-1 CONTROL RELAY

PUMP P-1 ELEMENTARY DIAGRAM

(AS SHOWN ON FAVORABLY REVIEWED SHOP DRAWING)

NOTE: REFER TO NOTES ON SKETCH 17010-4

SKETCH 17010-3

ELEMEN TARY DIAGRAMS

037012.10
January 2004 FINAL

17010
Instrumentation and Controls
General Requirements
NOTES FOR SKETCHES 17010–3 AND 17010–4

1. A NUMBER FOR EACH RUNG (1,2,3, ETC.)
2. A NUMBER FOR EACH CONTACT AND DEVICE (101 CR, 104 TR, ETC.)
3. RUNG CROSS REFERENCE NUMBERS FOR ALL RELAY CONTACTS
   ASSOCIATED WITH EACH RELAY COIL. UNDERLINE RUNG NUMBERS
   FOR EACH NORMALLY–CLOSED CONTACT (5,7,9,11, ETC.)
4. A FUNCTIONAL ANNOTATION BELOW EACH CONTACT (“PUMP 1 CALL,”
   “SUMP HIGH LEVEL,” ETC.)
5. A FUNCTIONAL ANNOTATION TO THE RIGHT OF EACH COIL, LIGHT, AND
   OTHER DEVICE (“PUMP 1 CALL,” “SUMP HIGH LEVEL,” ETC.)
6. WIRE NUMBER SHOWN ON ELEMENTARY DIAGRAM.

SKETCH 17010–4
EQUIPMENT WIRING DIAGRAMS
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<th>Type</th>
<th>Loop Number</th>
<th>Description</th>
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<th>Setpoint</th>
<th>P&amp;ID</th>
<th>Spec Section</th>
<th>Spec Para.</th>
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<td>200</td>
<td>Screening Channel – High Level Switch, Float Type</td>
<td>Close at El. 5083.59</td>
<td>I - 2</td>
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<td>205</td>
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<td>0 - 20 ft</td>
<td>I - 2</td>
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<td>LSH</td>
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<td>In-Plant Pump Station – High Level Switch, Float Type</td>
<td>Close at El. 5067.75</td>
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<td>201</td>
<td>Wastewater – 8&quot; Magnetic Flowmeter</td>
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<td>I - 2</td>
<td>17120</td>
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<td>LSHH</td>
<td>300</td>
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<td>-1500mv to 1500mv</td>
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<td>17140</td>
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<td>AE/AIT</td>
<td>301</td>
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<td>I - 3</td>
<td>17110</td>
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<td>Oxidation Ditch – Dissolved Oxygen Analyzer</td>
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<td>I - 3</td>
<td>17110</td>
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<td>17140</td>
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<td>Seal Water System – Low Pressure Switch</td>
<td>0 - 100 psi</td>
<td>I - 5</td>
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<td>PSH</td>
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<td>Centrifuge Feed Pump – High Pressure Switch</td>
<td>0 - 100 psi</td>
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<td>NaOCl Pump Meter – ½&quot; Magnetic Flowmeter</td>
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<td>Diamond Peak Lift Station – Level</td>
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<td>17150</td>
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SECTION 17110
ANALYTICAL INSTRUMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.

B. Work Included: This Section specifies analytical instruments for process instrumentation, auxiliary equipment and supplies directly related to the installation of and operation of these analytical instruments, to perform the required functions in conjunction with information and equipment specified in other sections of Division 17. See Section 17010; this is the Schedule referred to herein. This Schedule shall not be construed as Bills of Material or as a complete listing of all required devices.

C. Related Work Specified Elsewhere: Additional analytical instruments are specified in other Divisions. These include chlorine residual analyzers, chlorine leak detectors, and sulfur dioxide leak detectors in Section 11355 and laboratory equipment in Section 11600.

1.02 SUBMITTALS

A. Shop drawings to be submitted in this Section shall be made in one package under the Product Review category of Shop Drawings.

B. Shop Drawings: In addition to the requirements of Section 17010, shop drawings shall include for each type of instrument: supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.

C. Installation Method: Provide proposed method of mounting sensors or probes and instruments with submittal.

D. Parts List: Submit a Parts List with current net prices and a list of recommended spares.

1.03 QUALITY ASSURANCE

A. Manufacturer: In addition to the requirements of Section 17010, analytical instruments furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.

B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly.
field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

PART 2 - PRODUCTS

2.01 ORP PROBES AND ANALYZERS

A. ORP measuring systems shall consist of the following:
1. ORP element and extension cord with watertight plug.
2. Analyzer/transmitter, junction box with weather tight receptacle.
3. Receptacle and switch for local calibration.
4. ORP element shall be housed in a Ryton, Teflon, or Derakone enclosure suitable for mounting as noted or shown. Each element shall be provided with a nonelectrolyte consuming reference electrode or standard, a glass measuring electrode, a thermocompensator, and an integrally mounted preamplifier/signal conditioner. Measuring electrodes shall be suitable for the scale ranges noted. Unit shall provide automatic temperature compensation for stream temperature variations of 0 to 50°C. Preamplifier/signal conditioner shall be encapsulated and suitable for operation in 100% relative humidity.
5. ORP elements shall be either in-stream or flow-through configurations as noted. Flow-through elements shall be suitable for mounting in-line as shown, with 1-inch NPT connections, and be capable of withstanding 50 psig pressure. Flow-through elements shall be provided with a 5-foot cable with watertight plug.
6. In-stream elements shall be provided with stainless steel support pipes as shown unless otherwise noted, complete with watertight cable connection and a 10-foot cable with watertight plug. The in-stream element configuration shall provide adequate stream contact and protection for the electrodes. Unit shall be suitable for complete submersion in the stream.
7. Each element shall be provided with a NEMA 4 junction box with watertight receptacle to mate with the sensor cable plug. Provide each element installation with sufficient cable for connection between the NEMA 4 junction box and the associated panel-mounted pH analyzer/transmitter.
8. ORP analyzer/transmitters shall be suitable for panel mounting unless otherwise noted. Cases shall be thermoplastic (polycarbonate or polypropylene). On the face of each unit shall be a 4-inch (minimum) indicating scale with range as noted, and a standardization adjustment. Where alarms are noted, face of each unit shall contain high and low adjustment knobs and alarm lights. Alarms shall have adjustable deadband. In addition to energizing the two alarm lights, alarm-equipped units shall make contact closures, rated for 5 amps at 120 Vac. In addition to receiving inputs from the field-mounted elements and locally indicating the measured ORP value, the unit shall
generate an electrically isolated 4-20 mA dc signal in linear proportion to ORP. 
The unit shall operate on 120 volt, 60 Hz power.

10. The analyzer shall have a selectable span. It shall have full range suppression.

B. Manufacturer: ORP elements shall be Stranco; ATI; or equal. Both ORP elements and analyzer/transmitters shall be the products of the same manufacturer.

C. Spare Parts: Provide the following spare parts:
   1. 1 - ORP probe.
   2. 1 - analyzer.

2.01 DISSOLVED OXYGEN PROBES AND ANALYZERS

A. General:
   1. Dissolved oxygen element shall be of the galvanic cell type, provided with probe, transmitter, and probe mounting hardware.
   2. Probe shall be of the galvanic cell type with a platinum cathode and lead anode. A replaceable 1 mil Teflon membrane shall separate the electrode assembly from the sampled liquid. Elements shall be provided with automatic temperature compensation in the range of 0 to 50°C and shall consistently have zero output at zero dissolved oxygen concentration. Accurate measurement of dissolved oxygen shall be unaffected by the presence of hydrogen sulfide, ammonia, sulfur dioxide, and carbon dioxide.
   3. Transmitter shall be 4-microprocessor-based which will receive the microampere signal from the element, amplify it, provide local indication with a selectable scale range of 0 to 100 mg/l and transmit a 4-20 mA dc signal linearly proportioned to the dissolved oxygen concentration into the loads with impedances in the range of 0 to 750 ohms without load adjustments. Unit shall be temperature compensated over the range of 0 to 50°C. Accuracy shall be ±0.1 mg/l. Transmitter shall be suitable for panel mounting unless otherwise noted and shall operate on 120 volt, 60 Hz power. Transmitter shall include 2.5" x 4.5" LCD display and keypad.
   4. Transmitters shall be of NEMA 4X construction.
   5. Each unit shall have a face-mounted receptacle to receive the dissolved oxygen element extension cable plug, a calibration knob, meter function selector switch, and a two-position selector switch to switch from field receptacle to local receptacle during calibration. Units shall transmit a 4-20 mA dc signal in linear proportion to measured dissolved oxygen.
   6. Probe operating range 0-10 mg/l.

