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SAN BERNARDINO COUNTY

SECTION F

TECHNICAL SPECIFICATIONS

PRADO EAST WELL PROJECT

FOR

SAN BERNARDINO COUNTY
CHINO, CALIFORNIA

PROJECT NO.: 30.30.0168

EAST PRADO WELLS
CHINO, CA

SECTION F
TECHNICAL SPECIFICATIONS

FINAL SUBMITTAL

Technical Specifications Prepared by:

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TECHNICAL SPECIFICATIONS

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SUBMITTALS

PART 1 – GENERAL

1.1 WORK INCLUDED

A. The Contractor shall submit to the Engineer, shop drawings, project data and samples required by specification sections.

1.2 SCHEDULES

A. The Contractor shall prepare and submit a Construction Schedule prior to beginning work.

B. The Contractor shall prepare and submit a separate schedule listing dates for submission of shop drawings, projected return dates and relationship to the Construction Schedule.

PART 2 – PRODUCTS

2.1 SHOP DRAWINGS

A. Original drawings, prepared by Contractor, Subcontractor, Supplier or Distributor, which illustrate portions of the Work; showing fabrication, layout, setting or erection details including, but not limited to the following:

1. Mechanical equipment
2. Valves and operators (w/specific locations)
3. Piping and fittings (w/specific locations)
4. Electrical wiring diagrams
5. Concrete mix designs (with specific locations indicating where each mix design is to be used), grouts, etc.

6. Paintings, coatings, liners, etc.

7. Tanks

8. Booster Pumps and Controls

9. Well Pump

B. Shop drawing submittals shall be prepared by a qualified detailer.

C. Identify details by reference to sheet numbers and detail shown on Contract Drawings.

2.2 PROJECT DATA

A. Manufacturer's standard schematic drawings:

1. Modify drawings to delete information which is not applicable to project.

2. Supplement standard information to provide additional information applicable to project.

B. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data.

1. Clearly mark each copy to identify pertinent materials, products or models.

2. Show dimensions and clearances required.

3. Show performance characteristics and capacities.

4. Show wiring diagrams and controls.

2.3 SAMPLES

A. Physical examples to illustrate materials, equipment, workmanship and finishes, and to establish standards by which completed work is to be judged for compliance with Contract provisions.

B. Office samples of sufficient size and quantity to clearly illustrate:

1. Functional characteristics of product or material, with integrally related parts and attachment devices.

2. Full range of color samples.

PART 3 – EXECUTION

3.1 SUBMISSION REQUIREMENTS

A. Allow a minimum of 14 days for Owner's review.

B. Electronic submissions in pdf format are acceptable.

C. Hard copy submissions – The Contractor shall submit the number of Shop Drawings, Project Datum, and Samples that Contractor requires for distribution plus 2 copies to be retained by Engineer.

D. Accompany submittals with transmittal letter, in duplicate, containing:

1. Date.

2. Project title and number.

3. Contractor's name and address.

4. Notification of proposed deviations from Contract Documents.

5. Other pertinent data.

E. Submittals must include:

1. Date of submittal and revision dates.

2. Project title and number.

3. The names of:

a. Contractor's or Supplier's Engineer.

b. Contractor.
c. Subcontractor.
d. Supplier.
e. Manufacturer.
f. Separate detailer when pertinent.

4. Identification of product or material.

5. Relation to adjacent structure or materials.

6. Field dimensions, clearly identified as such.

7. Identification of deviations from Contract Documents.

8. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.

3.2 RESUBMISSION REQUIREMENTS

A. Shop Drawings:

1. Revise initial drawings as required and resubmit as specified for initial submittal.

2. Indicate on drawings any changes which have been made other than those specifically requested by Engineer.

B. Project Data and Samples:

1. Submit new datum and samples as required for initial submittal.

3.3 DISTRIBUTION OF SUBMITTALS AFTER REVIEW

A. Distribute copies of Shop Drawings and Project Datum which carry Engineer's approval stamp, to:

1. Contractor's file.
2. Job site file.
3. Record Documents file.

4. Other prime contractors.
5. Subcontractors.
6. Supplier.
7. Fabricator.

B. Distribute samples as directed.

END OF SECTION 01 33 00

SECTION 01 71 13

MOBILIZATION

PART 1 GENERAL

1.1 SUMMARY

A. Work Included:

This section shall consist of payment for mobilization, preparatory work (including schedules and Quality Control Program), and demobilization and is intended to compensate the Contractor for operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to/from the project site; for the establishment of offices, buildings, plants, and other facilities at the project site; and for transportation of buildings, Quality Control personnel, laboratory field testing equipment and tools, testing supplies, maintenance of haul roads and other facilities for payment of premium bonds and insurance for the project; for all necessary costs of acquisition of equipment, including purchase and mobilization expense; all permits and fees, maintaining the Contractor's staging area and for all other work and operations which must be performed and costs that must be incurred incident to the initiation of meaningful work at the site and for which payment is not otherwise provided under the contract.

1.2 PROJECT CONDITIONS

A. All facilities, plants, and equipment which are established at or brought to the worksite by the Contractor shall conform to the provisions of these Special Provisions unless the Engineer specifically directs otherwise, in writing, for a specific item or items. The Contractor shall be solely responsible for the adequacy of all facilities and all utilities, structures and other site features that are to remain in place from damage caused by impact, settlement, lateral movement, undermining, washout, and other hazards created by excavation, construction of facilities, and compaction operations equipment.

B. Demobilization costs will include, but not be limited to, removal of temporary utilities to the staging area and removal of temporary field offices, and materials laboratories, demobilization of equipment, and the clean-up and restoration of the construction staging area.

C. This item shall also include noise control, dust control, and the provision of portable construction lighting and back up equipment.

1.3 SUBMITTALS

A. Staging and Storage Area Layout Plan

PART 2 – PRODUCTS

2.1 Water

A. The Contractor shall furnish and maintain an adequate supply of suitable quality water as required for construction and for domestic use. The Contractor shall investigate the availability of suitable water, make all arrangements for the purchase of the water and provide all facilities necessary to furnish water for use during construction. The Contractor shall not draw any water from a fire hydrant for use on the work without first obtaining a permit from the authority having jurisdiction.

PART 3 - EXECUTION

3.1 CONTRACTOR'S STAGING AND STORAGE AREA.

A. The Contractor's staging and storage area location shall be determined in coordination with the County. This area may be used for the Contractor's operations, staging, and storage. The staging and storage area shall be kept in a neat and orderly condition at all times. The County reserves the right to direct the Contractor to correct any deficiencies in the maintenance of the staging and storage area and the Contractor shall promptly comply with the directives of the County.

B. The Contractor's field offices, if needed for this project, shall be located within the staging area.

C. The Contractor shall be responsible for verifying the condition of any existing pavement near and adjacent to the staging and storage area for use to support their construction equipment, stockpiles and materials storage. Damaged pavement, as a result of the Contractor's use of this area, shall be restored to a new paved condition to the satisfaction of the County.

3.2 NOISE CONTROL

A. The Contractor shall endeavor to keep the noise level resulting from its operations to a minimum at all times.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Mobilization will not be measured for payment.

4.2 PAYMENT

A. The Contract lump sum paid for Mobilization shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Mobilization, complete in place as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

END OF SECTION 01 71 13

SECTION 02 41 13

SELECTIVE SITE DEMOLITION

PART 1 – GENERAL

1.1 SUMMARY

A. Work Included:

This section shall consist of:

- Existing Utility Verification and Location
- Clearing and Grubbing
- Apply Weed Killer

B. Existing improvements, adjacent property, utilities, and other facilities that are not called for or otherwise required for removal to accommodate this project shall be protected in-place from injury or damage. Any cost related to protection of these facilities is considered included in the price bid for the various work items and no additional payment will be made therefor. Existing facilities damaged by the Contractor shall be restored to pre-damage condition by the Contractor without cost to the County.

C. Reference Standards:

This Special Provision makes references to the Standard Specifications for Public Works Construction (Greenbook), referred to collectively hereinafter as SSPWC.

1.2 PROJECT CONDITIONS

A. Protect all utilities, structures and facilities, and other site features that are to remain in place from damage caused by impact, settlement, lateral movement, undermining, washout, and other hazards created by excavation, construction of facilities, and compaction operations.

B. The County and Engineer do not warrant the accuracy or completeness of the locations and type of existing utilities and substructures shown on the Plans.

1.3 SUBMITTALS – NOT USED

PART 2 – PRODUCTS

2.1 WEED KILLER

A. Weed killer applied to clear and grubbed area as shown on the Plans.

PART 3 – EXECUTION

3.1 EXISTING UTILITY LOCATION AND VERIFICATION

The Contractor is responsible for accurately locating, by potholing or other suitable methods, all existing utilities such as service connections and substructures, to identify utility facilities within the work area and in potential conflict with the work and to prevent unwanted damage to such facilities and to identify any conflicts with the proposed work.

The Contractor shall perform, or cause or arrange to be performed, all utility mark-out, locating, status verification, and potholing work prior to the start of construction.

The Contractor shall fill all potholes on the same day of excavation, and, if no trenching is performed within 10 working days, fully restore all potholes and any damaged surrounding areas to their original condition unless otherwise allowed by the County.

The Contractor will coordinate with the County or other utility owners to obtain record information and to verify the operational status of utilities in conflict with the proposed construction.

The Contractor shall notify the County, in writing, of any conflicts between existing utilities and the proposed work a minimum of 5 working days, and 300 feet in advance of the work to provide adequate time, and space for any changes to the work needed to avoid unforeseen conflicts. The Contractor shall perform utility location and status verification far enough in advance of the Work to provide the written notification specified in this section.

The Written notification shall include; date of utility location, method of utility location, method of operational status verification, type, size, and material of utility, horizontal location, depth from existing pavement or ground surface to top and bottom of utility, suspected or presumed ownership of utility, and date on which any conflict with the utility will impact the critical path.

The Contractor shall not be entitled to an extension of Contract time or compensation for delay if direction to the Contractor is provided by the County within 5 working days from receipt of the Contractor's written notification of the utility conflict.

3.2 CLEAR AND GRUB AND APPLY WEED KILLER

A. Clearing and grubbing shall be defined as removing and disposing of unwanted surface material such as brush, grass, weeds, trash, and other debris; and stumps, roots, and other unwanted vegetation from underground that conflicts with the proposed improvements. Excludes removal and disposal of concrete structures.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Clear and Grub and Apply Weed Killer will be measured by lump sum.

4.2 PAYMENT

A. The Contract lump sum paid for Clear and Grub and Apply Weed Killer shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Clear and Grub and Apply Weed Killer, including any hauling and disposal costs at an approved landfill as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

END OF SECTION 02 41 13

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Work Included:

This section shall consist of:

- Formwork,
- Reinforcement,
- Accessories,
- Cast-in-place concrete, and
- Finishing and curing.

B. Reference Standards:

This Technical Specification makes references to the Standard Specifications for Public Works Construction ("Greenbook" or SSPWC).

1.2 SUBMITTALS

A. Shop Drawings:

1. Reinforcing placing plan shall be submitted in accordance with the requirements of Section 303-1.7.1 of the SSPWC.

B. Concrete mix design shall be submitted in accordance with the requirements of Section 201-1.1 of the SSPWC.

C. Product Data.

1. Product data and source of material as applicable for chemical admixtures, aggregates, Portland cement and supplementary cementitious materials shall be submitted in accordance with the requirements of Section 201-1.1 of the SSPWC.

2. Certifications for reinforcing materials shall be submitted in accordance with the requirements of Section 201-2.4 of the SSPWC.

3. Product data for waterstops including details for placement of waterstops and details for vertical and horizontal waterstop joint and corner construction and installation.

1.3 QUALITY CONTROL

A. Testing of Portland Cement Concrete shall be in accordance with the requirements of Section 201-1.1.5 of the SSPWC.

PART 2 PRODUCTS

2.1 FORM MATERIALS AND ACCESSORIES

A. Form materials shall conform to the requirements of Section 303-1.3 of the SSPWC.

B. Provide ribbed type waterstops conforming to the requirements of COE CRD C 572 or equal, and manufactured from virgin polyvinyl chloride plastic compound.

1. Construction Joints:
   a. Provide flat ribbed 6-inch by 3/8-inch construction joints, such as Greenstreak Group Inc, Catalog Number 786 Or equal.

2. Manufacturers:
   a. Vinylex Corporation, catalog numbers as specified above, www.vinylex.com or equal.
   b. The Euclid Chemical Company/Tamms Industries, Inc., www.euclidchemical.com or equal.
   c. W. R. Meadows, Inc., www.wrmeadows.com. Greenstreak, www.greenstreak.com or equal.
   d. Approved equal.

2.2 PORTLAND CEMENT CONCRETE

A. Portland Cement Concrete shall conform to the requirements of Section 201-1 of the SSPWC.

B. Portland Cement Concrete used for construction of equipment pad slab on grades shall meet the mix design requirements of mix 658-CME-4500P per Table 201-1.1.3(A) of the SSPWC.

C. Portland Cement Concrete used for construction of manholes and other miscellaneous drainage and sewer structures shall meet the mix design requirements of the *Sewer & Storm Drainage Facilities* section of Table 201-1.1.2(A) of the SSPWC for the various elements constructed unless noted otherwise.

D. Portland Cement Concrete used for construction of all other miscellaneous structures shall meet the mix design requirements of the *Miscellaneous* section of Table 201-1.1.2(A) of the SSPWC for the various elements constructed unless noted otherwise.

2.3 REINFORCEMENT

A. Reinforcement shall be Grade 60 billet steel conforming to ASTM A 615 and shall conform to the requirements of Section 201-2 of the SSPWC.

2.4 CONCRETE CURING MATERIALS

A. Concrete Curing compound shall conform to the requirements of Section 201-4 of the SSPWC.

2.5 GROUT

A. High strength non-shrink grout shall conform to the requirements of non-shrink grout according to Section 201-7 of the SSPWC.

2.6 CONTROLLED LOW STRENGTH MATERIAL

A. CLSM shall conform to the requirements of Section 201-6 of the SSPWC and shall be 190-E-400.

PART 3 EXECUTION

3.1 GENERAL

A. Concrete structures shall be constructed in conformity with the Plans and these Special Provisions. Concrete for use in work constructed under this section shall conform to the requirements contained herein and the requirements of Section 201-1 of the SSPWC as referenced herein.

B. The compressive strength of the concrete referred to in this section will be based on the results of concrete test cylinders made and tested by the contractor in accordance with the requirements contained herein and the requirements of Section 201-1 of the SSPWC as referenced herein.

C. Subgrade for concrete structures shall be prepared in accordance with the requirements of the Plans and these Special Provisions and Section 303-1.2 of the SSPWC.

D. Contractor shall verify equipment foundation dimensions are appropriate for the selected/purchased equipment prior to forming and pouring foundations. Contractor may need to adjust length and width dimension of foundations to fully support the equipment if equipment dimensions vary from plan. Notify Engineer of any discrepancies in final equipment dimensions from those indicated for the foundation on the plans prior to forming and pouring foundations.