B. Manufacturer:
   1. Hach (Great Lakes) Model Z-63 with 3041 probe,
   2. Royce Model 9200 with 95A probe,
   3. Or equal.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 17010.

END OF SECTION
SECTION 17120

FLOW MEASUREMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Requirements of Division 1 and Sections 17010 and 11001 form a part of this Section.

B. Work Included: This section specifies flow measurement devices for process instrumentation, auxiliary equipment and supplies directly related to the installation of and operation of these flow measurement devices, to perform the required functions in conjunction with information and equipment specified in other sections of Division 17.

C. Related Work Specified Elsewhere:
   1. Section 01190: Seismic Requirements for Contractor Furnished/Installed Items
   2. Section 15050: Piping, Valves and Accessories

1.02 QUALITY ASSURANCE

A. Manufacturer: In addition to the requirements of Section 17010, flow measurement devices furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.

B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or as specified.

1.03 SUBMITTALS

A. Shop drawings to be submitted in this section shall be made under the Product Review Category of Shop Drawings.

B. Shop Drawings
1. In addition to the requirements of Section 17010, shop drawings shall include for each type of instrument: supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.

2. Furnish Shop Drawings for each item of mechanical equipment presenting sufficient data to determine compliance to these Specifications. Submit completed ISA S20 forms for each device and physical dimensions. Also submit manufacturer's recommended upstream and downstream straight piping lengths, recommended location of any pressure taps, and estimates of pressure losses through the device.

C. Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.

D. Parts List: Submit a Parts List with current net prices and a list of recommended spares.

E. Factory Testing and Calibration: All meters shall be factory tested. Perform a factory test and/or provide certification of calibration from an independent test laboratory. Calibration curves based on factory and/or laboratory testing (see option below) shall be provided for the Engineer's favorable review. Furnish calibration curves in units of output (inches or rpm/gpm) versus measured flow. Upon receipt of the Engineer's favorable review, the Contractor may have the meters shipped to the job site:

1. As an option to laboratory testing each meter, the calibration curves of six (6) "like devices" may be substituted provided the calibration data is available from at least one identical device (pipe size, flow range, and type plus accessories such as extension registers).

2. The flow tube supplier shall provide laboratory calibration data to the transmitter supplier or, where practical, test the flow tube and transmitter as an integral assembly. The integral test shall be accomplished at no extra cost to the customer.

F. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

G. Affidavits: Furnish affidavits from the manufacturers stating that the meters have been properly installed and tested and each is ready for full time operation.

1.04 SEISMIC PROTECTION

A. Seismic restraint for metering devices that are integral with piping shall be as specified for the piping system in which they are installed. Seismic design certification and anchorage descriptions are required by Section 01190.

1.05 INDICATING UNITS

A. Provide flow indication in GPM, CFS, MGD, etc. Do not use indicators that read 0 to 100%, 4-20 mA, etc.
PART 2 – PRODUCTS

2.01 MAGNETIC FLOWMETER - INDUCTION TYPE

A. General: Magnetic meters shall utilize the principle of electromagnetic induction to produce an output proportional to the rate of fluid flow. A set of pulsed dc, electrically powered coils shall generate a magnetic field, which in turn induces a voltage in the flowing fluid, which is sensed by a pair of electrodes in contact with the fluid.

1. Protect coils from contact with the fluid. The electrodes shall be made of Type 316 stainless steel. The meters shall be housed in a NEMA 4 enclosure. The metering tube shall be lined with hard rubber. Meters shall be resistant to electrode coating. The electrode shall be designed to be inserted in water pipes and shall not be affected by solids, air bubbles, oil or coating. The electrode wetted parts shall be of Type 316 stainless steel.

2. The meters shall be designed to operate from a 120-volt ac, 60 cycle, single-phase power supply. A 10% variation in power line voltage or frequency shall not affect the meter output accuracy in excess of 1% of full scale.

3. Provide magnetic flowmeters suitable for fluids with conductivities as low as 5.0 micromho/cm.

4. Each magnetic flow meter system shall have an accuracy within 1% of actual for flow velocities between 10% and 100% of full scale. Meters shall have a repeatability within 0.25% of full scale.

5. Each magnetic flow meter shall be equipped with a signal converter (transmitter) to transmit an analog 4-20 mA dc signal proportional to flowrate. The signal converter shall be microprocessor-based unit with keypad for calibration. Output span and zero shall be manually adjustable. Provide span adjustment capable of producing 100% strength analog at flow rates that are 30% of maximum. Signal shall be linear with flow within the accuracy specified above. The converter shall be a wall-mounted unit.

6. The signal converter shall have the capability of positive zero return for shutdown conditions.

B. The magnetic flow meters shall have flanged end connections. Field coils shall be either completely encapsulated in the meter lining material or a protective shield shall be provided suitable for withstanding the scouring velocities of the process fluid at the maximum flow rates.

C. Grounding: Provide a grounding circuit for each magnetic meter. Furnish and install grounding rings or protective shield when meter is installed in nonconductive line.

D. Manufacturer: Meters and signal converters shall be Foxboro, Fischer & Porter, or equal.

E. Special Tools: Furnish special tools, which are necessary for the replacement of parts and the adjustment of the equipment.
PART 3 - EXECUTION

3.01 INSTALLATION.

A. Provide installation, testing, calibration, verification, and startup instructions in accordance with Sections 15050 and 17010.

3.02 FIELD TESTING

A. All flow devices are to be field-tested against a secondary standard at the normal (or expected) process flow rates.

B. The Contractor may select at his option to either install a second flow device of known calibration in the line to verify flow device calibration or perform fluid capacity tests such as volumetric measurement per unit time.

END OF SECTION
SECTION 17140
LEVEL MEASUREMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.

B. Work Included: Level measurement devices for process instrumentation, auxiliary equipment and supplies directly related to the installation of and operation of these level measurement devices, to perform the required functions in conjunction with information and equipment specified in other sections of Division 17. Refer to the Instrument Schedule in Section 17010 for a listing of required devices.

1.02 SUBMITTALS

A. Shop drawings to be submitted in this section shall be made in one package under the Product Review Category of Shop Drawings.

B. Shop Drawings: In addition to the requirements of Section 17010, shop drawings shall include for each type of instrument: supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.

C. Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.

D. Parts List: Submit a Parts List with current net prices and a list of recommended spares.

1.03 QUALITY ASSURANCE

A. Manufacturer: In addition to the requirements of Section 17010, level measurement devices furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.

B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the
same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

PART 2 - PRODUCTS

2.01 LEVEL SWITCH – FLOAT TYPE, SUMP DUTY

A. General: Level switch shall use the movement of a float, the weight of whose moving parts is less than that of the displaced process liquid, to actuate switches as the level changes. The switch(es) shall be integrally mounted within the float and connected to a terminal box by a waterproof electric cable. A movable weight shall be mounted on the cable to keep the cable immersed in the liquid.

B. The switch operating levels shall be adjusted by moving the weight along the cable or altering the height of the cable fixing point.
1. The switch covering shall be made of indestructible polypropylene material. The cable shall be PVC coated.
2. The switches shall be reversible such that the switching action operates on rising or falling level.
3. The switch actuating points shall be as listed in the Instrument Schedule.
4. The float shall be rated for 150 psi (10.5 kg/cm²) pressure and 140°F (60°C) temperature. The float shall not be greater than 7 inches (178 mm) in diameter.
5. The switches shall be rated for 250 volts ac or dc and 5 amperes minimum, and shall be terminated with 14 AWG wires in a NEMA 4X terminal box.
6. Provide intrinsically-safe relays (IR) for switches used in hazardous locations where shown on the Drawings.

C. Manufacturer: Float type sump level switches shall be as manufactured by Flygt Corporation; Kari; or equal.

2.02 SUBMERSIBLE PRESSURE TRANSMITTER

A. General: Electric-indicating type submersible pressure transmitters shall convert a differential or gauge pressure measurement to a 4-20 mA linear electric output signal capable of transmission into at least a 600-ohm maximum load at 24 Vdc or less. Signal and power transmission shall be provided by a single pair of wires. Operating ambient temperature shall be at least -15° to +82°C centigrade.

B. Range: Shall be as indicated on the Instrument Schedule and calibrated span shall be field adjustable over at least a 4 to 1 range. Elevation and suppression shall be provided. Overrange protection shall be at least 1-1/2 times span without degradation of accuracy. Reference accuracy shall be plus or minus 0.2% of calibrated span or better. Integral adjustable hydraulic or electronic damping shall be provided. The indicator shall be provided with scale markings calibrated in the units gpm, psig, feet, etc., specified in the Instrument Schedule.