3.2 FORMWORK ERECTION

A. Formwork erection, shoring and bracing shall conform to the requirements of Section 303-1.3 and 303-1.6 of the SSPWC.

3.3 INSERTS, EMBEDDED COMPONENTS, AND OPENINGS

A. Provide formed openings where required for work to be embedded in and passing through concrete members.

B. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install concrete accessories straight, level, and plumb.

D. Install waterstops continuous without displacing reinforcement.

3.4 REINFORCEMENT PLACEMENT

A. Placing Reinforcement shall conform to the requirements of Section 303-1.7 of the SSPWC.

3.5 PLACING CONCRETE

A. Placing Concrete shall conform to the requirements of Section 303-1.8 of the SSPWC.

3.6 FORM REMOVAL

A. Removal of forms shall conform to the requirements of Section 303-1.4 of the SSPWC.

3.7 FINISHING

A. Surface finishes shall conform to the requirements of Section 303.1.9 of the SSPWC.

1. Unless noted otherwise all exposed formed surfaces shall receive a Class 1 Surface Finish.

B. Surfaces to receive waterproofing shall be finished to meet the requirements of the waterproofing system manufacturer.

3.8 CURING AND PROTECTION

A. All concrete shall be cured in conformance with the requirements of Section 303-1.10 of the SSPWC.

3.9 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with ACI 318 and the requirements for special inspections according to the 2010 California Building Code as required.

B. Reinforcement Inspection:

1. Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.

C. Strength Test Samples:

1. Sample concrete and make one set of three cylinders for every150 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area for slabs and walls.

D. Field Testing:

1. Measure slump and temperature for each compressive strength concrete sample.

2. Measure air content in air entrained concrete for each compressive strength concrete sample.

E. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39/C39M.

2. Test Acceptance: In accordance with ACI 318.

3. Test two cylinders at 28 days.

4. Test one cylinder at 56 days.

5. Dispose remaining cylinders when testing is not required.

3.10 DEFECTIVE CONCRETE

A. Modify or replace concrete not conforming to required lines, details and elevations, as directed by the County.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Construct Reinforced Concrete Pedestal for Well Pump will be measured for payment by lump sum.

B. Construct Reinforced Concrete Pad for Booster Pump will be measured for payment by lump sum.

4.2 PAYMENT

A. The Contract lump sum paid for Construct Reinforced Concrete Pedestal for Well Pump shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Construct Reinforced Concrete Pedestal for Well Pump, including forms,

excavation, base, concrete and reinforcing, complete in place as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

B. The Contract lump sum paid for Construct Reinforced Concrete Pad for Booster Pump shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Construct Reinforced Concrete Pad for Booster Pump, including forms, excavation, base, concrete and reinforcing, complete in place as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

END OF SECTION 03 30 00

SECTION 22 14 33

BOOSTER PUMPING STATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Materials, fabrication, testing and installation of pump stations

1.2 PRICE AND PAYMENT PROCEDURES

A. Skid Mounted Booster Pumps
   1. Basis of Measurement: Per each simplex skid mounted booster pump station with bladder tank and control panel.

   2. Basis of Payment: Includes materials and equipment to properly install and implement skid mounted booster pump station.

1.3 REFERENCE STANDARDS

A. Section 212 and 306 of the Standard Specifications for Public Works Construction (SSPWC) (Greenbook)

B. Hydraulic Institute

C. ANSI – American National Standards Institute

D. ASTM – American Society for Testing and Materials

E. IEEE – Institute of Electrical and Electronics Engineers

F. NEMA – National Electrical Manufacturers Association

G. NEC – National Electrical Code

H. ISO – International Standards Organization

I. UL – Underwriters Laboratories, Inc.

J. NFPA – National Fire Protection Association

K. AWWA – American Water Works Association

1.4 SUBMITTALS

A. Product Data: Submit data on: pumps, pump motors, pump controller.

1.5 QUALITY ASSURANCE

A. Quality Control shall meet the requirements of Section 306 of the SSPWC Greenbook.

PART 2 PRODUCTS

2.1 DOMESTIC BOOSTER PUMP SKID

A. Variable Speed Packaged Pumping System with Integrated Variable Frequency Drive Motors

1. Furnish and install a pre-fabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure

2. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pump and pump logic controller, shall be designed, built, and tested by the same manufacturer.

3. The complete packaged water booster pump system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. and Canadian Standards.

4. The complete packaged pumping system shall be NSF372 Listed for drinking water and low lead requirements.

B. Pumps

1. The pump shall be NSF 372 Listed for drinking water.

2. The pump shall be of the end-suction horizontal multi-stage design with the discharge vertical on the centerline of the pump.

3. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

4. Cast Iron Horizontal End-suction Multi-Stage Pumps shall have the following features:

   a. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement with a Stop Ring and Nord-lock® washer or similar, which makes it possible to disassemble the pump from the pump side.

   b. The suction/discharge shall have internal pipe thread (NPT) connections as determined by the pump station manufacturer.

   c. On the top of the inlet part should be a priming plug to allow the pump to be nearly completely filled with the liquid to be pumped.

   d. On the lower side of the inlet part should be a drain plug.

5. Pump Construction

a.	Inlet Part, Discharge Part:	Cast iron (Class 30)
b.	Impellers, chambers:	304 Stainless Steel
c.	Shaft:	431 Stainless Steel
e.	Spacing Pipe:	316 Stainless Steel
f.	O-rings:	EPDM

6. The shaft seal shall be an o-ring seal with fixed driver type with the following features:
   a. Retainer and Driver for Seal Ring: 304 or 316 Stainless Steel
   b. Spring: 304 or 316 Stainless Steel
   c. Stationary Seal: Silicon Carbide (Graphite Imbedded)
   d. Rotating Seal: Silicon Carbide (Graphite Imbedded)
   e. O-rings: EPDM

C. Integrated Variable Frequency Drive Motors

1. Each motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (VFD) built and tested as one unit by the same manufacturer.

2. The VFD shall be of the PWM (Pulse Width Modulation) design using current IGBT (Insulated Gate Bipolar Transistor) technology.

3. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.

4. The VFD shall utilize an energy optimization algorithm to minimize energy consumption. The output voltage shall be adjusted in response to the load, independent of speed.

5. The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.

6. An integral RFI filter shall be standard in the VFD.

7. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.

8. The VFD shall have internal solid-state overload protection designed to trip within the range of 125-150% of rated current.

9. The VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%.

10. The VFD motor shall have, as a minimum, the following input/output capabilities:
    a. Speed Reference Signal: 0-10 VDC, 4-20mA
    b. Digital remote on/off
    c. Fault Signal Relay (NC or NO)
    d. Fieldbus communication port (RS485)

11. The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face, Class F insulation with a temperature rise no higher than Class B.

12. The cooling design of the motor and VFD shall be such that a Class B motor temperature rise is not exceeded at full rated load and speed at a minimum switching frequency of 9.0 kHz.

13. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

D. Pump System Controller

1. The pump system controller shall be a standard product developed and supported by the pump manufacturer.

2. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller shall be designed specifically for control of parallel connect pumps in constant pressure applications.

3. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.

4. The controller shall display the following as status readings from a single display on the controller (this display shall be the default):
   - Current value of the control parameter, (typically discharge pressure)
   - Alarm indication (if any)

5. The controller shall have as a minimum the following hardware inputs and outputs:
   - Two analog inputs (4-20mA or 0-10VDC)
   - Two digital inputs
   - Two digital outputs
   - Three PTC connections for motor monitoring
   - Field Service connection to PC for advanced programming and data logging

6. Pump system programming (field adjustable) shall include as a minimum the following:
   - Current setpoint
   - Pump control Off/Auto
   - System control On/Off
   - Alarm reset

7. Pump system programming (field Service connection to PC for advanced programming) shall include as a minimum the following:
   - Water shortage protection (analog or digital)
   - Transducer Settings (Suction and Discharge Analog supply/range)
   - PI Controller (Proportional gain and Integral time) settings
   - High system pressure indication and shut-down

- Low system pressure indication and shut-down
- Low suction pressure/level shutdown (via digital contact)
- Low suction pressure/level warning (via analog signal)
- Low suction pressure/level shutdown (via analog signal)
- Flow meter settings (if used, analog signal)

8. The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.

9. The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for the pump and the control circuit and control relays for alarm functions.

10. The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).

11. The controller shall have the ability to communicate common field-bus protocols, (BACnet, Modbus, Profibus, and LON), via optional communication expansion card installed inside controller.

E. Sequence of Operation

1. The system controller shall operate equal capacity variable speed pumps to maintain a constant discharge pressure (system set-point). The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure. As flow demand increases the pump speed shall be increased to maintain the system set-point pressure. When the operating pump(s) reach 97% of full speed (adjustable), an additional pump will be started and will increase speed until the system set-point is achieved. When the system pressure is equal to the system set-point all pumps in operation shall reach equal operating speeds. As flow demand decreases the pump speed shall be reduced while system set-point pressure is maintained. When all pumps in operation are running at low speed the system controller shall switch off pumps when fewer pumps are able to maintain system demand.

2. The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.

3. All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable.

F. Low Flow Stop Function

1. The system controller shall be capable of stopping pumps during periods of low-flow or zero-flow without wasting water or adding unwanted heat to the liquid. Temperature based no flow shut-down methods that have the potential to waste water and add unwanted temperature rise to the pumping fluid are not acceptable.

2. Standard Low Flow Stop and Energy Saving Mode
A bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When only one pump is in operation the system controller shall be capable of detecting low flow (less than 10% of pump nominal flow) without the use of additional flow sensing devices. When a low flow is detected, the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50% of programmed on/off band). The pump shall remain off until the discharge pressure reaches the start pressure (system set-point minus 50% of programmed on/off band). Upon low flow shut-down a pump shall be restarted in one of the following two ways:
a. Low Flow Restart: If the drop in pressure is slow when the start pressure is reached (indicating the flow is still low), the pump shall start and the speed shall again be increased until the stop pressure is reached and the pump shall again be switched off.
b. Normal Flow Restart: If the drop in pressure is fast (indicating the flow is greater than 10% of pump nominal flow) the pump shall start and the speed shall be increased until the system pressure reaches the system set-point.

G. System Construction

1. Suction and discharge manifold construction shall be in way that ensures minimal pressure drops, minimize potential for corrosion, and prevents bacteria growth at intersection of piping into the manifold. Manifold construction that includes sharp edge transitions or interconnecting piping protruding into manifold is not acceptable. Manifold construction shall be such that water stagnation cannot

exist in manifold during operation to prevent bacteria growth inside manifold.

2. The suction and discharge manifolds shall be constructed of 316 stainless steel. Manifold connection sizes shall be as follows:

3 inch and smaller:	Male NPT threaded
4 inch	ANSI Class 150 rotating flanges

3. Pump Isolation valves shall be provided on the suction and discharge of the pump. Isolation valve sizes 2 inch and smaller shall be nickel plated brass full port ball valves. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy.

4. A spring-loaded non-slam type check valve shall be installed on the discharge of the pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the check valve shall not exceed 5 psi at the pump design capacity. Check valves 1-1/2" and smaller shall have a POM composite body and poppet, a stainless steel spring with EPDM or NBR seats. Check valves 2" and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.

5. For systems that require a diaphragm tank, a connection of no smaller than ¾" shall be provided on the discharge manifold. The diaphragm tank shall be an epoxy coated steel shell with butyl rubber diaphragm, rated to 150 PSI working pressure, and sized for proper operation of pump system.

6. A pressure transducer shall be factory installed on the discharge manifold (or field installed as specified on plans). A factory installed pressure switch on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.

7. A bourdon tube pressure gauge, 2.5 inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts in a stainless steel case. Gauge accuracy shall be 2/1/2 %. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.

8. The base frame shall be constructed of corrosion resistant 304 stainless steel. Rubber vibration dampers shall be fitted between each pumps and base frame to minimize vibration.

H. Testing

1. The entire pump station shall be factory tested for functionality. Functionality testing shall include the following parameters: Dry Run Protection, Minimum Pressure and Maximum Pressure alarms (where applicable), Setpoint Operation, and Motor Rotation.

2. The system shall undergo a factory hydrostatic test at the end of the production cycle. The system shall be filled with water and pressurized to 1.5 times the nameplate maximum pressure. Systems with 150# flange connections shall be tested at 350 psig, and systems with 300# flange connections shall be tested at 450 psig. The pressure shall be maintained for a minimum of 15 minutes with no leakage (slight leakage around pump(s) mechanical seal is acceptable) prior to shipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. Pump station installation shall conform to the pump manufacturers installation procedures.

B. Pump station installation shall conform to the details shown on the plans and shall include the installation of the pump, piping including fittings, couplings, valves, anchor brackets, and control panel.

C. The pump manufacturer shall supply the services of a factory representative to check over the completed pump installation to the satisfaction of the Owner.

D. Qualified supervisory services, including manufacturers' engineering representatives, shall be provided for a minimum of 2 days to ensure that the Work is done in a manner fully approved by the respective equipment manufacturer. The pump manufacturer's representative shall specifically

supervise the installation and alignment of the pump with the driver, the grouting, the alignment of the connecting piping and the installation of the field installed packing. If there are difficulties in the start-up or operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. Services of the manufacturer's representatives and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.

3.2 FIELD TESTING

A. In the presence of the Owner such tests as necessary to indicate that the pump and motor conform to the efficiencies and operating conditions specified shall be performed.

B. If a pump performance does not meet the specified requirements, corrective measures shall be taken including removal of the pump and replacement with a pump which satisfies the conditions specified at no additional cost to the Owner. All test procedures shall be in accordance with factory test procedures and certified results of the tests shall be submitted. Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Owner for approval 30 days prior to testing. The Contractor shall be responsible for obtaining and paying for construction water used in pump testing.

C. If required, take corrective action and have the units retested to ensure full compliance with the specified requirements. All costs associated with the field tests, obtaining water for testing or any required corrective action shall be borne by the Contractor.

D. Contractor shall obtain permit coverage from the local authority having jurisdiction for discharges of hydrostatic test water and potable water to surface waters and storm drains or other conveyance systems before discharging test water from the pump station.

E. Upon completion of the testing and acceptance by the Owner, the Contractor shall set the pump station to function in automatic condition.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Furnish and Install Simplex Booster Pump Package System with Bladder Tank shall not be measured for separate payment.

4.2 PAYMENT

A. The Contract lump sum paid for Furnish and Install Simplex Booster Pump Package System with Bladder Tank shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Furnish and Install Simplex Booster Pump Package System with Bladder Tank, including forms, excavation, base, concrete and reinforcing, installation of booster pump and bladder tank, complete in place as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

END OF SECTION

SECTION 20 00 10

ELECTRICAL GENERAL PROVISIONS

PART 1 – GENERAL

1.1 GENERAL CONDITIONS

A. The General Conditions and Requirements, Special Provisions, are hereby made a part of this Section.

B. The Electrical Drawings and Specifications under this Section shall be made a part of the Contract Documents. The Drawings and Specifications of other sections of this contract, as well as supplements issued thereto, information to bidders and pertinent documents issued by the Owner's Representative are a part of these Drawings and Specifications and shall be complied with in every respect. All the above documents will be on file at the office of the Owner's representative and shall be examined by all the bidders. Failure to examine all documents shall not relieve the responsibility or be used as a basis for additional compensation.