C. Submersible sensor shall be explosion proof, Class 1, Division 1, Groups C and D.
D. Construction: The transmitter shall be a sealed probe with cable and integral isolated diaphragm sensor. The sensor assembly shall provide for a variety of pressure inputs as well as electrical output connections. The transmitter enclosure shall be NEMA 4X.

D. Manufacturer: Druck; KPSI; Consolidated Electric; or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 17010.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Requirements of Division 1 and Section 17010 form a part of this section.

B. Work Included: This section specifies pressure measurement devices for process instrumentation, auxiliary equipment and supplies directly related to the installation of and operation of these pressure measurement devices, to perform the required functions in conjunction with information and equipment specified in other sections of Division 17. Refer to the Instrument Schedule in Section 17010 for a listing of required devices.

1.02 SUBMITTALS

A. Shop drawings to be submitted in this section shall be made in one package under the Product Review Category of Shop Drawings.

B. Shop Drawings: In addition to the requirements of Section 17010, shop drawings shall include for each type of instrument: supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.

C. Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.

D. Parts List: Submit a Parts List with current net prices and a list of recommended spares.

1.03 QUALITY ASSURANCE

A. Manufacturer: In addition to the requirements Section 17010, pressure measurement devices furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.

B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards,
and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated in the Instrument Schedule.

PART 2 - PRODUCTS

2.01 PRESSURE TRANSMITTERS - ELECTRONIC

A. General:
   1. Electronic indicating-type pressure transmitters shall convert a gauge or absolute pressure measurement to a 4-20 mAdc linear electrical output signal capable of transmission into at least a 600 ohm maximum load at 24 Vdc or less. Signal and power transmission shall be provided on a single pair of wires. Operating ambient temperature limits shall be at least -40° to +82°C.
   2. Range shall be as indicated in the Instrument Index. Overrange protection shall be at least 1-1/2 times span without degradation of accuracy. Reference accuracy shall be ±1/2 percent or better.

B. Construction: The transmitter enclosure shall be NEMA 4X rated. The process connection for clean liquid service shall be 1/4-inch NPT. Enclosure and wetted surface material shall be corrosion resistant and suitable for the process fluid.

C. Manufacturers: Rosemount, Model 115; Foxboro; or equal.

2.02 PRESSURE SWITCHES

A. Pressure switches shall incorporate bourdon tubes, diaphragms, or bellows as the sensing and actuating element. The actuating element shall be Type 316 stainless steel or phosphorous bronze, depending on compatibility with the process fluid. The actuating point shall be readily field-adjustable in the range specified with adjustable dead band. Switches shall be SPDT, rated at 5 ampere minimum at 120 Vac. Enclosures shall be NEMA 4X unless specified explosion-proof as shown on the Drawings. Process connection shall be 1/4-inch NPT.

B. There shall be calibrated external adjustments for set point and differential. Element shall be rated for at least 50% over range pressure. Switches used for alarm shall have manual reset. Provide diaphragm seals on corrosive fluid and gas lines and those lines having large amounts of suspended solids.

C. Pressure switches shall be as manufactured by ASCO; Mercoid; or equal.

2.03 DIAPHRAGM PRESSURE SEALS

A. General:
   1. Units shall consist of corrosion-resistant lower housing and diaphragm, and instrument mounting upper housing. Lower housing shall have a 1-inch NPT female process and a 3/8-inch flushing connection terminated with a 3/8-inch hose bibb and shall be Type 316 stainless steel. Diaphragm shall be Type 316 stainless steel, unless otherwise noted. Upper housing shall have bleed screw,
NPT female instrument connection, and shall be steel, unless otherwise noted. Filling fluid shall be suitable for a temperature range of -17° to +260°F.

2. Where noted on the Drawings, capillary assembly shall be furnished to connect diaphragm seal to instrument.

B. Manufacturer: Units shall be Mansfield & Green, Type SG; Ashcroft, Type 101; or equal.

2.04 INSTRUMENT MANIFOLDS

A. General: Test valve manifolds shall be used with all pressure transmitters including pressure switches installed in clean liquid (no entrained solids) service. Test manifolds shall be corrosion resistant with integral 2-valve assembly (block and bleed) for pressure transmitters and switches and 3-valve assemblies (block and bypass with manometer ports) for differential pressure transmitter and switch installation.

B. Mounting: Pipe mounting brackets shall be provided with each manifold.

C. Manufacturer: Anderson-Greenwood Company, M Series, Hoke, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. On systems requiring diaphragm seals, the Contractor shall order (or assemble) a completely filled system. The filling fluid shall be silicone oil. Interconnecting piping shall be kept short. The filled system shall retain the same calibration requirements of the individual components.

B. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 17010.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Requirements of Division 1 and Sections 17010 and 16955 form a part of this Section.

B. Work Included: This Section specifies the panel mounted and miscellaneous field instruments and equipment to perform the required functions in conjunction with information and equipment specified in other sections of Division 17. Refer to the Instrument Schedule in Section 17010 for a list of required devices. This schedule shall not be construed as complete bills of material.

C. Related Work Specified Elsewhere:
   1. Section 17510: Panels

D. Unit Responsibility: It shall be the responsibility of the qualified single firm as described in Section 17010 of this Division to ensure that the instruments and equipment furnished under this Section are compatible with the equipment furnished under sections of this Division and other Divisions of these Specifications, and that the signal transmission methods are compatible.

E. Control and Performance Terminology used hereinafter in this Section shall be as defined in SAMA Standard PMC20-2-1970, "Process Measurement and Control Terminology."

F. Cases: Cases of front of panel-mounted instruments shall be of uniform design and color scheme wherever possible. Front of case colors shall be compatible with panel colors, subject to final approval by the Owner. Normally, compatible standard colors of the manufacturer shall be acceptable.

G. Panel Mounted Equipment:
   1. All flush mounted miniature electronic recorders, and stations shall be a matching style family of instruments utilizing multiple unit mounting cases and back of panel plug-in cable connections.
   2. All front panel mounted instruments shall be capable of withdrawing chassis to all service and test positions without affecting operation, and complete removal by a single plug connection from the front.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA) Publications:
   1. ICS 1 Industrial Control and Systems: General Requirements
   2. ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
1.03 SUBMITTALS

A. Shop drawings to be submitted in this section shall be made in one package under the Product Review Category of Shop Drawings.

B. Refer to Section 17010 for additional submittals required for each item herein.

1.04 QUALITY ASSURANCE

A. Manufacturer: In addition to the requirements of Section 17010, instrumentation and control equipment furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of the most recent design. Except where specified otherwise, the instruments furnished under this Section shall be as manufactured by Fischer & Porter; Foxboro; or equal. Behind-the-panel equipment shall be as manufactured by the above or by AGM Electronics; Moore Products; or equal.

B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

PART 2 - PRODUCTS

2.01 CONTROL PANEL ACCESSORIES

A. Relays, timers and other internally mounted equipment shall be of the types specified in other sections of these Specifications.

B. Panel face-mounted equipment shall be of the types specified in other sections of these Specifications.

C. Standards: All control devices shall conform to applicable provisions of NEMA Standards ICS 1 and ICS 2.

D. Pushbuttons, selector switches and pilot lights shall be heavy-duty oil-tight units. Pushbuttons and selector switches shall have contacts rated 10 amperes continuous, Rating Designation A600 in conformance with NEMA ICS 2.

1. Pushbuttons used as emergency stop devices shall have a padlockable means for maintaining an open circuit. Indicating lights shall be push-to-test transformer type with lenses of the colors shown on the Drawings.
2. Multi-position control switches shall have rotary action, round knurled handle and the number of positions and stages shown on the Drawings. They shall be suitable for panel mounting. Each position shall have a positive detent. Contacts shall have a continuous current rating of 10 amperes at 300 Vac. Switches shall have integral indicator.

E. Nameplates: Unless specified otherwise in the Drawings, nameplates shall be black lamacoid with minimum 3/16-inch-high white letters for major area titles, 5/32-inch for component titles, and 1/8-inch for subtitles, and shall be fastened with a permanent but dissolvable adhesive or by screws.

2.02 INSTRUMENT LOOP POWER SUPPLIES

A. General:
   1. For two-wire transmitters, provide a 24 Vdc regulated 50-mA power supply with 120 Vac input. Output voltage may be 24 Vdc ±5% manufacturing tolerance at no load, but shall hold within 1% from no load to full load at 120 Vac ±10% input.
   2. Line-to-load regulation shall be within 0.1% from no-load to full load. Ripple shall be less than 15 mV peak-to-peak.