C. Furnish all work, labor, tools, superintendence, material, equipment and operations necessary to provide for a complete and workable electrical system as defined by the Contract Documents. A licensed journeyman shall be on site at all times while electrical work is being performed and a licensed master electrician shall be in charge of the work. Submit license for master electrician and all journeymen.

D. Be responsible for visiting the site and checking the existing conditions. Ascertain the conditions to be met for installing the work and adjust bid accordingly. This project shall include electrical work as shown on the Location Map.

E. It is the intent of the Contract Documents that upon completion of the electrical work, the entire system shall be in a finished, workable condition.

F. All work that may be called for in the Specifications but not shown on the Drawings, or, all work that may be shown on the Drawings but not called for in the Specifications, shall be performed by the Contractor as if described in both. Should work be required which is not set forth in either document, but which work is nevertheless required for fulfilling of the intent thereof, then the Contractor shall perform all work as fully as if it were specifically set forth in the Contract Documents.

G. The definition of terms used throughout the Contract Documents shall be as specified by the following agencies:

1. Underwriters Laboratories
2. National Electrical Manufacturers Association
3. American National Standards Institute
4. Insulated Power Cable Engineers Association
5. National Electrical Code
6. National Fire Protection Association

H. The use of the terms "as (or where) indicated", "as (or where) shown", "as (or where) specified", or "as (or where) scheduled" shall be taken to mean that the

reference is made to the Contract Documents, either on the Drawings or in the Specifications, or both documents.

I. The use of the words "furnish", "provide", or "install" shall be taken to mean that the item or facility is to be both furnished and installed under Division 26, unless stated to the contrary that the item or facility is to be either furnished under another Division or under another Contract, furnished under this Division and installed under another Division or under another Contract, or furnished and installed under another Division or under another Contract.

1.2 PERMITS AND CODES

A. Secure all permits, licenses, and inspection as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, rules, regulations and contract requirements bearing on the work.

B. The minimum requirements of the electrical system installation shall conform to the latest edition of the National Electrical Code, as well as state and local codes.

C. Codes and ordinances having jurisdiction and specified codes shall serve as minimum requirements, but, if the Contract Documents indicate requirements which are in excess of those minimum requirements, then the requirements of the Contract Documents shall be followed. Should there be any conflicts between the Contract Documents and codes, or any ordinances, report these with bid.

PART 2 - PRODUCTS

2.1 STANDARDS

A. All materials and equipment shall conform to the requirements of the Contract Documents. They shall be new, free from defects, and they shall conform to the following standards where these organizations have set standards:

1. Underwriters Laboratories (UL)
2. National Electrical Manufacturer's Association (NEMA)
3. American National Standards Association (ANSI)
4. Insulated Cable Engineers Association (ICEA)

B. All material and equipment of the same class shall be supplied by the same manufacturer, unless specified to the contrary.

C. All products shall bear UL labels where standards have been set for listing. All other products shall be UL labeled. Motor control centers, switchboards, and switchgear shall have UL labels. Custom panels, modified motor starters, control panels, and instrument panels and the like shall be manufactured by a fabricator approved as a UL508A shop and shall bear a UL 508A or UL Industrial Control Panel label.

D. When the Contractor provides a product for this project he shall be bound by the terms and conditions of the Contract Documents and he shall agree to warrant and to be liable for the merchantability and fitness of his product to the applications to which his product is applied under the Contract Documents.

2.2 SHOP DRAWINGS AND SUBMITTALS

A. Shop drawings and submittals shall comply with general conditions and as specified herein.

B. Shop drawings shall be taken to mean detailed drawings with dimensions, schedules, weights, capacities, installation details and pertinent information that will be needed to describe the material or equipment in detail.

C. Submittals shall be taken to mean catalog cuts, general descriptive information, catalog numbers and manufacturer's name.

D. Submit for review all shop drawings and submittals as hereinbefore called for.

E. Review of submittals or shop drawings shall not remove the responsibility for furnishing materials or equipment or proper dimensions, quantity and quality, nor will such review remove the responsibility for error in the shop drawings or submittals.

F. Failure to process submittals or shop drawings on any item and/or items specified shall make the Contractor responsible for the suitability for the item and/or items, even though the item and/or items installed appear to comply with the Contract Documents.

G. Assume all costs and liabilities which may result from the ordering of any material or equipment prior to the review of the shop drawings or submittals, and no work shall be done until the shop drawings or submittals have been reviewed. In case of correction or rejection, resubmit until such time as they are accepted by the Owner's Representative, and such procedures will not be cause for delay.

H. Submittals and shop drawings shall be compiled from the manufacturer's latest product data. Should there be any conflicts between this data and the Contract Documents, report this information for each submittal and/or shop drawing.

I. Shop drawings and submittals will be returned and unchecked if the specific items proposed are not clearly marked, or if the General Contractor's approval stamp is omitted.

J. When requested, furnish samples of materials for acceptance review. If a sample has been reviewed and accepted, then that item of material or equipment installed on the job shall be equal to the sample; if it is found that the installed item is not equal, then replace all such items with the accepted sample equivalent.

2.3 ACCEPTANCE AND SUBSTITUTIONS

A. All manufacturers named are a basis as a standard of quality and substitutions of any equal product will be considered for acceptance. The judgment of equality of product substitution shall be made by the Engineer.

B. Substitutions after award of Contract shall be made only within sixty (60) days after the notice to proceed. Furnish all required supporting data. The submittal of substitutions for review shall not be cause for time extensions.

C. Where substitutions are offered, the substituted product shall meet the product performance as set forth in the specified manufacturer's current catalog literature, as well as meeting the details of the Contract Documents.

D. The details on the drawings and the requirements of the Specifications are based on the first listed material or equipment. If any other than the first listed material or equipment is furnished, then assume responsibility for the correct function, operation, and accommodation of the substituted item. In the event of misfits or changes in work required, either in this section or other sections of the Contract, or in both, bear all costs in connection with all changes arising out of the use of other than the first listed item specified.

E. Substitutions of products under other sections may occur. Make necessary adjustments and additions to work under Division 26 to accommodate those substitutions. Such adjustments and additions shall be performed in compliance with Division 26 Specifications at no additional charge.

F. Energy efficiency of each item of power consuming equipment shall be considered one of the standards for evaluation.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. Cutting and patching required under this section shall be done in a neat workmanlike manner. Cutting lines shall be uniform and smooth.

B. Use concrete saws for large cuts in concrete and use core drills for small round cuts in concrete.

C. Where openings are cut through masonry walls, provide lintel or other structural support to protect the remaining masonry. Adequate support shall be provided during the cutting operation to prevent damage to masonry.

D. Where large openings are cut through metal surfaces, attach metal angle around the opening.

E. Patch concrete openings that are to be filled with nonshrinking cementing compound. Finish concrete patching shall be troweled smooth and shall be uniform with surrounding surfaces.

3.2 WATERPROOFING

Provide waterproof flashing for each penetration of exterior walls and roofs.

3.3 CONSTRUCTION REQUIREMENTS

A. Except where specifically noted or shown, the locations and elevations of equipment are approximate and are subject to small revisions as may prove necessary or desirable at the time the work is installed. Locations changed substantially from that shown on the drawings shall be confirmed with the Engineer in advance of construction.

B. Where equipment is being furnished under another Division, request from Engineer an accepted drawing that will show exact dimensions of required locations or connections. Install the required facilities to the exact requirements of the accepted drawings.

C. All work shall be done in the best and most workmanlike manner by qualified, careful electricians who are skilled in their trade. The standards of work required throughout shall be of the first class only.

D. Unless shown in detail, the Drawings are diagrammatic and do not necessarily give exact details as to elevations and routing of raceways, nor do they show all offsets and fittings; nevertheless, install the raceway system to conform to the structural and mechanical conditions of the construction.

E. Holes for raceway penetration into sheet metal cabinets and boxes shall be accurately made with an approved tool. Cutting openings with a torch or other device that produces a jagged, rough cut will not be acceptable.

F. Cabling inside equipment shall be carefully routed, trained and laced. Cables so placed that they obstruct equipment devices will not be acceptable.

G. Equipment shall be set level and plumb. Supporting devices installed shall be set and so braced that equipment is held in a rigid, tight-fitting manner.

3.4 EQUIPMENT PROTECTION

A. Provide suitable protection for all equipment, work and property against damage during construction.

B. Assume full responsibility for material and equipment stored at the site.

C. Conduit openings shall be closed with caps or plugs during installation and made watertight. All outlet boxes and cabinets shall be kept free of concrete, plaster, dirt and debris.

D. Equipment shall be covered and tightly sealed against entrance of dust, dirt and moisture.

E. All dry-type transformers prior to energization shall be protected against moisture and dirt absorption by a suitable covering. Also, maintain heat inside the covering by means of 100 watt minimum lamps.

F. Interiors of and motor control centers shall be kept clean and dry prior to energization. Maintain heat inside each unit with one (1) 100 watt lamp located at bottom of each vertical section or energize section space heaters.

3.5 COOPERATION WITH WORK UNDER OTHER DIVISIONS

A. Cooperate with all other trades so as to facilitate the general progress of their work. Allow all other trades every reasonable opportunity for the installation of their work and the storage of their materials.

B. The work under this section shall follow the general building construction closely. Set all pipe sleeves, inserts, etc., and see that openings for chases, pipes, etc.., are provided before concrete is placed or masonry installed.

C. Work with other trades in determining exact locations of outlets, conduits, fixtures, and pieces of equipment to avoid interference with lines as required to maintain proper installation of other work.

D. Make such progress in work that will not delay the work of other trades. Schedule the work so that completion dates as established by the Engineer are met. Furnish sufficient labor or work overtime to accomplish these requirements if directed to do so.

3.6 INSTALLATION OF WORK UNDER ANOTHER DIVISION

A. Verify the electrical capacities of all motors and electrical equipment furnished under other sections, or furnished by the Owner, and request wiring information from the Engineer if wiring requirements are different from that specified under this Section. Do not make rough-ins until equipment verification has been received.

B. Install all motors, controllers, terminal boxes, pilot devices, and miscellaneous items of electrical equipment that are not integrally mounted with the equipment furnished under other divisions. All such equipment shall be securely mounted and adequately supported in a neat and workmanlike manner.

3.7 CLEAN-UP

A. Remove all temporary labels, dirt, paint, grease and stains from all exposed equipment. Upon completion of work, clean equipment and the entire installation so as to present a first class job suitable for occupancy. No loose parts or scraps of equipment shall be left on the premises.

B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer or with an approved paint.

C. Clean interiors of each item of electrical equipment. At completion of work all equipment interiors shall be free from dust, dirt and debris.

3.8 TESTS

A. Test all systems furnished under Division 26 and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the Owner's personnel in the proper operation of the system.

B. Make all circuit breaker and protective relay adjustments and settings.

C. Make the following minimum tests and checks prior to energizing the electrical equipment:

1. Check all wire and cable terminations for tightness.
2. Test all wiring as specified in Section 26 01 20.
3. Test grounding system as specified in Section 26 04 50.
4. Set all transformer taps as required to obtain the proper secondary voltage.
5. Carefully check all interlocking, control and instrument wiring for each system to ascertain that the system will function properly as indicated by schematics, wiring diagrams, or as specified herein.
6. Mechanical inspection of all low voltage circuit breakers, disconnect switches, motor starters, control equipment, etc. for proper operation.
7. Provide all instruments and equipment required for the above tests.

3.9 RECORD DRAWINGS

A. At the start and during the progress of the job, keep one separate set of blue-line prints for making construction notes and mark-ups.

B. Show conduit routing and wiring runs as constructed and identify each.

C. Record all deviations from the Contract Documents.

D. Submit set of marked-up drawings for review. The final payment will not be made until the review is complete.

3.10 OPERATIONS AND MAINTENANCE MANUALS

A. Compile an Operations and Maintenance Manual on each item of equipment. These manuals shall include detailed instructions and maintenance as well as spare parts lists.

B. Submit copies for review as hereinbefore specified.

C. Preliminary Operations and Maintenance Manuals shall be included with the initial shipments.

END OF SECTION

SECTION 26 01 10

RACEWAYS

PART 1 - GENERAL

1.1 SCOPE

A. This section shall include raceways, enclosures, supporting devices ancillary fittings and appurtenances. Furnish and install the complete raceway systems as shown on the Drawings and as specified herein.

B. Raceway is a broad-scope term that shall be defined by the National Electrical Code under Article 100.

1.2 APPLICATIONS

A. Except as otherwise shown on the Drawings, or otherwise specified, all underground and in-slab conduit raceways shall be shall be made with schedule 40 PVC. Bends to grade shall be made with plastic coated rigid galvanized steel conduit.

B. Except as otherwise shown on the Drawings, or otherwise specified, all outdoor exposed power, control, and instrumentation, signal, and communication conduit shall be rigid steel conduit, except where areas are denoted as corrosive or NEMA 4X. The inside of the chlorine storage building shall be a NEMA 4X corrosive area. In those area furnish plastic coated rigid steel conduit, fittings, and boxes.

1.3 SUBMITTALS AND SHOP DRAWINGS

A. Process catalog submittals for the following:

1. Plastic Jacketed Rigid Steel Conduit
2. Rigid Non-Metallic Conduit
3. Liquid-tight Flexible Conduit
4. Liquid-tight Fittings
5. Conduit Bushings
6. Conduit Bodies
7. Conduit Sealing Fittings
8. Expansion-Deflection Fittings
9. Expansion Fittings
10. Cast Metal Boxes
11. NEMA 4X J-Boxes
12. Tape Products
13. Wiring Devices
14. Supporting Devices
15. Labels
16. Grounding Devices
17. Foam Sealant
18. Conduit End Bell Fittings

PART 2 - PRODUCTS

2. 1 RACEWAYS

A. Rigid metallic aluminum conduit shall be manufactured of 6063 alloy, T-1 temper, with no more than 0.02% copper content. All conduit couplings shall be threaded aluminum. All such conduit shall be listed with UL and comply with UL-6 and ANSI C80.5. Aluminum conduit shall be Easco, Indalex or equal.

B. Rigid metallic steel conduit shall be hot-dip galvanized inside and outside and over threads. All such conduit shall comply with U.L. Standard UL-6, Federal Specification WWC-581-D, ANSI C90.1, and NEMA RN1-1980. Furnish Wheatland, Allied or equal.

C. Plastic coated rigid steel conduit shall consist of rigid steel body that complies with above specifications for rigid metallic steel conduit, plus conduit shall have 40 mil thick heat-fused PVC over outside and 2 mil coat of fully catalyzed phenolic inside. The inside coat shall have the chemical resistance of the outer coating and shall not dissolve in lacquer thinner. All couplings shall be equipped with PVC sleeves that extend one pipe diameter or 2", whichever is less, beyond the end of the coupling. All plastic coated conduit shall conform to NEMA Standard #RNI-1974 (Type A) and such conduit shall be Robroy "Plastibond Red", or equal.

D. Non-metallic rigid conduit shall be Schedule 40 PVC. Such conduit shall be UL listed for 90 degrees C and shall conform to NEMA TC-2 and UL-651 standards. Furnish Carlon, Cantex, or equal. Furnish manufacturer's approved solvent for joining couplings.

E. Liquid-tight flexible conduit shall consist of hot-dipped galvanized, flexible interlocking steel core with thermoplastic cover, integral copper ground wire (through 1-1/4" trade size) and shall be Anaconda Sealtite or equal.

2.2 CONDUIT FITTINGS

A. NEMA 4 locknuts for rigid metallic conduit shall consist of galvanized steel body with neoprene sealing ring. Furnish Crouse-Hinds, T&B, or equal.

B. NEMA 1 locknuts for rigid metallic conduits shall be galvanized steel for use with galvanized steel conduit and hardened aluminum for use with aluminum conduit.

C. Conduit field-applied hubs for sheet metal enclosures shall be aluminum body with recessed neoprene sealing ring, threaded NPT insert, and shall be, T&B 370 AL series, or equal products by OZ/Gedney.

D. Conduit hubs for non-metallic enclosures shall be fiberglass polyester reinforced with galvanized steel core, complete with locknut and grounding bushing. All such hubs shall be Crouse-Hinds Type NHU, or equal.

E. Rigid metallic conduit chase nipples, split couplings, slip fittings, unions, reducers, and enlargers, shall be hot-dip or mechanically galvanized malleable iron.

F. Rigid metallic conduit short els and long els shall be hot-dip galvanized malleable iron with NPT threaded hubs and male ends. Throats shall be smooth and free from burrs. All such fittings shall be OZ/Gedney Type "9" Series, Appleton, or equal.

G. Rigid metallic conduit split couplings shall have threaded body with split tightening shelves with neoprene sandwich. Furnish malleable iron mechanically galvanized body. Such fittings shall be OZ type "SSP", or equal.

H. Rigid metallic conduit grounding bushings shall be aluminum body with threaded hub, bakelite insulated throat, and tin-plated copper ground lug. Furnish OZ/Gedney type ABLG, or equal.

I. Liquid-tight flexible conduit fittings shall be hot-dip galvanized steel body with internal locking ring and ground cone plus external ground wire fitting. Furnish straight or angle connectors as required. All such connectors shall be OZ/Gedney 4Q series, or equal.

J. Rigid metallic conduit expansion/deflection fittings shall consist of galvanized malleable iron hubs with heat-fused epoxy coating, flexible neoprene joining sleeve banded to hubs with stainless steel bands, and with internal bonding jumper and guide cones. Furnish Crouse-Hinds type "XDHF" or equal.

K. Rigid metallic conduit expansion fittings shall consist of metallic barrel joined to hubs at each end. One hub shall be threaded to barrel and other hub shall have slip fit to allow up to four (4") inches of conduit lateral movement. Provide external bonding jumper for each expansion joint. Furnish Crouse-Hinds type "XJ", OZ Type "AX", or equal.

L. Conduit waterstops for sealing inside of conduit runs shall consist of aluminum pressure discs with sandwiched neoprene seal and with 316 stainless steel hardware. Furnish OZ/Gedney type "CS" series products, as indicated.

2.3 CONDUIT BODIES AND BOXES

A. Conduit bodies such as "C", "LB", "T" and the like pulling fittings shall be zinc coated with malleable iron or aluminum (material shall match conduit). Covers for damp and/or wet location use shall be gasketed cast metal with "wedge-nut" clamps. Covers for dry locations shall be cast aluminum and hardware shall be 316 stainless steel. All covers shall be equipped with clamp type clevises. Furnish Crouse-Hinds Form 7, or Appleton Form "FM7" products.

B. Conduit bodies for use in corrosive areas shall be as specified above but shall have 40 mil plastic coated PVC jacket and 2 mil interior coating as specified for plastic coated rigid steel conduit. Furnish Robroy Plasti-bond Red fittings or equal.

C. Conduit bodies such as "GUA", "GUAT", "GUAL", and the like pulling/splicing fittings shall be cast aluminum with threaded cast aluminum covers. All such conduit bodies shall be Killark "GE" series, or equal products by Crouse-Hinds or Appleton.

D. Cast metal outlet boxes, pullboxes, and junction boxes whose volume is smaller than 100 cubic inches, and cast metal device boxes, shall be sand-cast, copper-free aluminum or zinc coated sand-cast malleable iron. All boxes shall have threaded hubs. Furnish Crouse-Hinds "FD" style condulets, Appleton "FD" style Unilets, or equal.

E. Covers for cast metal boxes shall be gasketed cast metal covers with 316 stainless steel screws and shall be suitable for use in wet or damp locations.

2.4 PULL AND JUNCTION BOXES

A. Pullboxes and junction boxes whose volume is less than 100 cubic inches shall be furnished as specified hereinbefore except where sheet metal types are shown, in which case, furnish such sheet metal enclosures in NEMA 4X 316 stainless steel construction with gasketed covers of same material.

B. Pullboxes and junction boxes whose volume is 100 cubic inches and greater shall be NEMA 4X 316 grade stainless steel type with gasketed stainless steel covers. Provide print pocket and interior back panel for mounting of terminal strips where terminal strips are called for on the drawings. Sheet metal boxes shall be as manufactured by Hoffman or equal.

C. Covers for sheetmetal pullboxes and junction boxes over 100 cubic inches (and for smaller sized where shown) shall have hinged doors. All hardware shall be 316 stainless steel.

D. Cast metal junction boxes shall be cast aluminum type with gasketed, cast metal covers and with stainless steel cover screws.

2.5 LABELS

A. Buried conduit marking tape for marking path of secondary buried conduits shall be four (4") inch nominal width strip of polyethylene with highly visible, repetitive marking "BURIED CONDUIT" or similar language, repeated along its length.

B. Voltage warning labels for cabinets shall be waterproof vinyl strips with adhesive back and shall have "DANGER (VOLTAGE) - DISCONNECT ALL SOURCES OF POWER BEFORE ENTERING". Letters shall be highly visible red color on white background.

2.6 SUPPORTING DEVICES

A. Mounting hardware, nuts, bolts, lockwashers, and washers, shall be Grade 304 stainless steel.

B. Unless otherwise indicated, channel framing and supporting devices shall be manufactured of ASTM 6063, TO6 grade aluminum; 1-5/8" wide x 3-1/4" deep (double opening type). Clamp nuts for use with channels shall be grade 316 stainless steel.

C. Where indicated, furnish grade 316 stainless steel slotted channel members 1-5/8" wide x 1-5/8" deep or 1 5/8" x 3 1/4" deep, double-faced type. All hardware and conduit clamps shall be grade 316 stainless steel.

D. Conduit clamp supports for terminating conduits onto cable trays shall be mechanically galvanized malleable iron with adjustable angle clamp. Fittings shall be provided with 316 stainless steel hardware. Furnish OZ/Gedney type CTC products.

E. All such channel members and fittments shall be B-Line, Unistrut or equal.

F. Conduit straps, and associated nuts, lockwashers and bolts for use with channels shall be 316 stainless steel with 316 stainless steel hardware. Furnish B-Line products or equal.

G. After-set concrete inserts (drilled expansion shields "D.E.S.") shall consist of two types. For anchors to accommodate 5/16" diameter bolts and smaller, provide HILTI "HDI" series 304 stainless steel anchors. For anchors to accommodate 3/8" diameter and larger bolts, provide HILTI "HVA" series with 316 stainless steel threaded inserts.

H. Hanger rod shall be 3/8" minimum diameter Type 316 stainless steel all-thread.

I. One hole conduit clamps shall be two piece nest-back or clamp-back type constructed of cast malleable iron or cast copper-free aluminum. The material shall match the conduit. Furnish Crouse-Hinds series 500 clamp and series CB spacer, T&B series 1270/1280 clamp + series 1350 spacer (add suffix "al" for aluminum items for T&B parts), OZ\Gedney 14G clamp + series 141G spacer + 141NG nestback (if required), or equal. Finish for malleable iron items shall be hot dip galvanized

J. Conduit beam clamps shall be hot-dip galvanized malleable iron and shall be as follows:

TYPE	MANUFACTURER
Right Angle	OZ/Gedney Type "UBCG", or equal.
Parallel	OZ/Gedney Type "UPCG", or equal.
Edge	OZ/Gedney Type "UECG", or equal.

K. Hanger rod beam clamps shall be clamp type with hardened steel, bolt, Steel City "500" Series, Crouse-Hinds series "500", or equal. Furnish swivel stud for each rod make- up.

L. Conduit "J" hangers shall consist of steel straddle with detachable bolt. Finish shall be electro-galvanized. Furnish Kindorf type "C-149", Unistrut "J-1200" Series, or equal.

M. Conduit "U" bolts shall be hot-dip galvanized steel with 316 stainless steel hex-head bolts.

N. Equipment stands for supporting devices such as control stations, device boxes and the like, shall consist of a welded structural steel c-channel and plate steel floor plate as detailed on the drawings. Equipment stands shall be hot-dipped galvanized after fabrication.

2.7 MISCELLANEOUS MATERIAL

A. Double bushings for insulating wiring through sheet metal panels shall consist of mating male and female threaded phenolic bushings. Phenolic insulation shall be

high-impact thermosetting plastic rated 150 degrees C. Furnish OZ Type "ABB", or equal.

B. Conduit pull-cords for use in empty raceways shall be glass-fiber reinforced tape with foot-marked identification along its length. Furnish Thomas, Greenlee, or equal products.

C. Conduit thread coating compound shall be conductive, non-galling, and corrosion-inhibiting. Furnish Crouse- Hinds Type "STL", Appleton Type "ST", or equal.

D. Plastic compound for field-coating of ferrous material products shall be PVC in liquid form that sets-up semi- hard upon curing. Furnish Rob Roy "Rob Kote", Sedco "Patch Coat", or equal.

E. Zinc spray for coating galvanized steel threads shall be Research Laboratory type "LPS", Mobil "Zinc-Spray" or equal conductive zinc-rich spray enamel product.

F. Foam sealant for waterproofing uses shall be "AV280 Hydrofoam" by Avanti Internarional of Webster, Texas or equal.

PART 3 - EXECUTION

3.1 RACEWAYS

A. Install the conduit system to provide the facility with the utmost degree of reliability and maintenance free operation. The conduit system shall have the appearance of having been installed by competent workmen. Kinked conduit, conduit inadequately supported or carelessly installed, do not give such reliability and maintenance free operation and will not be accepted.

B. Raceways shall be installed for all wiring runs, except as otherwise indicated.

C. Conduit sizes, where not indicated, shall be N.E.C. code-sized to accommodate the number and diameter of wires to be pulled into the conduit. Unless otherwise indicated, 3/4" trade-size shall be minimum size conduit.

D. Unless otherwise noted, conduit runs shall be installed exposed. Such runs shall be made parallel to the lines of the structure. Conduit shall be installed such that it does not create a tripping hazard or an obstruction for headroom.

E. All runs of rigid conduit shall be threaded, and all male threads shall be coated with non-galling thread compound prior to assembly.

F. Plastic coated metallic conduit lengths shall be joined with threaded metallic coupling that shall be each equipped with a 40 mil thickness sleeve that shall extend over the threads of the joined conduit. Each joint shall be watertight.

G. Field-cut threads in runs of plastic coated metallic conduit shall be cut with a special die that has rear reamed out oversize so as to slip over plastic coating. Do not attempt to cut threads on plastic coated conduit with regular dies, whereby plastic coating is skinned back to allow the incorrect die to be used. Coat all field-cut threads with cold-galvanizing spray, use two coats to provide 1-mil minimum coating thickness.

H. Conduit runs made in concrete pours or surface-mounted runs that are attached to the structure shall be equipped with an expansion/deflection fitting where they cross an expansion joint, or at every 100 feet.

I. Unless otherwise shown, conduit penetrations through floors located below enclosures, shall be made each with couplings set flush with the outside faces of the concrete pour. Each pair of couplings shall be joined with a threaded spool piece. Use coated aluminum or galvanized steel couplings.

J. Rigid metallic conduit runs shall have their couplings and connections made with screwed fittings and shall be made up wrench-tight. Check all threaded conduit joints prior to wire pull. Coat all male threads with Crouse-Hinds "STL" or equal, conductive lubricant prior to joining.

K. All conduit runs shall be watertight over their lengths of run, except where drain fittings are indicated. In which cases, install specified drain fittings.

L. Plastic jacketed flexible steel conduit shall be used to connect wiring to motors, limit switches, bearing thermostats, and other devices that may have to be removed for servicing. Unless otherwise indicated, maximum lengths of flex shall be three (3') feet.

M. Where plastic jacketed flex is installed, make up terminal ends with liquid-tight flex connectors. In wet locations, install sealing gaskets on each threaded male connector. Each flex connector shall be made-up tightly so that the minimum pull-out resistance is at least 150 lbs. Install external spirally-wrapped ground wire around each run of liquid-tight flex and bond each end to specified grounding-type fittings.

N. Empty conduits shall have pull-ropes installed. Identify each terminus as to location of other end and trade size of conduit. Use blank plastic waterproof write-on label and write information on each label with waterproof ink. Pull a mandrel through each conduit to check and clear blockage before installing pull-rope. Owner's representative shall witness test. Provide documentation that all conduits are clear and ready for future use. Cap exposed ends of empty conduit with threaded plugs.

O. Conduit runs into boxes, cabinets and enclosures shall be set in a neat manner. Vertical runs shall be set plumb. Conduits set cocked or out of plumb will not be acceptable.

P. Conduit entrances into equipment shall be carefully planned. Cutting away of enclosure structure, torching out sill or braces, and removal of enclosure structural members, will not be acceptable.

Q. Use approved hole cutting tools for entrances into sheet metal enclosure. Use of cutting torch or incorrect tools will not be acceptable. Holes shall be cleanly cut and they shall be free from burrs, jagged edges, and torn metal.

R. All raceways shall be swabbed clean after installation. There shall be no debris left inside. All interior surfaces shall be smooth and free from burrs and defects that would injure wire insulation.

3.2 CONDUIT BODIES AND BOXES

A. Conduit bodies such as "LB", "T", "GUAT", etc., shall be installed in exposed runs of conduit wherever indicated and where required to overcome obstructions and to provide pulling access to wiring. Covers for such fittings shall be accessible and unobstructed by the adjacent construction. GUA series pulling bodies rather than LB fittings and the like, shall be used for splicing purposes as well as pulling access.

B. Covers for all conduit bodies shall be installed with gasketed cast metal type where located in damp or wet locations.

C. All conduit boxes installed whose inside volume is less than 100 cubic inches shall be cast metal type with gasketed cast metal cover, unless otherwise indicated.

D. All conduit boxes whose inside volume exceeds 100 cubic inches shall be sheet metal type except where gasketed cast metal type, stainless steel or fiberglass reinforced polyester are indicated.