B. Manufacturer: Provide Power One, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation, testing, calibration, verification, startup and instruction shall be in accordance with Section 17010.

B. Wiring: Refer to Section 17010, Part 3.

C. Control Voltage: When the control voltage is not specified in the schematics, the Contractor may elect to use the 120 Vac power, as supplied from the power panels supplies under Division 16; however, he shall provide a separate low voltage circuit for the indicating lamps or provide individual transformers with lamps. In any event the lamp voltage shall not exceed 30 Vac or dc.

END OF SECTION
SECTION 17330
PROGRAMMABLE LOGIC CONTROLLER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.

B. Related Sections Specified Elsewhere:
   1. Section 16955: Control Devices - control relays
   2. Section 17010: Instrumentation and Controls, General Requirements
   3. Section 17510: Panels

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA) Publication:
   1. ICS 1 Industrial Control and Systems: General Requirements

1.03 SUBMITTALS

A. The following items shall be submitted in this Section shall be made in one package under the Product Review category of Shop Drawings.
   1. Catalog cuts for the central processing unit, input modules, output modules, programmer, magnetic program storage device, interfacing equipment, power line voltage regulation transformer, and power line surge protection device.
   2. A layout drawing of the PLC and control panel.
   3. An Input/Output (I/O) record containing a textual description for each item of input and output, connection diagram addressing (rack, module, channel and address numbers), and data table bit and data table word assignments.
   4. A typewritten document containing startup, operation, and maintenance procedures.
   5. The Factory and Field Witnessed Test procedure.
   6. The Factory and Field Witnessed Test results.
   7. Documentation to confirm that the spare memory requirement is complied with.
   8. Spare Parts Items: As specified herein

1.04 QUALITY ASSURANCE

A. Provide programmable logic controllers (PLCs), which comply with NEMA Standard ICS 1. This standard applies to the construction, programming, performance, test, installation, protection, and safety of PLCs.

1.05 UL LABEL

A. Programmable controller enclosures shall bear the UL label. See Section 17510.
1.06 APPENDICES

A. Section 17330A: Control Strategies. These strategies are to be used to program the PLC. The PLC shall be programmed by the Engineer and these Control Strategies are included for reference only.

B. Section 17330B: PLC Input/Output Schedule. This schedule indicates PLC I/O. Additional I/O may be configured as required to implement control strategies by first assigning an instrument tag number, description, function and I/O type.

PART 2 - PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLERS

A. General: Furnish, install, configure, test, and place the PLC into satisfactory operation as required by the Drawings and Specifications.

B. Programmable Logic Controller: Provide each PLC with the following hardware.
   1. I/O Chassis: Provide a 13-slot universal I/O chassis to house the processor, power supply and I/O modules. The selection of size slot and number of chassis to achieve a satisfactory complement of I/O modules is the responsibility of the Contractor.
   2. Power Supply: Provide power supply module to power the processor and local I/O modules. I/O back plane loading shall not exceed 75% of power supply rating amps on any chassis.
   3. Memory Enhancement: The processor shall come with 32K word of basic memory. Provide memory enhancement if the program exceeds 75% of capacity.
   4. Cables: Provide a full complement of cables for connecting to programming terminal and interface devices.
   5. Central Processing Unit: The Central Processing Unit (CPU) shall be powered by 115 Vac, 60 Hertz, and shall have the following:
      a. Four 3-pin connector, user configurable ports that support data highway communications modes.
      b. PLC "ladder logic" software with extend math functions and on line/off line programming functions.
      c. Local I/O Scanner.
      d. Floating point arithmetic.
      e. PID loop control.
      f. Battery-backed (10-year lithium) CMOS RAM.
      g. A watchdog timer that monitors CPU activity, and a relay output for watchdog timer alarm.
   6. Inputs and Output Modules:
      a. Analog inputs (AI) shall meet the following requirements:
         1) Four to 20 mAdc inputs, 250-ohm impedance maximum, eight double ended or 16 single ended configuration.
         2) Accuracy of +/-0.1% of span.
         3) Resolution: 12-bit
         4) Common Mode Rejection of 90 dB at 60 Hz, minimum.
5) Normal Mode Rejection of 45 dB at 60 Hz, minimum.
6) Isolation shall meet or exceed surge-withstand test, IEEE-472.
7) Drift shall not exceed 0.25% within a 30-day period.

b. Discrete inputs (DI) shall meet the following requirements:
1) Unpowered contact inputs or power inputs at 24 VAC.
2) Input isolation shall meet or exceed IEEE-472. Relay isolation is unacceptable.
3) Provide filtering on a per unit point basis to provide contact bounce protection.
4) Discrete inputs shall be powered by the PLC by a 24-Vdc power supply; shall be current limited to conform with NEC Class 2 remote control and signal wiring circuits.
5) Modules with 16 inputs with common ground terminals. Voltage input modules shall have their channels fully isolated.

c. Analog outputs (AO) shall meet the following requirements.
1) Output: 4-20 mAdc into a 0 to 500 ohm load; 4- or 8-isolated output configuration with separate grounds.
2) Isolation: From the multiplexer ground.
3) Resolution: 12 bits.
4) Accuracy: ±0.25% of span.
5) Drift: Shall not exceed 0.25% in a 30-day period.

d. Discrete outputs (DO) shall meet the following requirements:
1) Electrically-latched outputs shall require one program command for set and reset. Loss of power shall return the output to a preselected state. Both fail open and fail close contact states shall be provided.
2) Contact configuration shall be Form A (SPDT); triac outputs - supply with suppression circuit for inductive load.
3) Provide the following ratings: 2 A at 115 Vac inductive load for external relays.
4) Provide arc-suppression for each contact.
5) Power Modules at 115 Vac shall have adequate inrush and holding current rating to operate a NEMA Size 5 motor starter without interposing relay. If a load or the PLC output exceeds the output rating, provide interposing relays.
6) Provide 8- or 16-optically-coupled output configuration.

e. Provide spare inputs and outputs so that a minimum of 15% of each type is spare, functional, and installed in the mounting racks. Permanently label each input and output on each module by the tag number and description given in the Instrument Schedule.

f. Provide at least two spare slots for future modifications/additions.

g. Real-time clock: Provide a real-time clock module for accurate time and data stamping of data.

h. Remote I/O Adapter: Provide a remote I/O adapter for communication between the CPU and other I/O chassis, if required.

7. Communications Module: Provide PLC with Ethernet communications using TCP/IP protocol.

C. PLC Software Requirements: PLC software will be provided and programmed by the Engineer.
D. Programmable Logic Controller Enclosure:
   1. The PLC hardware shall be furnished completely assembled and wired in
      control panel (see Section 17510). Provide for serviceable layout of parts.
      Provide enclosure finish and color to match the motor control center.
   2. Note that certain selector switches, pushbuttons, relays and instruments shall
      be furnished and installed in addition to the programmable logic controller
      hardware proper.

E. Uninterruptible Power Supply (UPS): Provide a UPS unit rated for 200% of PLC
   load with batteries sized to provide at least 1-hour service. Provide Best Products,
   APC, or equal.

F. Spare Parts: Provide the following spare parts.
   1. One input/output module for each type provided.
   2. PLC processor card including memory.
   3. Power supply.

F. Manufacturer: PLCs shall be Allen-Bradley SLC 5/05; AEG Modicon; or equal.

2.02 OPERATOR STATION HARDWARE AND SOFTWARE

A. Computer Purchase: Computers shall be purchased 3 months before the factory
   test. Computers shall use the latest technology at the time. The Contractor shall
   include $4,500 for one SCADA computer (including monitor) in his bid for this
   purchase. The Engineer shall specify hardware requirements based on available
   products from Dell computers.

B. Printer Purchase: Similar to subparagraph A above. The Contractor shall include
   $1,500 for the purchase of one color laser printer.

C. Laptop Computer Purchase: Similar to subparagraph A above. The Contractor
   shall include $3,500 for the purchase of one laptop computer. Laptop computer
   shall be used for remote access to the SCADA system and for downloading
   programs to the PLC.

D. HMI Programming Software: Operator station HMI software will be provided and
   programmed by the Engineer.

PART 3 - EXECUTION

3.01 FACTORY TEST

A. General: The PLC shall be tested at the factory together with the computer system
   and Human Machine Interface Software (HMI).

   1. Programming of the PLC and SCADA will be by the Engineer. The programs
      will be loaded to each PLC during the Factory Test and the entire system will
      be tested jointly by the Engineer and the I&C Subcontractor.
2. The I&C Subcontractor shall coordinate with the Engineer and provide any technical information regarding PLC hardware.