3.3 RACEWAY SUPPORT

A. All raceway systems shall be adequately and safely supported. Loose, sloppy and inadequately supported raceways will not be acceptable. Supports shall be installed at intervals not greater than those set forth by the NEC, unless shorter intervals are otherwise indicated, or unless conditions require shorter intervals of supports.

B. Multiple runs of surface mounted conduit on concrete or masonry surfaces shall be supported off the surface by means of aluminum channels. Attach each slotted channel support to concrete surface by means of two (2) 1/4" diameter stainless steel bolts into drilled expansion shields.

C. Single runs of surface mounted conduit on concrete or masonry surfaces shall be supported with hot-dipped malleable iron conduit clamps and nest-back spacers. Furnish plastic coated malleable iron conduit clamps and nest backs where corrosive areas are called out.

D. Conduit runs that are installed along metallic structures shall be supported by means of hot-dipped galvanized beam clamps as specified herein.

3.4 LABELING

A. In addition to labeling requirements as specified throughout this and other Sections, install wiring and raceway labeling as follows:

1. Apply write-on identification to empty conduits to identify each conduit as to terminus of other end and also to identify trade size of conduit.

2. Where active conduits terminate into bottoms of motor control centers, install label on each conduit terminus and show number and size of wiring and function of circuitry and trade size of conduit.

END OF SECTION

SECTION 26 01 20

WIRE AND CABLE

PART 1 - GENERAL

1.01 SCOPE

A. This section shall include wire and cable, terminating devices, splice kits, labeling, and appurtenances.

1.02 STANDARDS

A. ASTM

B. UL 1277 Electrical Power and Control Tray Cables

C. UL 1685 Flame Exposure Test for Tray Cables

D. ICEA T-29-520 Vertical Cable Tray Flame Test

E. IEEE 1202 Flame Testing of Cables for use in Cable Tray

1.03 SUBMITTALS AND SHOP DRAWINGS

A. Process catalog submittals for the following:

1. Power and control cable
2. Instrument cable
3. Conductor Connectors
4. Tape Products
5. Labels

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

A. All conductors shall be soft-drawn annealed copper, Class B stranding that meets ASTM B-8. Copper conductors shall be uncoated, except as otherwise specified.

B. Single conductor cable for power, control, and branch circuits shall have cross-linked polyethylene insulation, rated for 600 volts. Cable shall be NEC type XHHW-2. All such cable shall be rated for wet or dry use. Cable insulation shall be color coded with factory pigmented colors below size #6 awg. Color coding shall be as specified under Part 3 of this section. Cable shall be as manufactured by Southwire or equal.

C. Instrument cable for analog circuits, shall be # 16 awg, twisted shielded pairs or triads with PVC insulation and overall jacket. Cable assembly shall be rated for 600 volts, wet or dry locations. Furnish Okonite "Okoseal-N Type P-OS" or approved equal.

D. Single conductor cable for 24 volt dc control shall be minimum size #16. Furnish MTW type insulation for panel wiring and XHHW-2 insulation for field wiring in conduits.

E. Single conductor cable 1/0 and above for use in cable trays shall be rated for CT (cable tray) use. Insulation shall be cross-linked polyethylene, XHHW-2. Furnish Southwire XHHW/TC or approved equal.

F. Multi-conductor power cable for use in cable trays shall be 600 volt and rated for CT use. Cable assembly shall be three or four conductor with ground conductor. Insulation of each conductor shall be cross-linked polyethylene, XHHW. Ground shall be bare. Cable assembly shall have an overall PVC jacket. Furnish Southwire type TC or approved equal.

G. Multi-conductor control cable for use in cable trays shall be 600 volt and rated for CT use. Insulation of each conductor shall be cross-linked polyethylene, XHHW. Cable assembly shall have an overall PVC jacket. Furnish Southwire type TC Control Cable or approved equal.

H. Multi-conductor instrumentation cable for use in cable trays shall be 600 volt rated and rated for CT use. Cable assembly shall consist of shielded pairs or triads with overall shield and Nylon jacket. Conductor insulation shall be flame retardant PVC. Furnish Okonite Company “Okoseal-N Type SP-OS or approved equal.

I. Multiconductor cable for connection of the output of VFDs to motors shall be 90 deg C rated, 2000 volt copper conductors with RHW insulation, copper tap shield and groiund conductors. Furnish Service Wire Company "ServiceDrive" or equal cable.

J. Ground mat and associated upcomers and grounding conductors shall be tin-plated stranded copper.

K. Cable for RS485 applications shall be Belden #9841.

L. Telephone cable for underground shall be solid conductor 22 awg and shall meet REA Specification PE-39. Furnish HWC series N08022-XX in pair numbers as indicated on the drawings.

M. Telephone cable for inside of buildings shall be unshielded, twisted pair, solid conductor 24 awg and shall be in pairs as indicated on the drawings. Furnish Belden model 9562 (two pair), 9566 (six pair), 9570 (ten pair), or 9585 (twenty five pair).

N. Fiber optic cable shall be 6 fiber count cables. Cable shall be 62.5 um multimode and shall be suitable for installation in conduit. Furnish Corning FREEDM One Riser Cables.

2.2 CONNECTORS

A. Mechanical connectors for 600V class wiring shall be tin-plated copper alloy bolted pressure type with bronze tin-plated hardware. Furnish connectors as follows:

TYPE	MANUFACTURER & TYPE
Single conductor to flat-plate connector	Blackburn LH
Multiple conductor to flat-plate connector	Blackburn L2H, L3H, L4H
Split-bolt connector	Blackburn HPS
Two-bolt parallel connector with spacer	Blackburn 2BPW
Cross Connector	Blackburn XT
Splice Connector	Blackburn S
Flush ground connector	OZ Type "VG"

B. Insulated spring wire connectors, "wire-nuts", for small building wire taps and splices shall be plated spring steel with thermoplastic jacket and pre-filled sealant. Connector shall be rated for 600 volts, 75 degrees C continuous. Furnish King Technology, or equal.

C. Connectors for control conductor connections to screw terminals shall be crimp-type with vinyl insulated barrel and tin-plated copper ring-tongue style connector. Furnish T&B "Sta-Kon", 3M "Scotchlok", or equal.

D. Terminal strips for miscellaneous field terminations of control and instrumentation circuits shall consist of 12 point box lug terminals with marking surface. Terminal assembly shall accept #18 to #12 awg and shall be rated 600 volts. Furnish Allen-Bradley #1492-HJ812 terminal blocks.

2.3 INSULATING PRODUCTS

A. Tape products shall be furnished as hereinafter specified and shall be Plymouth, Okonite, 3M, or equal.

B. General purpose electrical tape shall be 7 mil thick stretchable vinyl plastic, pressure adhesive type, "Slipknot Grey", 3M Scotch 33+, or equal.

C. Insulating void-filling tape and high voltage bedding tape shall be stretchable ethylene propylene rubber with high-tack and fast fusing surfaces. Tape shall be rated for 90 degrees C continuous, 130 degrees C overload, and shall be moisture-proof. Void filling tape shall be "Plysafe", 3M Scotch 23, or equal.

D. High temperature protective tape shall be rated 180^{o}C continuous indoor/outdoor, stretchable, self-bonding silicone rubber. High temperature tape shall be Plysil #3455, 3M Scotch 70, or equal.

E. Insulation putty filler-tape shall be Plymouth #32074, 3M Scotchfill, or equal.

F. Arc and fireproofing tape shall be Plymouth #3318, 3M Scotch #70 or equal.

2.4 LABELS

A. Colored banding tape shall be 5 mil stretchable vinyl with permanent solid color. Colors shall be as hereinafter specified. Tape shall be Plymouth "Slipknot 45", 3M Scotch #35, or equal.

B. Numbered wire marking labels shall be PVC sleeve-type markers, T&B, Brady or equal. Markers using adhesive are not acceptable.

C. Cable identification ties shall be weather resistant polyester with blank write-on space, T&B, Brady or equal.

2.5 MISCELLANEOUS MATERIAL

A. Cable grips shall be 316 SS grip-type wire mesh with machined metal support. Furnish Kellems, Appleton, or equal products.

B. Wire pulling compound shall be non-injurious to insulation and to conduit and shall be lubricating, non- crumbling, and non-combustible. Furnish Gedney "Wire-Quick", Ideal "Yellow" or equal.

C. Fiber Optic Patch Panels shall be 12 fiber with SC connectors. Furnish Corning SPH-01P units. Furnish two patch panels per RTU enclosure. One shall be for the 6 fiber cable ring and the other shall be for interconnection of fiber optic cables for the video surveillance system cameras.

D. Patch cables shall be factory terminated and tested in lengths as needed with SC or ST connectors as required. Furnish Industrial Networking Solutions or equal products.

E. Conduits for concrete encased ductbanks that are supported by piers shall be fiberglass conduits manufactured by Champion.

PART 3 - EXECUTION

3.1 POWER AND CONTROL CABLE

A. Power and control conductors shall be sized as shown and where no size is indicated, the conductor size shall be #12 awg for power circuits #14 awg for 120 vac control circuits, and #16 awg for instrumentation circuits.

B. Equipment grounding conductors shall be installed with type XHHW insulated stranded copper conductors and the insulation color shall be green in sizes up to and including #10 awg.

C. Color coding shall be as follows. Non-factory color coded cables shall be marked
with specified color tape. Use the following colors:

CONDUCTOR	120/208V SYSTEMS	480V SYSTEMS

Phase A or L1	Black	Brown
Phase B or L2	Red	Orange
Phase C	Blue	Yellow
Neutral	White	N/A
Ground	Green	Green

D. Branch circuits may be spliced for receptacle, lighting and small appliance load inside appropriate junction boxes. Feeders, branch circuit, power wiring, control wiring, and signal wiring shall be installed without splice.

E. Except as otherwise specified, taps and splices with #10 AWG and smaller, shall be made with insulated spring wire connectors. Such connectors in damp or wet locations shall be waterproofed by filling interstices around wires with silicone rubber and further insulating with an envelope of stretched piece of EPR tape around each wire. Then, apply one-half lapped layer of electrical tape over all.

F. Motor connections made with #10 AWG and smaller wire shall be made up with set-screwed copper lugs with threaded-on insulating jacket. After make-up of each connector, install two (2)

G. layers half-lapped, of high temperature tape over connector barrel and down one (1") inch over wires.

G. Taps, splices, and connections in #8 AWG and larger wires shall be made with copper alloy bolted pressure connectors. Each such connector shall be insulated by means of applying insulation putty over sharp edges so as to present a smooth bonding surface. Next, apply at least four (4) layers, half-lapped each layer of EPR tape. Then, make final wrapping of at least three (3) layers, half-lapped each layer of electrical tape.

H. Control wiring connections to stud type and screw type terminals shall be made with ring-tongue type crimp connectors. Label each terminal jacket with wire marking label at each connection.

I. Each wire connection shall be made up tightly so that resistance of connection is as low as equivalent length of associated conductor resistance.

J. Numbered marking labels shall be installed to identify circuit numbers from panelboards. Install labels on each wire in each panelboard, junction, pullbox and device connection.

K. Label each wiring run with write-on waterproof labels inside motor control center. Install write-on label ties around wire group at conduit entrance and write-on label the wire size, conduit size and service.

L. Install PVC sleeve type numbered marking on each control wire termination at each terminal strip and at each device. Do this in motor control center, terminal cabinets, safety switches, remote controllers, pilot operators, and instrumentation equipment. Number selected shall correspond to number on terminal strip.

M. All wiring inside equipment enclosures shall be neatly trained and laced with nylon tie-wraps.

N. Tie wrap cables in tray.

3.2 INSTRUMENTATION WIRING

A. All 4-20mA analog pairs shall have shields grounded at the instrumentation panel and insulated on the field end unless otherwise required by instrument supplier. Single point grounding shall be maintained.

3.3 GROUND WIRING

A. Each item of equipment shall be adequately and thoroughly grounded. Comply with Article 250 of N.E.C., except where higher standards of grounding have been specified. In addition to requirements as specified under Section 26 04 50, install grounding for general wiring systems as follows.

B. Equipment grounding conductors (EGC) shall be installed in each run of power and control conduits. These wires shall be green colored in sizes #6 AWG and smaller and green banded in larger sizes. Ground wires shall be type XHHW-2 insulated copper wires.

C. EGC runs into equipment shall be grounded to equipment bus where available, or to equipment ground lugs.

D. Where grounding type bushings are installed, bond EGC thereto, and furthermore, ground each bushing lug to equipment ground bus or ground lug, or ground rod.

E. In each motor terminal box, install equipment ground lug and connect EGC thereto. Bond pump frame to motor frame. Bond motor and pump to grounded electrode conductor.

F. Run continuous ground in tray, bond to each section and to all switchgear, panels, and transformers.

3.4 LABELING

A. In addition to labeling requirements as specified throughout this Section, install wiring and raceway labeling as follows:

1. Apply numbered wire marking labels to control wiring terminations for each termination in each item of equipment. Use PVC sleeve type labels.

2. Apply numbered wire marking labels to power and control wiring terminations in motor control centers, panelboards, and at outlets, to identify circuit numbers. Use PVC sleeve type labels.

3. Apply numbered wire marking labels to each signal wire termination in each instrument junction box, and in each item of equipment served by instrumentation circuits. Use PVC sleeve type labels.

4. Apply write-on identification labels to wiring sets in each motor control center, and in each pullbox and junction box. Show wire size, conduit size, and line

and load information. Use waterproof plastic write-on labels with nylon tie-wraps.

3.5 TESTING

A. Each run of 600V class power and control wiring shall be tested prior to connection of line and load. Make tests with 1000V dc hand-crank or motor driven ohmmeter. Each run of wiring shall be tested phase-to-phase and/or phase-to-neutral, and phase-to-ground. Test results for each test shall be equal to or greater than 25,000,000 ohms with 1000V dc applied. All tests shall be made in the presence of the Owners representative or Engineer.

B. Test all runs of signal wiring with 250V dc megger. Insulation values shall meet or exceed 1,000,000 ohms per 100 feet (cable to shield).

C. Should any cable or circuit fail to meet the above tests, replace wire and retest.

3.6 FIBEROPTIC CABLE INSTALLATION

A. The fiberoptic cable shall be installed and terminated per the manufacturer's installation guidelines for the particular cable. No splices shall be made in manholes without prior approval.

B. Connectors shall be compatible with the fiberoptic equipment specified in Section 4.1.18.04. Terminations shall be made by qualified technicians trained in the termination of fiberoptic cables. Specified testing shall be performed after all terminations are made.

C. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B (B.1, B.2, B.3) and any additional requirements with respect to the extended product and/or application assurance warranties. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

D. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project engineer/designer for clarification and resolution.

END OF SECTION

SECTION 26 01 94

DISTRIBUTION PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. This specification covers the requirements for 480 volt distribution panelboards.

B. This specification defines minimum requirements, characteristic guidelines and features required.

1.2 STANDARDS

A. All panelboards shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA. Panelboards shall be UL listed.

1.3 SUBMITTALS

A. Submit outline and dimensional drawings and catalog literature to Engineer for review.

PART 2 - PRODUCTS

2.01 GENERAL

A Ratings shall be as indicated on the drawings.