B. Prior to shipment of the PLC to the jobsite, perform a Witnessed Test. This test shall demonstrate full compliance of the PLC with contract requirements. The test shall be performed by the I&C Subcontractor and the Engineer.

C. Prepare a detailed written witnessed test procedure to be submitted at least two weeks prior to start of the test. The test procedure shall describe testing methods and provide detailed specification of the input data and data sequences to be used in the test. If, in the opinion of the Engineer, a resubmission of the proposed test procedure is required, the date for the performance of this test shall be set at least six weeks following delivery of the resubmitted test procedure.

D. Perform the witnessed test in accordance with the test procedure and coordinate with the Engineer. Any deviation in performance from that specified in these Specifications shall be corrected prior to shipment. If the deviation in performance is deemed by the Engineer to be substantial and if it is not corrected within the period allowed for the test, then a second test shall be performed. No extension of Contract time will be allowed in the event that this second test is necessary.

E. Submit the results of the test in a formal document within two weeks following satisfactory performance of the test. The test results shall document all problems encountered in running the test, corrective action taken, and the detailed results of each phase of the test.

3.02 FIELD TEST

A. After the PLC has been installed at the jobsite, a demonstration of compliance with all functional objectives shall be made under actual or simulated operating conditions, subject to favorable review by the Engineer.

B. Prepare a detailed written witnessed test procedure to be submitted at least two weeks prior to start of the test. The test procedure shall describe testing methods and provide detailed specification of the input data and data sequences to be used in the test. If, in the opinion of the Engineer, a resubmission of the proposed test procedure is required, the date for the performance of this test shall be set at least six weeks following delivery of the resubmitted test procedure.

C. Perform the witnessed test in accordance with the test procedure. Any deviation in performance from that specified in these Specifications shall be corrected prior to shipment. If the deviation in performance is deemed by the Engineer to be substantial and if it is not corrected within the period allowed for the test, then a second test shall be performed. No extension of Contract time will be allowed in the event that this second test is necessary.

D. Submit the results of the test in a formal document within two weeks following satisfactory performance of the test. The test results shall document all problems
encountered in running the test, corrective action taken, and the detailed results of each phase of the test.

3.03 TRAINING

A. General: To familiarize the Owner's personnel with PLC operation, training shall be provided as detailed hereunder. The training course shall be conducted under the direction of a training director who shall design a detailed training plan that complements the experience and skill levels of the Owner's personnel. The training course shall be conducted at the treatment plant. The text for training courses below shall be the O&M Manual and selected handouts. The Owner may videotape the training at the Owner's expense.

B. PLC Operations Training: A minimum one-day course shall be provided for up to six persons. The level of training shall be sufficient to familiarize the personnel with the operation of the PLC and programming and program storage device. All essential system operating procedures shall be described as required to enable Owner's personnel to observe the controller operation via the programming device displays.

END OF SECTION
SECTION 17330A

PLC CONTROL STRATEGIES
(FOR REFERENCE ONLY)

CONTROL STRATEGY 1.1

TITLE: PLC System Configuration

A. General: This strategy describes the configuration of the PLC and associated operator workstation (HMI). Programming of the PLC and HMI software shall be provided by the Engineer. All control strategies included in this appendix are for reference only.

B. Description: The PLC shall control operation of the new processes as part of the facility expansion. The screening system for the new Headworks is controlled by a packaged control panel and monitored by the PLC. The operator workstation (HMI) shall be configured and programmed to provide the following:

1. Indication of equipment status and total running hours.
2. Indication and logging of alarms.
3. Indication and totalization of flows.
4. Indication of process variables such as levels, flows.
5. Adjustment of control settings such as time delay and levels setpoints.
6. Scheduling the control of equipment based on 24-hour time clock.
7. Display of alarms and alarm acknowledge system.

C. Operator interface: The HMI shall include indication of functions indicated above. Screen layouts and function selection buttons shall be programmed by the Engineer.

D. Field instruments and devices are connected as PLC Inputs. While some signals are not processed by the PLC for control, they shall be programmed and monitored at the HMI.
CONTROL STRATEGY 1.2

TITLE: General Equipment Interface

AREA: All

RELATED CONTROL STRATEGIES: All

A. General: This strategy describes typical interface logic of the PLC with final control elements such as pumps and other equipment. This applies to all control strategies in this section of the Specifications.

B. Description: The PLC shall monitor or determine the equipment's related inputs/outputs as follows:

1. Monitor whether equipment is in "Ready" mode before initiating or queuing equipment for control.
2. If equipment is ready, the PLC shall activate a normally open discrete output "DO" to start the equipment.
3. The PLC shall interrogate the circuit and monitor the input "RUN" discrete input.
4. If the "RUN" input is not activated within an adjustable time period of \( t = 0 - 10 \) seconds, the PLC shall annunciate an equipment "Fail" condition on the operator interface panel.
5. The PLC shall also annunciate an equipment "Fail" on the operator interface panel if a separate discrete input signal is detected.
6. The "RUN" signal shall activate on elapsed time register in the operator interface to monitor the total run time of equipment.

C. Equipment Alternation: For two or more pieces of equipment of the same function, the PLC shall alternate their operation in one of the following manners. The selection shall be made manually from the HMI.

1. Manual: The "lead" piece of equipment is assigned and will continue to run unless it fails or process conditions require the "lag" or "standby" equipment to run. In the next cycle of operation, the same equipment continues the same assignment unless manually reassigned.
2. Automatic (Run Time): The equipment alternates from "lead," "lag" or "standby" based on manually set run time. When the actual run time exceeds the set point, the PLC places the current "lead" time last in the sequence and starts the next "Ready" equipment in the sequence.

D. Lead-Lag (Standby) Operation (typical for tandem pump arrangements):

1. The Lag or Standby pump starts if a lead pump fails.
2. A pump failure shall occur if a pump fails to run after a call to run following a 0-60 second delay,
   or while called-to-run but fails to continue running,
   or the Lag or Standby pump has been selected but the Lead pump is OFF.

3. A failed pump shall be locked OFF and prevented to restart until reset by the operator. A pump is reset from failed condition when both HOA selectors are placed in OFF.

E. Runtime:
   1. Log the runtime of all pumps.
   2. To determine Runtime, the PLC monitors a start or run contact such as from a MCC motor starter.
   3. Monitor for and determine Runtimes even if the "Ready" signal is not activated.
CONTROL STRATEGY 1.3

TITLE: Alarm System

RELATED EQUIPMENT AND CONTROL STRATEGIES: All

A. General: This strategy describes the monitoring and display of alarm conditions. The alarm conditions can be 1) Discrete input and 2) Derived.

B. Description:
   1. Discrete Input: Whenever a discrete input alarm is detected, the PLC shall annunciate an alarm after an adjustable delay of 0 - 5 seconds. The PLC shall activate a DO to energize a horns at the PLC Control.
   2. Derived Alarms: A derived alarm consists of monitoring of analog inputs and/or logic derivation within control strategies. The PLC monitors these events and produce alarms after an adjustable delay of 0 - 5 seconds.
   3. Setting of alarm setpoint shall be available on the operator interface.

C. Alarm Sequence: The PLC programs shall execute alarms as follows:
   1. Upon the activation of an alarm, the alarm horns shall sound and a flashing indication and alarm text message shall be displayed on the operator interface.
   2. A “Horn Silence” touch pushbutton at the operator interface shall silence the horns and the alarm message shall stay steady.
   3. An “Alarm Reset” touch pushbutton shall remove the alarm message.
CONTROL STRATEGY 2

TITLE: In-Plant Pump Control

AREA: In-Plant Pump Station

RELATED EQUIPMENT:
- In-Plant Pumps: P-205, P-206
- Level Transmitter: LIT-205
- High Level Sensors: LSH-206

A. General: Two pumps, P-205 and P-206, run on lead-lag operation based on level in the In-Plant Pump Station wet well.

B. PLC Functions:
1. Monitoring:
   - Influent Pumps:
     - Ready: YI-205, YI-206
     - Running: XI-205, XI-206
     - Fail: XA-205, XA-206
   - Level: LI-205

2. Alarms:
   - Discrete Input:
     - High Level: LAH-206
   - Derived:
     - High Level: LAH-205

3. Pump Control: The pumps can be started in one of three ways
   b. Hand: At the HMI.
   c. Automatic: By the PLC
      1) Assign a lead pump HS-200 (P-205/P-206). The PLC starts the lead pump HS-205 (P-205)/HS-206 (P-206) and monitors the RUN signal. The lead pump shall start when the level in the In-Plant Pump Station wet well reaches a preset level. Level shall be monitored by ultrasonic level transmitter LIT-205.
      2) The lag pump (P-111/P-112) shall start when a high level (LAH-205) is detected.
      3) Pumps P-205 and P-206 shall alternate based on runtime.
      4) All pumps shall stop when a low level alarm is detected (LAL-205).
      5) The PLC shall annunciate a pump FAIL alarm (XA-205/XA-206) if the pumps are running during a low flow condition when the level in the tank reaches a preset level.
CONTROL STRATEGY 3.1

TITLE: Oxidation Ditch Rotors and Mixers

AREA: Oxidation Ditch

RELATED EQUIPMENT: Oxidation Ditch Rotors: ME-300, ME-301, ME-302
Oxidation Ditch Mixers: M-300, M-301
ORP Analyzer: AIT-301
DO Analyzer: AIT-302
High High Level Sensor: LSHH-300

A. General: PLC control of the Oxidation Ditch equipment shall be as described herein.

B. PLC Functions:
   1. Monitoring:
      Brush Rotors
      Ready: YI-300A, YI-301A, YI-302A
      Running: XI-300A, XI-301A, XI-302A
      Fail: XA-300A, XA-301A, XI-302A
      Speed: SI-300A, SI-301A, SI-302A

      Mixers
      Ready: YI-300B, YI-301B
      Running: XI-300B, XI-301B
      Fail: XA-300B, XA-301B

      ORP: AI-301
      DO: AI-302

   2. Alarms:
      Discrete Input:
      High High Level: LAHH-300

      Derived:
      High/Low ORP: AAH/L-301
      High/Low DO: AAH/L-302

   3. Rotor Control: The rotors can be started in one of three ways
      a. Manual: At the AFD.
      b. Hand: At the HMI.
      c. Automatic: By the PLC
         1. The PLC starts the rotors (ME-300/ME-301/ME-302) and monitors the RUN
            signal and rotor speed. Rotor operation shall be manually assigned at the
            PLC. The rotors shall start when the either the ORP or DO level in the
            Oxidation Ditch reaches a preset (adjustable) level. ORP and DO are
            measured by analyzers AIT-301 and AIT-302, respectively.
4. Mixer Control: The mixers can be started in one of three ways
   b. Hand: At the HMI.
   c. Automatic: By the PLC
      1. The PLC starts the mixers (M-300/M-301) and monitors the RUN signal. Mixer operation shall be manually assigned at the PLC. The rotors shall start when the either the ORP or DO level in the Oxidation Ditch reaches a preset (adjustable) level, as measured by AIT-301 (ORP) and AIT-302 (DO).
CONTROL STRATEGY 4.1

TITLE: Scum Pump Control

AREA: Scum Pump Station

RELATED EQUIPMENT: Scum Pump: P-400
High/Low Level Sensors: LSH/L-400

A. General: The PLC shall monitor and control the sludge pump as described herein.

B. PLC Functions:
   1. Monitoring:
      Influent Pumps:
      Ready: YI-400
      Running: XI-400
   2. Alarms:
      Discrete Input:
      High Level: LSH-400
      Low Level: LSH-400
   3. Pump Control: The pump can be started in one of three ways
      b. Hand: At the HMI.
      c. Automatic: By the PLC
         1) The PLC starts the scum pump (HS-400) and monitors the RUN signal. The pump shall run when a high level is detected in the Scum Pump Station wet well (LAH-400).
         2) The pump shall stop when a low level alarm is detected in the pump station wet well (LAL-400).
CONTROL STRATEGY 4.2

TITLE: Utility Water Fill Pump Control

AREA: Equalization Basin

RELATED EQUIPMENT:
Utility Water Fill Pump: P-402
High/Low Level Sensors: LSH/L-402

A. General: The PLC shall monitor and control the Utility Water Fill Pump as described herein.

B. PLC Functions:

1. Monitoring:
   Utility Water Fill Pump:
   Ready: YI-402
   Running: XI-402

2. Alarms:
   Discrete Input:
   High Level: LSH-402
   Low Level: LSL-402

3. Pump Control: The pump can be started in one of three ways
   b. Hand: At the HMI.
   c. Automatic: By the PLC:
      1) The PLC starts the utility water fill pump (HS-402) and monitors the RUN signal. The pump shall run when a high level is detected in the equalization basin (LAH-402).
      2) The pump shall stop when a low level alarm is detected in the equalization basin (LAL-402).
CONTROL STRATEGY 5.1

TITLE: Return Activated Sludge Control

AREA: Solids Processing Building

RELATED EQUIPMENT: RAS Pumps: P-500, P-501, P-502
                      RAS common flowmeter: FIT-500

A. General: Three adjustable speed pumps are available to pump RAS from Secondary Clarifier back to the distribution box.

B. PLC Functions:

1. Monitoring
   Pump Status:
   Ready: YI-500, YI-501, YI-502
   Fail: XA-500, XA-501, XA-502
   Flow: FIT-500, Indicate and Totalize

2. Pump Control: The pumps can be started in one of three ways
   a. Manual: At the AFD.
   b. Hand: At the HMI. The PLC shall provide speed control for the Adjustable Frequency Drives (AFDs) based on a speed entry by the operator from the HMI.
   c. Automatic: By the PLC
      1) The PLC starts the pump HS-500 (P-500)/HS-501 (P-501)/HS-502 (P-502) at a preset speed and monitors the RUN signal. The pump shall start when called to run by an operator input to the HMI.
      2) The pump speed shall be based on a ratio of the influent flow. Influent flow rate shall be monitored by flowmeter FIT-201.
      3) The pump shall stop on a no flow condition on the RAS line. RAS flow shall be monitored by a common flowmeter FIT-500.

3. Flow Alarm: If at least one RAS pump is running and no flow is detected by FIT-500 after an adjustable time (0-20 seconds) and a flow setpoint is reached, the PLC shall issue a low flow alarm.
CONTROL STRATEGY 5.2

TITLE: WAS Pump Control

AREA: Solids Processing Building

RELATED EQUIPMENT: WAS Pumps: P-503, P-504
WAS Flowmeter: FIT-501

A. General: The PLC shall monitor and control the WAS Pumps as described herein.

B. PLC Functions:

1. Monitoring:
   WAS Pumps:
   Ready: Yl-503, Yl-504
   Running: XI-503, XI-504
   Flow: FIT-501, Indicate and Totalize

2. Pump Control: The pump can be started in one of three ways
   b. Hand: At the HMI.
   c. Automatic: By the PLC:
      1) Assign a lead pump HS-500 (P-503/P-204). The PLC starts the lead pump
         HS-503 (P-503)/HS-504 (P-204) and monitors the RUN signal. The pump
         shall run based on a timer (KIC-500). Run times are adjustable by the
         operator at the HMI.
      2) Pumps P-503 and P-504 shall alternate based on runtime.
      3) The pump shall stop on a no flow condition on the WAS line. WAS flow shall
         be monitored by FIT-501.
      4) See Control Strategy 1.2, paragraph D, for Lead-Standby pump operation.

3. Flow Alarm: If a WAS pump is running and no flow is detected by FIT-501 after an
   adjustable time (0-20 seconds) and a flow setpoint is reached, the PLC shall issue a
   low flow alarm.
CONTROL STRATEGY 6.1

TITLE: Centrifuge Feed Pump Control

AREA: Existing Treatment Facility Pipe Gallery

RELATED EQUIPMENT: Centrifuge Feed Pump: P-703
                    Centrifuge Flowmeter: FIT-700
                    High Pressure Switch: PSH-703

A. General: The Centrifuge Feed Pump shall be adjustable speed and shall pump digested sludge to the centrifuge. The PLC shall monitor and control the pump as described herein.

B. PLC Functions:

1. Monitoring:
   Centrifuge Feed Pump:
   Ready: YI-703
   Running: XI-703
   Fail: XA-703
   Speed: SI-703
   Flow: FIT-700, Indicate and Totalize

2. Alarms:
   Discrete Input:
   High Pressure: PAH-703

3. Pump Control: The pump can be started in one of three ways
   a. Manual: At the AFD.
   b. Hand: At the HMI.
   c. Automatic: By the PLC:
      1) The PLC starts the Centrifuge Feed Pump (P-703) and monitors the RUN signal. Pump feed rate shall be based on a flow rate signal from the Centrifuge Control Panel at the Solids Processing Building.
      2) The pump shall stop when a high pressure alarm (PAH) is detected at the discharge line of the pump.
CONTROL STRATEGY 6.2

TITLE: Polymer Feed Pump

AREA: Solids Processing Building

RELATED EQUIPMENT: Polymer Feed Pump: P-704

A. General: The Polymer System includes a control panel with an Adjustable Frequency Drive (AFD) for the polymer feed pump. The Centrifuge Control Panel sends start/stop signals to the polymer system control panel for pump operation.