B Circuit Breakers shall be rated 22,000 amps rms symmetrical interrupting capacity.

C Panelboards shall have integrated 480 volt SPD rated for 200 kA. Provide alarm contacts, event counter, and indicator lights.

2.02 CONSTRUCTION

A. All buses shall be tin-plated copper.

B. Enclosures shall be painted steel.

C. NEMA 3R for installation outdoors.

2.03 MANUFACTURER

A. Panelboards shall be Square D type I-Line or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install panelboards as scheduled and in locations shown on the drawings. Provide grounding as specified per 26 04 50 and per NEC.

END OF SECTION

SECTION 26 02 10

ELECTRIC UTILITY SERVICE

PART 1 - GENERAL

1.1 SCOPE

A. The well site service will be by Southern California Edison (SCE). The service voltage shall be 480Y/277 volts, 3 phase, 4 wire, solidly grounded. The CONTRACTOR shall allow in bid for furnishing and installing all work associated with the service and as required by the utility. This work shall be as specified herein and per utility specifications. Contact Amy Olson 909-942-8238.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Raceways shall be as specified under Section 26 01 10.

2.2 WIRE AND CABLE

A. Service wire and cable (480 volt) shall be as specified under Section 26 01 20.

2.3 UNDERGROUND

A. Underground shall be as specified under Section 26 04 10 and as specified herein.

PART 3 - EXECUTION

3.1 GENERAL

A. Underground conduit shall be installed per Section 26 04 10. Furnish and install all secondary conduits. Furnish and install secondary cables.

B. Utility will furnish and install transformers on pole. Coordinate conduit stub up with utility.

C. Coordinate with electric utility inspector for inspection of work prior to backfilling and as otherwise required by utility.

END OF SECTION

SECTION 26 04 50

GROUNDING

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install complete grounding systems in accordance with Article 250 of the National Electrical Code as shown on the Drawings and as specified herein.

B. Provide ground mat grounding electrode system as shown on the drawings and as specified herein.

1.2 SUBMITTALS

A. Submit manufacturers' catalog sheets with catalog numbers marked for the items furnished, which shall include:

1. Ground well casings
2. Ground rods
3. Terminal lugs and clamps
4. Exothermal welding materials
5. Ground cable
6. Ground connection hardware

PART 2 - PRODUCTS

2.1 GROUNDING ELECTRODES

A. All ground mat grounding electrodes and grounding electrode conductors shall consist of tin plated stranded copper.

B. All ground rods shall be copper clad steel products, 3/4" diameter x 10 foot long, unless otherwise indicated. Ground rods shall be Blackburn #6258, or equal. Provide heavy duty ground rod clamps, exothermic welds where concealed or below grade. Equal to Blackburn #GG58 where vertical connections are installed and #GUV where U-bolt connectors are installed to serve horizontal connections.

2.2 GROUNDING DEVICES

A. Connectors shall be furnished as specified under Section 26 01 20.

B. Conduit grounding bushings shall be furnished as specified under Section 26 01 10.

C. Equipment grounding conductors shall be furnished as specified under Section 26 01 20.

D. Flush cast metal grounding plates shall consist of bronze body with flat plate on top and bolted clamp connector on bottom. Furnish OZ type "VG", or equal flush connectors. Each such connector shall be furnished with silicon bronze connector bolts for installation of top-mounted grounding connectors.

E. Exothermal welding kits shall be "Cadweld" products as manufactured by Erico. Molds, cartridges, powder, and accessories shall be as recommended by the manufacturer.

2.3 GROUND TEST WELLS

A. Ground test wells shall be furnished each ground rod for the purpose of field testing the ground mat system.

B. Ground test wells shall each consist of ground rod with connector attached to a #4 upcomer from the ground mat and contained within an access well with labeled top.

C. Ground test well enclosures shall be Brooks product #3RT series, or equal. Enclosures shall be 10 1/4" diameter and shall include cast iron cover with integrally cut "GROUND TEST WELL" in top of cover.

PART 3 - EXECUTION

3.1 GROUND MATS AND GROUND WELLS

A. Install ground mat around the perimeter of structures, electrical equipment racks, the generator pad and where indicated on the drawings. Use #4/0 AWG tin-plated copper stranded conductor for the ground mat. Install upcomer with indicated wire sizes of tin plated copper conductors. Exothermally weld all connections.

B. Unless other larger sizes are indicated on the drawings, install #2 upcomers from ground mat to PLC, and other equipment indicated on the drawings. Install "VG" flush floor connector to serve each upcomers and run #2 stingers from top side of each "VG" to ground bus in equipment. Bond VG to rebar in concrete.

C. Install ground rods in test wells where indicated on the drawings.

3.2 TRANSFORMER

A. Bond transformer neutral to cabinet.

B. Install grounding electrode conductor from each transformer neutral to system ground and to local electrodes as shown. Run #2 ground wire to ground mat.

3.3 WIRING SYSTEMS GROUNDING

A. All equipment enclosures, motor and transformer frames, metallic conduit systems and exposed structural steel systems shall be grounded.

B. Equipment grounding conductors shall be run with all wiring. Sizes of equipment grounding conductors shall be based on Article 250 of the N.E.C. except where larger sizes may be shown. Bond each equipment grounding conductor to the equipment grounds at each end of each run. Run 4/0 ground full length of tray, bond to each section and every enclosure where conductors originate or terminate. Protect grounded equipment conductor in conduit where it leaves the tray.

C. Liquid tight flexible metal conduit in sizes 1" and larger shall be equipped with external bonding jumpers. Use liquid tight connectors integrally equipped with suitable grounding lugs.

D. Where conduits enter into equipment free of the metal enclosure, install grounding bushing on each conduit and bond bushing lug to equipment ground bus.

E. Where conduits enter equipment enclosures, equip each penetration inside with grounding bushing. Install bonding jumper from each grounding bushing to ground bus.

F. Equipment enclosures that do not come furnished with a ground bus, install ground lug in each enclosure that shall be bonded to the metal cabinet or backpan of the enclosure.

G. Separately derived systems shall be each grounded as shown and shall comply with Article 250 of the NEC except where higher standards are shown.

3.4 TESTING

A. All exothermic weld connections shall successfully resist moderate hammer blows. Any connection which fails such test or if upon inspection, weld indicates a porous or deformed connection, the weld shall be remade.

B. All exothermic welds shall encompass 100 percent of the ends of the materials being welded. Welds which do not meet this requirement shall be remade.

C. Test the ground resistance of the system. All test equipment shall be furnished by Contractor and be approved by Engineer. Test equipment shall be as

manufactured by Biddle or approved equal. Dry season resistance of the system shall not exceed five ohms. If such resistance cannot be obtained with the system as shown, provide additional grounding as directed by Engineer.

END OF SECTION

SECTION 33 01 32

PIPELINE TESTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hydrostatic Testing of Pressure Pipe
2. Deflection Testing Plastic Piping.

B. Related Sections:

1. Section 33 41 00 – Utility Piping.

1.2 REFERENCES

A. ASTM International:

1. ASTM A377 – Standard Index of Specifications for Ductile Iron Pressure Pipe
2. ASTM D1598 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
3. ASTM D2290 - Standard Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe

1.3 SUBMITTALS

A. Submit the following prior to start of testing:

1. Testing procedures.
2. List of test equipment.
3. Testing sequence schedule.
4. Provisions for disposal of flushing and test water.

5. Certification of test gauge calibration.

6. Deflection mandrel drawings and calculations.

B. Test Reports: Indicate results of piping tests.

PART 2 PRODUCTS

2.1 AIR TEST EQUIPMENT

A. Air compressor.

B. Air supply line.

C. Shut-off valves.

D. Pressure regulator.

E. Pressure relief valve.

F. Stop watch.

G. Plugs.

H. Pressure gauge, calibrated to 0.1 psi.

2.2 HYDROSTATIC TEST EQUIPMENT

A. Hydro pump.

B. Pressure hose.

C. Water meter.

D. Test connections.

E. Pressure relief valve.

F. Pressure gauge, calibrated to 0.1 psi.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify piping is ready for testing.

B. Verify trenches are backfilled.

C. Verify pressure piping concrete reaction support blocking or mechanical restraint system is installed.

3.2 FIELD QUALITY CONTROL

A. Pressure test pressure system in accordance with AWWA C651 and the following:

1. Pressure pipe to be pressure tested shall include all PVC and ductile iron pipe and fittings. Hydrostatically test each portion of pressure piping, including valved sections to 200 psi.

2. Conduct hydrostatic test for at least a two-hour duration.

3. Fill section to be tested with water slowly, expel air from piping at high points. Install corporation cocks at high points. Close air vents and corporation cocks after air is expelled. Raise pressure to specified test pressure.

4. Observe joints, fittings and valves under test. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage. Retest.

5. Correct visible deficiencies and continue testing at same test pressure for additional 2 hours to determine leakage rate. Maintain pressure within plus or minus 5.0 psig of test pressure. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of text.

6. Compute maximum allowable leakage by the following formula:

$L = (SD\sqrt{P})/C$
L = testing allowance, in gallons per hour (liters per hour)

S = length of pipe tested, in feet (meters)
D = nominal diameter of pipe, in inches (mm)
P = average test pressure during hydrostatic test, in psig (kPa)
C = 148,000 (794,797)
When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

7. When test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections and retest until leakage is within allowable limits. Correct visible leaks regardless of quantity of leakage.

B. Deflection Testing of Plastic Pipe:

1. Perform vertical ring deflection testing on PVC piping, after backfilling has been in place for at least 30 days but not longer than 12 months.

2. Allowable maximum deflection for installed plastic pipe limited to 5 percent of original vertical internal diameter.

3. Perform deflection testing using properly sized rigid ball or 'Go, No-Go' mandrel.

4. Furnish rigid ball or mandrel with diameter not less than 95 percent of base or average inside diameter of pipe as determined by ASTM standard to which pipe is manufactured. Measure pipe in compliance with ASTM D2122.

5. Perform test without mechanical pulling devices.

6. Locate, excavate, replace and retest pipe exceeding allowable deflection.

C. Dewater Pipeline After Testing:

1. After completion of testing and acceptance of pipeline – dewater pipeline and leave in a dry condition.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Pipeline testing shall not be measured for separate payment

4.2 PAYMENT

A. Full compensation for pipeline testing shall be considered as included in the price paid for the various items of work requiring Pipeline Testing, and no additional compensation will be allowed therefor.

END OF SECTION 33 01 32

SECTION 33 41 00

UTILITY PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Accessories
3. Underground pipe markers.
4. Connection to existing pipes.
5. Manholes.
6. Split Butt Straps.
7. Bedding, backfill, and cover materials.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM B177 – Standard Test Method for Operating Salt Spray (Fog) Testing.

2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.

3. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

5. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

6. ASTM C924 – Standard Practice for Testing concrete Pipe Sewer Lines by Low-Pressure Air Test Method.

7. ASTM C 969 – Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

8. ASTM C1103 – Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

9. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

10. ASTM D714 – Standard Test Method for Evaluating Degree of Blistering of Paints.

11. ASTM D1238 – Measuring Flow Rates of Thermoplastics by Extrusion Plastometer.

12. ASTM D1248 –Polyethylene Plastics Molding and Extrusion Materials.

13. ASTM D1505 – Density of Plastics by Density-Gradient Technique.

14. ASTM D1599 – Test for Short Term Rupture Strength of Plastic Pipe, Tubing, and Fitting.

15. ASTM D1693 – Environmental Stress Cracking of Ethylene Plastics.

16. ASTM D1784 – Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

17. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

18. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) .

19. Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

20. ASTM D1928 – Preparation of Compression Molded Polyethylene Test Samples.

21. ASTM D2152 – Test Method for Degree of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion.

22. ASTM D2241 – Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).

23. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

24. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

25. ASTM D2657 – Heat Joining of Thermoplastic Pipe and Fittings.

26. ASTM D2665 – Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

27. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

28. ASTM D2837 – Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

29. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

30. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

31. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

32. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

33. ASTM D3035 – Polyethylene Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.

34. ASTM D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

35. ASTM D3261 – Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

36. ASTM F3350 – Polyethylene Plastic Pipe and Fittings Materials.

37. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

38. ASTM F585 – Insertion of Flexible Polyethylene Pipe in Existing Sewers.

39. ASTM F679 – Standard Specification for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings.

40. ASTM F714 – Standard Specification for Polyethylene Plastic Pipe Based on Outside Diameters.

41. ASTM F1417 – Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.

42. ASTM G95 – Standard Test Method for Resistance to Cathodic Disbondment by the Attached Cell Method.

C. American Water Works Association:

1. AWS Standard Qualification Procedure.

D. American Water Works Association:

1. AWWA C104 – American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.

4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. AWWA C150 - ANSI Standard for the Thickness Design of Ductile Iron Pipe.

6. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

7. AWWA M23 – AWWA Manual of Supply Practices PVC Pipe – Design and Installation, Second Edition.
8. AWWA C200 – Steel Water Pipe 6-inches and Larger
9. AWWA C206 – Field Welding of Steel Water Pipe
10. AWWA C208 – Dimensions for Fabricates Steel Water Pipe Fittings
11. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 12 inch for Water Transmission and Distribution.

E. National Fire Protection Association:

1. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances.

F. National Sanitation Foundation, most recent version:

1. NSF-14 – Plastics Piping System Components and Related Materials.

G. Plastics Pipe Institute, most recent version:

1. PPI TR-2 – PVC Range Composition Listing of Qualified Ingredients.

H. UNI-BELL PVC Pipe Association, most recent version:

1. UNI-B-6 – Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.
2. UNI-PUB-08 – Tapping Guide for PVC Pressure Pipe

1.3 SUBMITTALS

A. Polyvinyl chloride pipe materials

B. Ductile Iron Pipe Materials

C. Pipeline layout diagrams

D. Valve types and materials

E. Precast structure design shop drawings

F. Grout materials

G. Pipe bedding

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Contractor: Company specializing in performing Well work specified in this section with a current California Well Drilling Contractors License C57.

C. Installer: Company specializing in performing work of this section with minimum three years documented experience.

D. Welder: Welder Certifications specializing in performing work of this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall exercise special care during the unloading, handling, and storage of all pipe to ensure that the pipe is not cut, gouged, scored, or otherwise damaged. Any pipe segment which has cuts in the pipe wall exceeding 10 percent of the wall thickness shall be cut out and removed from the site at the Contractor's expense.

B. The pipe shall be stored so that it is not deformed axially or circumferentially which may hinder pipe installation. No vertical load shall be placed on pipe during storage. Contractor shall test all pipe for ovality prior to installation. Pipe not meeting specified requirements shall be replaced with new material.

C. All plastic pipes shall have an ultraviolet inhibitor and shall also be stored in a covered area on blocks, such that no individual pipes weight shall bear on another pipe segment. Pipes shall be supported so as not to allow the pipe to sag along its length between blocks during storage.