B. PLC Functions:

1. Monitoring:
   Polymer Feed Pump:
   Alarm: XA-704

2. Pump Control: The pump runs based on signals from the Centrifuge Control Panel (hard-wired I/O between the Centrifuge Control Panel and the Polymer System control panel.) The PLC shall send an output to the Polymer System control panel to pace the polymer feed pump. Pacing shall be based on an operator input to the HMI.
CONTROL STRATEGY 7

TITLE: Sodium Hypochlorite Pumps

AREA: Pump Building

RELATED EQUIPMENT:
- Sodium Hypochlorite Pumps: P-481, P-482
- Utility Water Line Flowmeter: FIT-480
- Sodium Hypochlorite Tank Level Transmitter: LIT-480

A. General: The PLC shall monitor and control the Sodium Hypochlorite Pumps as described herein.

B. PLC Functions:

1. Monitoring:
   - Sodium Hypochlorite Pumps:
     - Running: XI-481, XI-482
   - Flow: FIT-501, Indicate and Totalize

2. Alarms:
   - Derived:
     - High/Low Tank Level: LAH/L-480
     - Low Flow: FAL-480

3. Pump Control: The pump can be started in one of three ways
   - a. Manual: At the pump control panel.
   - b. Hand: At the HMI.
   - c. Automatic: By the PLC:
     1). Each pump shall be assigned for manual feed or automatic feed by the operator at the HMI. Manual feed shall be to the following systems:
        a. Potable Water
        b. Secondary Clarifiers
        c. Headworks
        d. RAS Pump discharge
     2). Automatic feed shall be for the Utility Water system. When assigned to operate for utility water, the pump shall run when the Utility Water Fill Pump (P-402) is running.

4. Utility Water Flow Alarm: If a pump is running and no flow is detected by FIT-480 after an adjustable time (0-20 seconds) and a flow setpoint is reached, the PLC shall issue a low flow alarm.
TITLE: Electrical Control

RELATED EQUIPMENT:  Electrical Switchboard  
                     Electrical Motor Control Center

A. General: This strategy describes the monitoring for electrical energy and status of the Main Switchboard. In addition, the control strategy shall automatically sequence the restart of major equipment after a restoration of power. [Normal and Emergency]

B. Description: The PLC shall perform the following:

1. Monitoring: Voltage current, power feeder, kW and kWH for power monitor via a serial link.

2. Alarm: Voltage unbalance, low voltage, phase loss or reversal.

3. Energy Monitoring: The Plant's power shall be monitored. Parameters include real power (kW) and reactive power (kVAR), kW, and power factor.

4. Power Failure Management: After the loss of normal power and transfer to standby, the PLC shall restart PLC controlled load in several steps. Stagger start loads in adjustable 20-second increments.

5. When normal load is restored, the PLC shall also restart equipment in steps similar to Item 4 above.
### SECTION 17330B

**PLC INPUT/OUTPUT**

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<th>Device Prefix</th>
<th>Tag</th>
<th>Description</th>
<th>Type</th>
<th>Sheet</th>
<th>PLC No.</th>
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<td>Sampler – Flow Rate</td>
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### SECTION 17330B

**PLC INPUT/OUTPUT**

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SECTION 17510
PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.

B. Work Included: This Section covers control panels shown on the Electrical or Instrumentation Drawings, or as specified in either Division 16 or 17, and sets minimum standards for all packaged unit panels specified in Divisions 11 to 15, unless modified under those sections.

C. Related Sections Specified Elsewhere:
   1. Section 16955: Control Devices
   2. Section 17200: Panel Mounted and Miscellaneous Field Instruments

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA) Publications:
   1. ICS 1 Industrial Control and Systems: General Requirements
   2. ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
   3. ICS 4 Industrial Control and Systems: Terminal Blocks
   4. ICS 6 Industrial Control and Systems: Enclosures

B. Underwriters Laboratories (UL) Publication: 508, Industrial Control Equipment.

1.03 SUBMITTALS

A. Shop drawings to be submitted in this Section shall be made in one package under the Product Review Category of Shop Drawings.

B. Shop Drawings: Submit shop drawings for all control panels, including details for the following items:
   1. Electric power wiring schematics.
   2. Electric signal wiring schematics.
   3. Elementary control diagram.
   4. Air supply piping schematics.
   5. Pneumatic signal tubing schematics.
   6. Fabrication drawings, including a dimensioned outline drawing to scale, showing space for conduits, etc.
   7. Details of seismic restraints (refer to Division 1, General Conditions, Paragraph 1-71, for requirements).
   8. Details of all panel accessories.
10. Panel layouts and nameplate inscriptions.
11. Connections to external equipment.
12. Wire marking scheme.

C. Arrange submissions in a logical manner and on the shop drawings use the device abbreviation identifications and equipment names as shown on the Drawings, in order to expedite and facilitate review by the Engineer.

D. Where unit arrangement or wiring deviates in any way from that shown on the Drawings, provide a complete record and explanation of such deviations.

E. Spare Parts List: Include a spare parts list showing recommended parts and quantities as well as complete ordering information for replacement components. Provide instruction books for special control devices and special equipment installed in the control panels. Submit these to the Engineer prior to installation of the equipment.

F. Manuals: Provide manuals as specified in Section 17010.

1.04 UL LABEL

A. UL Label:
1. Each control panel and terminal cabinet shall bear the UL label except as noted in the following paragraph. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault interrupters, isolation transformers, fuses, and any other necessary equipment, even though such equipment is not indicated on the Drawings. The fabricator shall be an approved UL listed manufacturer.

2. Control panel enclosures containing instruments mounted through the enclosure walls or door shall meet all requirements for UL labeling as above, but no UL label is required. This exception applies only if UL Recognized instruments for the intended purpose are not made.

1.05 PRODUCT DELIVERY AND HANDLING

A. Ship assembled control panels in sections that facilitate handling and field installation.

PART 2 - PRODUCTS

2.01 CONSTRUCTION

A. General:
1. Provide panels as shown on the Drawings. Panels shall conform to the requirements of NEMA Standards ICS 1 (General Standards for Industrial Controls and Systems) and ICS 2 (Standards for Industrial Control Devices, Controllers and Assemblies). The panels shall be wall-mounted or freestanding floor mounted, as shown. Provide sufficient access to the panels.
2. The enclosures shall be code gauge steel of adequate strength, when complete, to withstand seismic forces equivalent to those noted in Division 1, General Conditions, Paragraph 1-71. Enclosures shall conform to requirements of NEMA Standard ICS 6 (Enclosures for Industrial Controls and Systems).

3. The enclosures shall have vertically hinged front doors; provide hinge on side of panel that ensures compliance with the 30-inch rule in NEC Paragraph 110-16(a). Freestanding enclosures shall have doors secured by keyed three point latches, except in corrosive locations. Mount the devices through the doors or on recessed plates. Provide nameplates indicated on the Drawings. Each component within the panel shall be securely mounted and arranged for easy servicing, such that all adjustments and component removal can be accomplished without disturbing other components. No fastening devices shall project through the outer surfaces of the cabinet and all components and terminals shall be mounted on mounting pans within the panels.

4. Construction requirements on a specific type of panel are provided in subsequent paragraphs.

B. Safety Requirements: The electrical supply to each control panel shall be arranged to be disconnected by a single switch or circuit breaker, except for necessary foreign circuits. Any live parts within the control panel fed from foreign control or signal circuits shall be covered or arranged to be disconnected by one of the following methods:

1. Enclosed relays that are automatically de-energized when the main disconnecting switch is opened.
2. Door-operated enclosed disconnect switches; or
3. Clearly identified enclosed manually operated disconnect switches, which may be located inside the control panel door, provided the operating handles are isolated or barriered from all open live parts. Each control panel shall be arranged so that adjustments to timing relays or replacement of fuses can be done without exposure to live parts.

C. Piping and Wiring: Factory wire and pipe control panels. Cable all panel wiring by securing to the panel surfaces with plastic cable ties. Permanently identify each wire at each termination by means of a heatshrink numbered sleeve. Number all electrically common wires the same, and number each electrically different wire uniquely. Provide red wire color for ac wiring, with white neutral and green ground. Provide blue wiring for dc wiring. Wiring shall be 14-gauge, Type MTW or THHN, 600 volt, stranded copper wire. Where wiring crosses hinged surfaces, provide an 18-inch "U" shaped hinge loop of extra flexible wires secured at both ends. Provide ring-type lugs for all panel wiring; spade-type lugs are unacceptable. Use ratchet type crimping tools that do not release until proper crimp pressure has been applied.

D. Terminal Blocks: Terminal blocks shall be rated 600 volts for signals greater than 30 V and 300 volts for signals less than 30 V, and shall conform to requirements of NEMA Standard ICS 4 (Terminal Blocks for Industrial Control Equipment and Systems). The terminal block and terminal lug shall be compatible. Provide disconnecting terminals for any circuit within the control panel that can be energized
when the branch circuit feeding the control panel, if any, is off. Provide terminals for all external (field) connections and provide at least 15% spare terminals. Identify each terminal permanently with the same number as the wire being terminated. Terminals shall be Allen-Bradley 1492 Series, Buchanan, or equal.

E. Nameplates: Provide nameplates as shown on the Drawings, and as specified in Section 17010. A "CAUTION" nameplate shall be attached to the outside of access doors warning of foreign voltages inside the panel (see "Safety Requirements").

F. Finish:
1. After fabrication all external welds shall be ground smooth. The entire unit shall be thoroughly degreased, then filled and sanded. All metal surfaces shall be given a rust-inhibiting treatment or passivator, then one coat of synthetic primer, followed by two coats of synthetic enamel. The average overall finish shall be at least 3 mils in thickness. All damage to the finish during installation shall be touched up at the jobsite as approved.
2. Exterior panel color shall complement adjacent panels and shall be approved by the Owner. Sharp angled horizontal front edges of panels shall be protected by brushed and coated stainless steel angled strip with concealed fasteners.

G. Size and Supports
1. Panels shall be of sufficient size to adequately enclose all instruments designated as "panel-mounted" plus ample interior clearance to allow for installation, general servicing, and maintenance of the instruments. Weight of instruments shall be supported by Unistrut, Famet, Caine, or equal, channel supports. Panel size shall be as indicated on the Drawings.
2. Provide rigid supports for all devices. Supports shall not cause warping or bowing sides or mounting plates.

H. Mounting:
1. Attachment methods shall be detailed on panel fabrication drawing submittals. Heavy panels shall be attached by anchor bolts embedded in beams supporting the floor. See the Structural Drawings for location of beams. Seismic restraints shall be installed as specified by the manufacturer.
2. Mounting pans of rigid sheet steel shall be provided for interior components and accessories as required. A steel divider shall separate pneumatic sections from electrical sections. Devices having both electric and pneumatic connections shall be in the pneumatic section and connected to the electric section with waterproof flexible conduit.

I. Arrangement:
1. The instruments mounted in the panels shall have the nominal size and general arrangement shown. Panel layouts and nameplates shall conform to the approved submittal.
2. Space shall be provided for instruments indicated as furnished by others to be mounted and wired by the control panel manufacturer. These units shall be shipped to the control panel manufacturer in sufficient time for wiring. Coordination of instrument delivery shall be the responsibility of the Contractor. The instruments and controls to be located on each panel are shown on the
J. Ventilation:
1. Ventilation shall be provided to prevent internal panel temperatures from exceeding 140°F.
2. Louvers shall be provided, when required for cooling, near the bottoms and tops on the rear doors and side of panels. 80-mesh screens shall cover the insides of louvers.
3. Provide a thermostatically controlled fan in each enclosure when louvers cannot dissipate heat adequately or cause sufficient flow to all panel areas. Ventilation fans shall be low acoustic type suitable for control rooms. Provide removable cleanable or disposable dust filter for each remote site enclosure.
4. Provide heaters and circulating fans in all outdoor panels to prevent condensation.
5. Provide air control cooling system for panels requiring less than 1,500 Btu/hr heat dissipation.
6. Provide air conditioning for panels requiring high heat removal.

K. Cable Entry Plates:
1. For top entry panels, a gasketed 10-gauge steel cover plate shall be cut that is suitable for the number of conduits. Cable entry plates are not required for bottom, side, or back conduit entry unless the Contractor must specifically control the position, size, and location of cutouts.
2. Cable entry plates shall mount to and be fastened along panel stiffeners and framing segments. Tee nut fasteners are preferred.

L. Signal Ground Buses:
1. Provide each panel with at least one isolated signal ground bus. Provide a bus 1-inch wide by 1/4-inch thick, running from top to bottom. Provide the bus with tapped holes to accommodate ground connections from various devices in the rack. Provide separate ground buses for analog and discrete/digital signals.
2. Connect all signal shield grounds within the panel to the ground bus(es) with ring-tongue connectors that bolt to the bus(es).

M. Signal Ground Plate: For rack, multiple enclosure, or bay systems provide a separate 1/4-inch-thick isolated copper system ground plate. Mount this plate in a location central to all system components.

N. Panel Lights and Receptacles: Panels shall be internally lighted by fluorescent lamps, provided with guards and a toggle switch located convenient to each access door. One duplex GFI type receptacle shall be provided in each panel section. The lights and receptacles shall be wired to outgoing terminal blocks for 120 volt, 60 Hertz, single-phase supply.
2.02 PANEL HARDWARE

A. All doors shall be set flush with three-point vault-type key-locking latches in addition to any required screw clamps. A minimum of two sets of keys supplied. Doors shall be labeled with "AUTHORIZED PERSONNEL ONLY" in 1-inch letters.

B. Hinges shall be piano type. All hardware and handles shall be stainless steel.

C. Leveling adjustments on each panel section shall be provided on freestanding panels.

D. Status lights, selector switches, and pushbuttons shall be as specified in Section 16955.

E. Provide a copy of the elementary control diagram for the control panel, enclosed in plastic and mounted inside the panel.

F. Control panels and electronic racks shall be supplied with door-operated switches (for control circuit interlocking) and accessories as required by Sections 17200 and 16955.

2.03 CONTROL PANELS

A. General:
1. Control panels of steel shall be formed of cold-rolled sheet steel of sufficient thickness and with stiffening as required for fabrication, shipping, erection, and service.
2. Panels shall be fully enclosed, including top, with no visible seams on the front. Panel front construction shall be minimum 3/16-inch stretcher-leveled, cold-rolled steel with stiffeners as necessary to maintain a flatness of ±1/16-inch of any 2-foot span and ±1/8-inch over any 8-foot span with all equipment installed. All other sections shall be 12 gauge except doors shall be minimum 14 gauge and shall maintain the same specified flatness when closed and latched. When shown on the Drawings, filler panels shall extend to the ceiling.
3. Panels shall be provided with adequate internal bracing to support the weight of instruments and wiring. The design shall be for front access. Connections to and from the panels shall be through conduit through the bottom except when otherwise indicated on the electrical drawings.

B. Finish: After fabrication, all external welds shall be ground smooth. The entire unit shall be thoroughly degreased, then filled and sanded. All metal surfaces shall be given a rust-inhibiting treatment or passivator, then one coat of synthetic primer, followed by two coats of synthetic enamel. The average overall finish shall be at least 3 mils in thickness. All damage to the finish during installation shall be touched up at the job site as approved.

C. Exterior panel color shall complement adjacent panels and shall be approved by the Owner. Sharp angled horizontal front edges of panels shall be protected by brushed and coated stainless steel angled strip with concealed fasteners.
2.04 MANUFACTURER

A. Manufacturers of the control panels and terminal cabinets enclosure shall be Hoffman Engineering Company, Circle A-W Products Company, Gibbons Metal Products, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 17010.

B. Install each control panel level and plumb, and secure by the favorably reviewed seismic mounting method. Doors shall swing freely and close tightly.

C. Provide a 3-inch-high concrete pad for each field-mounted, freestanding control panel. Provide a 3-1/2-inch-high I-beam kick panel for each control-room mounted, freestanding panel.

D. Carefully repair any damage to the structure, components or finish to the satisfaction of the Engineer. Clean all nameplates.

E. Exercise care at all times after installation of control panels to keep out foreign matter, dust, dirt, debris, or moisture. Use protective sheet metal covers, canvas, heat lamps, etc., as needed to ensure equipment protection.

F. For all metal panels mounted on concrete walls or floors, install 1/8-inch shims, and paint the backsides and bottom of the panels with Mobil Hi-Build Bituminous Coating 35-J-10; Koppers Bitumastic Super Tank Solution; or equal. Film thickness shall be 10-mils minimum.

END OF SECTION