D. Block individual and stockpiled pipe lengths to prevent moving.

1.6 FIELD MEASUREMENTS

A. Verify field measurements and elevations are as indicated.

1.7 COORDINATION

A. Coordinate the Work with other trades and operations at the site.

PART 2 PRODUCTS

2.1 DUCTILE PIPE AND FITTINGS

A. Dual spigot centrifugally cast ductile iron pipe conforming to AWWA C150 or AWWA C151, 250 minimum pressure class flanged ends. Joints shall conform to ANSI/AWWA C111/A21.11.

1. Manufacturers:

   a. U.S. Pipe

   b. American Ductile Iron Pipe Company

   c. Or approved equal

2. Outside Coating: Paint in accordance with System No. 5, as described in these Technical Specifications.

3. Lining:

   a. Pipe and fittings: Cement-mortar lining in accordance with AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

   b. Valves: Fusion Bonded Epoxy in a uniform thickness, conforming to AWWA C116.

4. Field cut pipe: Pipe shall be cut and reconditioned to make up the next joint per pipe and pipe liner manufacturer's recommendations. Remove any sharp, rough edges that might otherwise damage the joint of coupling. Freshly cut ends shall be immediately coated with Cement Mortar Liner joint compound, and compatible with interior

lining of pipe. Pipe that is to be cut in the field shall be "Gauged Full Length" pipe. Field gauge all field cut ends and ensure it to be within manufacturer's tolerances. Cut ends found to be outside of manufacturer's tolerances shall be rounded in accordance with manufacturer's recommendations.

5. Cast iron and ductile iron specials and fittings shall conform to ANSI A21.10 (AWWA C110) or ANSI 21.53 (AWWA C153) with joints as shown on the Drawings or a required elsewhere in these specifications or for the installation.

6. Interior lining of specials and fittings shall match the adjoining specified pipe lining. All standard fittings shall be factory lined with cement mortar lining.

7. Flanges shall meet or exceed ANSI B16.1, Class 250 unless otherwise indicated, or required for the installation.

8. Flanges for spool pieces shall be factory installed threaded flanges. Flanges for fittings shall be cast integrally with the fitting.

9. Where specified, called for on the drawings, or otherwise required for thrust restraint, mechanical joints shall be made using retainer glands with set screws or clamping lugs. Retainer glands shall be as manufactured by EBAA Iron, Tyler Pipe, or equal.

10. Rubber gasket for mechanical or push-on joints shall meet ANSI A21.11 (AWWA C111), vulcanized natural or vulcanized synthetic rubber.

11. Flanged gaskets shall be full face, 1/16-inch thick cloth inserted rubber or metallic packing.

12. Bolts and nuts for all service conditions (above ground, submerged and buried) shall be Type 316 stainless steel.

13. Valves shall be factory lined with Fusion Bonded Epoxy.

2.2 GATE VALVES

A. Gate valves shall be resilient seated solid wedge gate valves. The valve shall have non-rising stem type for buried service or outside screw and yoke (OS&Y) for non-buried service and shall exceed the AWWA C509 and C515 standards.

B. The valve body, bonnet, gland, and handwheel shall be cast from thick wall patterns resulting in a minimum wall thickness as shown on page 9 in Section 4.4 Table 1 of AWWA C500 and C509 and be constructed of ductile iron ASTM A536 grade 65-45-12. The wedge on 2-36" shall be ductile iron, encapsulated with EPDM rubber. The wedge shall be male guided into the body seat of the valve, plastic wedge guiding mechanism not allowed.

C. Valve stems shall be AISI stainless steel with an integral stainless steel tem thrust collar (machined as part of the stem). Shaft seals must be EPDM triple o-rings positively located in the grooves on the shaft not in the gland for NRS valves. The valve must have two thrust washers constructed of copper: non-metallic thrust washers are not acceptable. Non-asbestos graphite packing must be used on OS&Y valves.

D. All nuts, bolts and washers shall be 316 Stainless Steel.

E. Gate valve shall be lined and coated with Fusion Bonded Epoxy.

2.3 RESTRAINED FLANGE ADAPTERS

A. Restrained flange adapters shall be fully restrained and constructed of ASTM A536 ductile iron and have flanged bolt circles that are compatible with ANSI/AWWA C110/A21.10 (125# /Class 150 bolt pattern).

B. Restraint for flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

C. The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6-inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

D. All internal surfaces of the gasket ring (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61. Exterior surfaces of the gasket ring shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

E. Pressure rating shall be a minimum of 250 psi.

2.4 POLYVINYL CHLORIDE PIPE (PVC) PRESSURE PIPE

A. Segmental PVC pressure pipe shall conform to AWWA C900. Minimum pressure class shall be 200 psi, DR 18.

B. Segmental PVC used shall be fully restrained at fittings and bends to the limits as indicated on the plans.

2.13 PIPE CONNECTIONS TO EXIST PIPE

A. Connections to existing pipe shall be made by a transition fitting manufactured by ROMAC, Mueller, or approved equal.

B. Type for each connection made shall be as called out on plans and details.

2.14 WELL CASING CONNECTIONS TO EXIST PIPE

A. Connections to existing well casing pipe shall be made by a split butt strap welded to the existing pump well casing to extend the well casing. Type for each connection made shall be as called out on plans and details.

B. Connections to the existing well pump piping shall be made by a split butt strap or other fully restrained pipe connection – to be determined upon pump removal and inspection of the material for the pump well piping.

2.15 UNDERGROUND PIPE MARKERS

A. Manufacturers:

1. Presco – Underground Warning Tape, Detectable.

2. Reef Industries, Inc. – Terra Tape, Detectable
3. Or equal.

B. Furnish materials in accordance with OSHA standards.

C. Plastic Ribbon Tape: Bright colored blue, continuously printed, minimum 3 inches wide by 4-mil thick, manufactured for direct burial service.

2.16 ACCESSORIES

A. Grout: Specified in Section 03 30 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PAINT COATING FERROUS SURFACES

A. Field apply paint and protective coating systems for all above ground pipes and appurtenances where shown on the plans that are not otherwise shop coated. Do not apply coating material if the relative humidity exceeds 80 percent or if the surface temperature is less than 5º F. above the dew point.

B. Surface to be coated must be cleaned as specified in subsection 310-2.5.1, part (c) of the SSPWC and these Special Provisions.

C. Surfaces to be coated must be cleaned and coated in conformance with manufacturer's recommendations for coating for the type of material being used. The metal must be cleaned after blasting with clean, dry compressed air. Use of rugs to remove residual dust after sandblasting will not be permitted.

D. Before blast cleaning, remove all oil, grease or other contaminants by solvent cleaning per Subsection 310-2.3, "Solvent Cleaning," of the SSPWC.

E. Shop applied primer must be by spray equipment.

F. Apply intermediate and top coat after priming and cure. White zinc salt, if present, must be cleaned off primed surface before applying intermediate coat.

G. Apply the appropriate System No. protective system as specified in these Special Provisions.

1. System No. 5 – Submerged Metal, Potable Water

   a. Type: Two component, three coat epoxy system.
   b. Surface Preparation: SSPC-SP 10.
   c. Coating System: Apply three coats. Apply to a minimum dry film thickness of 12 mils.

2. System No. 20 -- Exposed Metal, Exterior

   a. Type: Gloss synthetic enamel with OSHA safety color coding.
   b. Surface Preparation: SSPC-SP 1. Apply one coat of vinyl wash primer on galvanized, zinc, or bronze surfaces use Sinclair No. 7113, or approved equal.
   c. Prime Coat: Sinclair No. 15 (non-ferrous or ferrous) or No. 25 (galvanized or zinc), 2 mils or approved equal.
   d. Intermediate Coat: Sinclair No. 248, 1.5 mils or approved equal.
   e. Finish Coat: Sinclair or approved equal – color per owner.

3.3 INSTALLATION - GENERAL

A. All pipe installation shall be in accordance with manufacturer's recommendations. Contractor shall immediately notify District of any conflicts between manufacturer's recommendations and drawings.

B. For plastic pipe, install pipe, fittings, and accessories in accordance with ASTM D2321Seal joints watertight.

C. Lay pipe to slope gradients noted on drawings. Begin at downstream end and progress upstream.

D. Assemble and handle pipe in accordance with manufacturer's instructions except as modified on the Drawings or by Engineer.

E. Keep pipe and fittings clean until work is completed and accepted by Engineer. Cap open ends during periods of work stoppage.

F. Connect pipe to new manhole as detailed in this Specification.

G. For plastic pipe, Install pipe, fittings, and accessories in accordance with ASTM D2321Seal joints watertight

3.4 PROTECTION OF FINISHED WORK

A. Protect pipe and aggregate cover from damage or displacement.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Install 4-inch C900 PVC Piping will be measured by the linear foot of pipe installed as determined from field measurement

B. Install 1-inch Air Release Valve will be measured by the number of air release valved installed as determined from field measurement

C. Install 4-inch Check Valve will be measured by the number of check valves installed as determined from field measurement.

D. Install 4-inch Dismantling Joint will be measured by the number of dismantling joints installed as determined from field measurement

E. Install 4-inch Electromagnetic Flow Meter will be measured by the number of flow meters installed as determined from field measurement.

F. Install 4-inch Gate valve will be measured by the number of valves installed as determined from field measurement.

G. Miscellaneous Piping Spools and Fittings shall not be measured for separate payment.

4.2 PAYMENT

A. The unit price paid for 4-inch C900 PVC Piping shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of 4-inch C900 PVC Piping, including excavation, bedding, pipe installation, restrained joints, warning tape backfill and testing and all other incidentals as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

B. The unit price paid for Install 1-inch Air Release Valve shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Install 1-inch Air Release Valve including installation and testing and all other incidentals as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

C. The unit price paid for Install 4-inch Check Valve shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Install 4-inch Check Valve including installation and testing and all other incidentals as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

D. The unit price paid for Install 4-inch Dismantling Joint shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Install 4-inch Dismantling Joint including installation and testing and all other incidentals as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

E. The unit price paid for Install 4-inch Electromagnetic Flow Meter shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Install 4-inch Electromagnetic Flow Meter including installation and testing and all other incidentals as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

F. The unit price paid for Install 4-inch Gate Valve shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Install 4-inch Gate Valve including installation and testing and all other incidentals as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

G. The Contract Lump Sum for Miscellaneous Piping, Spools and Fittings shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Miscellaneous Piping, Spools and Fittings, including installation and testing, painting DI spools above ground, Poly-wrapping DI Spools below ground, excavation, bedding and backfill, and all other incidentals as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

END OF SECTION 33 41 00

SECTION 43 23 31

SUBMERSIBLE WELL PUMP

PART 1 - GENERAL

1.1 GENERAL

A. TYPE OF PUMP AND PUMP COMPONENTS: This Specification is for submersible well pumps. All parts of the pump exposed to water shall be of stainless steel, brass, heavy cast iron, or equivalent corrosion-proof material.

B. AWWA STANDARD: Unless otherwise specified herein, all applicable provisions of AWWA E-102 (Submersible Vertical Turbine Pumps), latest, are hereby made a part of these Specifications.

C. TERMS AND DEFINITIONS:

1. The term “Pumping Unit” or “Units” shall be defined as a pump complete with motor, head assembly, bowl assembly, column assembly and other materials and components as described herein.

2. The term “Contractor” shall be defined as the general contractor or the organization entering into the contract with the Owner.

D. ACCEPTED MANUFACTURER: The pumps shall be manufactured as detailed in this specification.

1. If the contractor submits pumping units from one of the listed alternate manufacturers, final acceptance of the alternate manufacturer rests solely with the Owner.

2. If a pumping unit from an alternate manufacturer listed herein is permitted by the Owner, pumping unit shall meet or exceed the technical specifications set forth herein. Any deviations from these specifications shall be listed and detailed on the submittal and the Owner shall be the final authority on whether any deviation will be accepted.

1.2 BASIC OPERATING REQUIREMENTS

A. GENERAL

1. Each pump will be used for pumping Cold Water and shall be NSF 61 certified.

2. The capacities, heads, efficiencies, and horsepower requirements specified herein are for completely assembled units.

3. Each pumping unit shall meet the requirements and design points as specified in the Pump Schedule.

B. PUMPING UNIT REQUIREMENT: Each pump and motor combination shall be matched to deliver at least the maximum flow rate at the maximum speed.

1.3 UNIT RESPONSIBILITY

A. GENERAL

1. The Pump Manufacturer shall be responsible for providing the pump, lineshaft, pump shaft, motor shaft (with adjusting nut), column piping discharge head, and the motor as a complete unit to the Contractor for installation.
2. During the submittal process, the Pump Manufacturer shall provide a notarized certificate stating that all equipment and materials listed above will be provided by the Pump Manufacturer.
3. Pump Manufacturer or representative shall attend pump start-up and provide field services for assistance to the Contractor.

B. COMPATIBLE EQUIPMENT:

1. All combinations of manufactured equipment which are approved under this specification shall be entirely compatible and the Contractor and the listed manufacturer shall be responsible for the compatibility and successful operation of the various components of the units conforming to the specified requirements.
2. All necessary mounting, couplings and appurtenances shall be included with each unit.
3. All materials employed in the pump equipment shall be suitable for the intended application and shall be high grade commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

1.4 REFERENCE CODES AND STANDARDS

All equipment and materials shall meet the applicable provisions of the following reference codes and standards.

A. Hydraulic Institute (HI)

B. American Iron and Steel Institute (AISI)

C. American National Standards Institute (ANSI)

D. American Society of Testing and Materials (ASTM)

E. American Water Works Association (AWWA)

F. International Organization for Standardization (ISO)

G. Anti-friction Bearing Manufacturers Association (AFBMA)

1.5 SUBMITTALS

A. GENERAL

1. Submit shop drawings, including related details and data, in accordance with the below.

2. The Contractor shall make a complete and acceptable submittal to the Owner, as determined by the Engineer, by the second submission.

B. PUMP DATA AND CALCULATIONS: Submit necessary data and calculations to demonstrate full compliance with the specification requirements, including, but not limited to:

1. Column and head losses, thrust data, etc.

2. Provide a detailed description of all pump materials and parts.

3. Other calculations or data that may be requested by the Owner or Engineer at additional cost.

C. ALLOWABLE OPERATING RANGE: Provide statement by Pump Manufacturer specifying the “Allowable Operating Range” as defined by the HI Standards and AWWA E-103 Standard.

D. CERTIFIED PUMP CURVES:

1. The Contractor shall submit certified pump curves based upon factory testing by the pump manufacturer for approval by the Owner, for each pumping unit to be furnished herein; showing head versus capacity, bowl efficiency versus capacity; and typical NPSHR.

2. Each curve shall be continuous over the full operating range from zero (0) flow up to the maximum flow permissible through each pump, and each curve shall be based upon the RPM listed herein.

3. For variable speed operation, if applicable, include curve for operation at the specified minimum RPM.

4. Each curve shall state the RPM speed of the pumping unit, and shall be furnished full-size on 8 1/2” x 11” paper.

5. The Contractor shall provide pumps capable of meeting all aspects of the Pumping Unit Design Data section herein (Par. 2.04) and as shown on the Drawings.

E. PUMPING UNIT OUTLINE DIAGRAMS: Before the manufacture of the pumping units and appurtenances is commenced, the Contractor shall submit to the Owner for approval, detailed fabrication drawings of said pumping unit material.

F. NPSH REQUIREMENTS: Submit calculations and written certification from

pump manufacturer that the pump furnished herein will operate compatible with the Net Positive Suction Head (NPSH) available.

G. DISCHARGE HEAD:

1. Submit details of fabricated steel discharge head and provide written certification from pump manufacturer that the discharge head has the capability of accommodating the specified drives and the design column length within acceptable vibration limits.

2. Submit seismic calculations signed and stamped by an engineer.

H. COATINGS: Provide coating manufacturer's information and data for fusion bonded epoxy lining and coating.

I. FIELD PROCEDURES: Submit detailed field procedure for installation, adjustment, inspection, and testing of all pumping equipment.

J. TEST PROCEDURES: Pump manufacturer shall submit shop testing procedures at least thirty (30) days prior to the test.

K. OPERATION AND MAINTENANCE INSTRUCTIONS: Complete and detailed operation and maintenance instructions shall be submitted in accordance with the Special Requirements.

1.6 QUALITY ASSURANCE

A. MANUFACTURER'S EXPERIENCE – GENERAL:

1. Manufacturer of the Pumping Equipment specified in this section shall have experience in providing similar type equipment.

2. If required by Engineer or Owner, manufacturers shall show evidence with his submittal of at least five (5) installations where equipment of the same material and same application of the type specified herein have been in satisfactory operation for at least five (5) years.

B. PERFORMANCE AND ACCEPTANCE TESTING: After completion of the facility, acceptance testing of the pumping units shall be performed.

1.7 ALTERNATE PUMP MANUFACTURER REQUIREMENTS

A. SUBMISSION REQUIREMENTS FOR ALTERNATE PUMP MANUFACURERS

1. Submission of a bid proposal with an alternate pump manufacturer is at the bidder's risk since no detailed review or "equal" status determination of any alternate pump or manufacturer (other than provided for under this specification) will be performed prior to the bid opening.

B. NON-APPROVED PUMP MANUFACTURER:

1. Submission of a non-approved manufacturer may be subject to rejection.
2. Authority for determination of “approved equal” pump and manufacturer, including conformance with Specification requirements, shall rest solely with the Owner.
3. In the event that the Contractor’s submission of an alternate pump selection and manufacturer is rejected, Contractor shall submit the specified pump and manufacturer at no additional cost to the Owner.
4. No additional contract time extension will be granted for the Owner’s review and evaluation.

C. POTENTIAL REQUIRED REVISIONS TO STRUCTURES:

1. Should the equipment selected by the Contractor require revisions to the structures, piping, electrical, or other work shown on the drawings, the Contractor shall include the cost of such revisions in his bid for the equipment, and no extra payment shall be made for such revisions.
2. All such revisions shall be submitted for Owner approval and shall be subject to the approval of the Owner.

1.8 SYSTEM START-UP

Contractor shall provide system start-up and testing. The Pump Manufacturer or Approved Representative shall furnish the services of a qualified field engineer to check installation, start-up and instruct Owner operating personnel in the proper operation and maintenance of the equipment.

1.9 CERTIFICATION OF INSTALLATION

The Contractor shall submit a letter to the Owner confirming that all pumping equipment was inspected, operation checked, and installation approved in writing by the respective Pump Manufacturer and the Contractor. The letter shall be included with the warranty and an executed “Certification of Proper Installation” from the manufacturer shall be provided. The form is included in the appendix of these specifications.

1.10 WARRANTY

All pumping equipment shall carry an warranty for a one-year period from the date of start up, not to exceed 18 months after shipment. All warranties shall be turned into the Owner prior to project completion.

PART 2 - PRODUCTS

2.1 PUMP CONSTRUCTION

A. PUMP:

1. The pump shall be Grundfos multistage submersible pump model

90S100-8 or approved equal.

2.2 PUMPING UNIT DESIGN DATA

A. GENERAL: The pumping unit shall be furnished in accordance with the design data described herein.

B. DESIGN DATA: The pumping units shall be furnished in accordance with the following:

1. Motor: Stainless Steel, 10 HP, Grundfos or Approved Equal
2. Column: 5.59” dia.
3. Pump: Grundfos 90S100-8; or Owner approved equal.

C. OPERATING CONDITIONS:

1. Operating Conditions:

Pump Design Points
75 GPM @ 307 feet*#

#Only primary point is guaranteed. Additional points specify curve shape

PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL: Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as indicated on the Contract Drawings, unless otherwise approved by the Owner.

B. ALIGNMENT: Equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, vibration, shaft run-out or other defects. Equipment shall be secured in position and fixed neatly in appearance. Pumping unit shall be within 0.005” per foot of level at discharge head base.

C. COATING: All exposed materials except corrosion-resistant metals which have not been shop painted shall be field coated as specified (Protective Coating). Shop painted items which have been damaged during transport and/or installation, shall be touched up per specifications and as approved by Inspector.

D. PUMP PEDESTAL: The pump station construction Contractor shall furnish and install the reinforced concrete pedestal and all necessary embedment and support items as described on the Specifications and Contract Drawings.

E. COORDINATION: The pump Contractor will be responsible for coordinating

all applicable aspects of the project with the pump and motor supplier including, but not limited to equipment installation procedures and requirements, specific materials to be furnished, scheduling of materials deliveries, overall construction schedule, equipment storage and protection requirements, and equipment testing requirements. The required coordination, including implementation of pump manufacturer's requirements as related to the equipment furnished, shall be included in the construction Contractor's bid price(s), and no additional compensation shall be made therefore.

3.2 FACTORY PUMP TESTS

A. GENERAL:

1. Pump(s) shall undergo factory non- witnessed pump testing.
2. Tests shall be performed in accordance with the applicable standards in the Hydraulic Institute.
3. The acceptance test shall be per Hydraulic Institute Acceptance grade 1U; with no minus tolerance on efficiency
4. To successfully pass a laboratory performance test, a pumping unit shall meet all performance requirements specified.

B. NON-COMPLIANCE: Should results of the test indicate, in the opinion of the Engineer, that the pumps fail to meet any of the specified requirements, the Owner will notify the Contractor of such failure. The manufacturer shall thereupon, at no expense to the Owner, make such modifications and perform additional testing as may be necessary to comply with these specifications.

3.3 FIELD ACCEPTANCE TEST RESPONSIBILITY

A. GENERAL: The Contractor under this specification shall have full responsibility for the proper installation and performance of said pumping equipment, including furnishing the services of a pumping equipment field Service Engineer to inspect during equipment installation, and to adjust, if necessary, any portion of the pumping equipment required herein.

B. TESTING AND PERFORMANCE: The Contractor's Field Service Engineer (Pump Manufacturer) shall be responsible for the pumping unit field acceptance tests. The pump unit(s) shall perform in the field substantially as shown on the certified pump curves furnished by the Contractor after reasonable allowances for field conditions. The head capacity, input horsepower, and overall efficiency values will be determined for at least three points in the stated operating range of the pump, and will be compared with the certified curves.

C. FIELD TEST DOCUMENTATION: Field Service Engineer for Pump Manufacturer shall provide documentation to Engineer (including

"Certification of Proper Installation") for all field adjustments made and tests performed.

D. NON-COMPLIANCE: In the event that the tests reveal noncompliance of the workmanship or equipment with these specifications, the Contractor shall be required to perform, at his own expense, such work and furnish materials as will, in the opinion of the Engineer, restore the equipment to the specified performance.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Furnish and Install Submersible Well Pump (75 gpm, 307' TDH) with Controls shall not be measured for separate payment.

4.2 PAYMENT

A. The Contract lump sum paid for Furnish and Install Submersible Well Pump (75 gpm, 307' TDH) with Controls shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Furnish and Install Submersible Well Pump (75 gpm, 307' TDH) with Controls, including forms, excavation, base, concrete and reinforcing, installation of booster pumps and controls, complete in place as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

END OF SECTION 42 23 31

SECTION 46 00 00

WATER STORAGE TANKS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Materials, fabrication, testing and installation of water storage tank

1.2 PRICE AND PAYMENT PROCEDURES

A. Polyethylene Storage Tank

1. Bases of Measurement: Per Each. Basis of Payment: Includes materials and equipment to properly install the water storage tank.

1.3 REFERENCE STANDARDS

A. Section 212 and 306 of the Standard Specifications for Public Works Construction (SSPWC) (Greenbook)

B. ASTM (American Society for Testing and Materials) Standards:

1. D618 Conditioning Plastics and Electrical Insulating Materials for Testing
2. D638 Tensile Properties of Plastics
3. D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
4. D883 Definitions of Terms Relating to Plastics
5. D1505 Density of Plastics by the Density-Gradient Technique
6. D1525 Test Method for Vicat Softening Temperature of Plastics
7. D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
8. D1998 Standard Specification for Polyethylene Upright Storage Tanks
9. D2837 Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
10. D3892 Practice for Packaging/Packing of Plastics
11. F412 Definitions of Terms Relating to Plastic Piping Systems

C. ARM (Association of Rotational Molders) Standards: Low Temperature Impact Resistance (Falling Dart Test Procedure)

D. ANSI Standards: B-16.5 Pipe Flanges and Flanged Fittings

E. OSHA Standards: 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids

F. IBC CODE: International Building Code 2018 Edition

G. CBC Code: California Building Code 2019 Edition

H. NSF/ANSI Standard 61 – Drinking Water System Components (Type II resin)

1.4 SUBMITTALS

A. Product Data: Submit data on : resin, wall thickness, tank restraint, fittings and accessories, technical manuals, manufacturer qualifications, manufacturer warranty, factory test report

1.5 QUALITY ASSURANCE

A. Quality Control shall meet the requirements of Section 306 of the SSPWC Greenbook.

1.6 DELIVERY, STORAGE, AND HANDLING

A. The tanks shall be marked to identify the product, date (month and year) of manufacture, capacity, and serial number. The tank shall be shipped with a 3 of 9, HRI bar code label containing tank description, manufacturing order number, part number, serial number, manufacturer, and date.

B. All packing, packaging, and marking provisions of ASTM Practice D3892 shall apply to this standard.

C. All fittings that do not interfere with tank shipment shall be installed unless otherwise specified. Fittings and accessories that interfere with tank shipment or could be broken during shipment are shipped separately.

PART 2 PRODUCTS

2.1 POLYETHYLENE STORAGE TANK

A. Resin

1. Type II - Tanks molded from linear polyethylene resin (HDLPE) with density between 0.941-0.950 g/cc.
2. The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer. Type I tanks shall be made from crosslinked polyethylene (XLPE) resin as manufactured by Ingenia Polymers Corp., or resin of equal physical

and chemical properties. Type II tanks shall be made from high density linear polyethylene (HDLPE) resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.

3. All polyethylene resin material shall contain a U.V. stabilizer as compounded by the resin manufacturer. Pigments may be added at the purchaser's request, but shall not exceed 0.25% (dry blended) of the total weight.

B. Tank Design

1. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 in. thick.

   T = P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
   T = wall thickness
   SD = hydrostatic design stress, PSI
   P = pressure (.433 x S.G. x H), PSI
   H = fluid head, ft.
   S.G. = specific gravity, g/cm3
   O.D. = outside diameter, in.

   The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress would be ≤ 660 PSI at 73 degrees Fahrenheit for Type I and Type II materials based the resin density. In accordance with the formula in 1.08 A., the tank shall have a stratiform (tapered wall thickness) wall. In no case shall the wall thickness be less than the minimum allowed per calculation of ASTM D1998.

   The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

   The standard design specific gravity shall be 1.35, 1.5 or 1.9.

2. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support.
3. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall.
4. The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head. The tie-down lugs shall be designed to allow tank retention in wind and seismic loading.

2.2 FITTINGS

A. Fittings - Threaded Bulkhead

1. Threaded bulkhead fittings are available for below liquid installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from the tank knuckle radius' and flange lines. Consult the manufacturer for placement questions. The maximum allowable size for bulkhead fittings placed on a curved sidewall section of tanks 48 in. to 142 in. in diameter is 2 inch size. Tank wall thickness must be considered for bulkhead fitting placement. The maximum wall thickness for each fitting size is shown below. The following chart is based upon PVC and CPVC fittings.

Fitting Size	Maximum Wall Thickness
1/2 in.	2 in.
3/4 in.	2 in.
1 in.	2 in.
1 1/4 in.	2 in.
1 1/2 in.	2 in.
2 in.	2 in.
3 in.	2.125 in. (Flat Surface Only)

2. The bulkhead fittings shall be constructed of PVC or other specified material. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton®, or other specified material.

B. Vents

1. Each tank must be properly vented for the type of material and flow rates expected. Vents must comply with OSHA 1910.106 (f) (2) (iii) or other accepted standard. All tanks must be vented for atmospheric pressure as well as any pressure created by filling and emptying the tank. Consult the manufacturer for necessary venting and placement information.
2. All u-vents shall be constructed of PVC or other specified materials.

C. Flexible Connections

1. All tank fitting attachments shall be equipped with flexible couplers or other movement provisions. Tank piping flexible couplers shall be designed to allow 4% tank design movement. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.

2. The flexible connection is to be manufactured of the same material as the tank or a compatible material approved by the project engineer. If an elastomer flexible connection is used control bolts are required if recommended by the manufacturer. The flexible connection is to be designed for a minimum of 4% tank movement. The flexible connection is to be designed with 150# flange connections to allow for attachment to the tank and the piping system. The flexible connection is to be attached as close as possible to the tank to reduce stress.

2.3 ACCESSORIES

A. Float Level Indicator

1. Contractor shall provide float level indicator and integrate it with the well pump. Levels shall be as specified on the Drawings.

PART 3 EXECUTION

3.1 INSTALLATION VERIFICATION

A. Install the tank in strict accordance with manufacturer's Guidelines for use and installation and shop drawings.

B. Tanks shall be hydro-tested (water test) for 24 hours before introduction of stored material.

C. The installer is to certify in writing that the tank system has been installed according to the tank manufacturer's guidelines for use & installation.

D. Check all pipe connections for leaks

E. A complete set of installation, operating and maintenance manuals shall be provided.

3.2 FIELD TESTING

A. Hydrostatic Water Test

1. The hydrostatic water test shall consist of filling the tank to brim full capacity for a minimum of four hours and conducting a visual inspection for leaks. Test all systems for proper calibration settings.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Furnish and Install Polyethylene Tank (18,800 Gallons) shall be measured by the number of tanks installed per field measurement.

4.2 PAYMENT

A. The unit price paid for each Furnish and Install Polyethylene Tank (18,800 Gallons) shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of Furnish and Install Polyethylene Tank (18,800 Gallons), including excavation and recompaction of soil, rock base, complete tank with inlets/outlets, vents, float controls, complete in place as shown on the Plans and as specified in these Technical Specifications and the SSPWC.

END OF SECTION