



State of Utah

GARY R. HERBERT
Governor

GREGORY S. BELL
Lt. Governor

Department of Administrative Services

KIMBERLY K. HOOD
Executive Director

Division of Facilities Construction and Management

DAVID G. BUXTON
Director

ADDENDUM NO. 1

Date: March 18, 2010

To: Short-Listed Contractors

From: Bob Anderson – Project Manager

Reference: Water Filtration System and Building – Springville Fish Hatchery
Division of Wildlife Resources – Springville, Utah
DFCM Project No. 07146520

Subject: **Addendum No. 1**

Pages

Addendum Cover Sheet	1 page
Revised Bid Form	2 pages
<u>Engineer's Addendum No. 1</u>	<u>66 pages</u>
Total	69 pages

Note: This Addendum shall be included as part of the Contract Documents. Items in this Addendum apply to all drawings and specification sections whether referenced or not involving the portion of the work added, deleted, modified, or otherwise addressed in the Addendum. Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject the Bidder to Disqualification.

While we contend that SB220 should only be potentially applicable to a contract issued after the effective date of said bill, this is to clarify that for purposes of this contract, regardless of the execution or effective dates of this contract, the status of Utah Law and remedies available to the State of Utah and DFCM, as it relates to any matter referred to or affected by said SB220, shall be the Utah law in effect at the time of the issuance of this Addendum.

1.1 **SCHEDULE CHANGES:** No Project Schedule changes.

1.2 **GENERAL ITEMS:**

1.2.1 See attached revised bid form – liquidated damages increased.

1.2.2 See attached Engineer's Addendum No. 1 dated March 18, 2010



**BID FORM - REVISED
PER ADDENDUM NO. 1 DATED MARCH 18, 2010**

NAME OF BIDDER _____ DATE _____

To the Division of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

The undersigned, responsive to the "Notice to Contractors" and in accordance with the "Instructions to Bidders", in compliance with your invitation for bids for the **WATER FILTRATION SYSTEM AND BUILDING - SPRINGVILLE FISH HATCHERY – DIVISION OF WILDLIFE RESOURCES SPRINGVILLE, UTAH – DFCM PROJECT NO. 07146520** and having examined the Contract Documents and the site of the proposed Work and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: _____

For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of: _____ DOLLARS
(\$ _____) (In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete by **August 31, 2010** should I/we be the successful bidder, and agree to pay liquidated damages in the amount of **\$500.00** per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor's Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of _____

The undersigned Contractor's License Number for Utah is _____.

Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in the Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract.

The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable 100% Performance and Payment bonds are not delivered within the time set forth.

Type of Organization:

(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

Respectfully submitted,

Name of Bidder

ADDRESS:

Authorized Signature



**DIVISION OF WILDLIFE RESOURCES
SPRINGVILLE FISH HATCHERY PROJECT
DFCM PROJECT # 07146520
2009**

**ADDENDUM # 1
March 18, 2010**

PLANHOLDER:

This Addendum #1 shall become part of the Plans (Drawings), Contract Documents, Specifications and Special Provisions of the above referenced project, and all provisions of the contract shall apply hereto.

Bidders shall acknowledge receipt of all addenda by number in the space provided in the bid proposal.

CONTRACT DOCUMENTS, SPECIFICATIONS AND SPECIAL PROVISIONS

1. There was a discrepancy between the plans and the specifications for the magnetic flow meter. The magnetic flow meter shall be an insertion type meter. The specification section 17210 shall be replaced with 17211 attached hereto.
2. In an effort to combine utilities for the site for this and another project on the same site. the pad mount transformer, meter base and CT enclosure with sufficient capacity for the site will be installed by the contractor currently constructing the raceway covers. This removes the need for a meter and CT base where shown on the current plans. In place of this the contractor will be responsible to run conduit & conductors the distance between the new location of the pad mount transformer, meter base and CT enclosure and the Automatic Transfer Switch located at the treatment building. This will increase the distance of conductor from approximately 50 feet to approximately 350 feet this distance is to be field verified. Reference attached drawings E-2.1, E-3, & E-4 for changes.
3. Power to the UV Weir gate shall be supplied by panel PP2 and the conduit shall be routed accordingly. An additional 3 pole breaker shall be supplied in PP2 to power the weir gate. Reference the attached drawings E-2.2, E-4.
4. The air conditioner model currently called for on the plans shall be changed to a model PKA-A18HAL with a model PUY-A18NHA3 outdoor unit. The air conditioning split system schedule shown in the plans on drawing number M-5 attached hereto has been updated to reflect this.
5. The PLC as referred to in section 17500 of the specifications and shown on sheet I-2 shall be as manufactured by Allen Bradley in order to be easily integrated with the UV manufacturers PLC. If the UV manufacturer submits a different type of PLC for approval the contractor shall coordinate the PLC in the MTU with the UV manufacture to insure compatibility.

6. The Bid Schedule as shown in contract documents of the specification manual for Schedule B has been updated and shall be replaced by the attached bid schedule. (i.e. item 5 has been changed and item 18-28 have been added)
7. Section 17000, 17100, and 17100-SP have been updated and shall be replaced by the attached specifications.
8. A 4-20 mA signal shall be supplied from the flow meter to the UV system's PLC as well as to the MTU.
9. As a note of clarification the type of construction shown in the code analysis and the building category are two different things. The building category in the specs refers to the level of importance and will remain Building Category 4. The Type of construction refers to the material the building is being constructed from and will remain Type II/B.
10. On C7, the concrete vault and the piping coming into the vault will be constructed by a separate contractor already under contract (Schedule A). The contractor bidding this contract (Schedule B) will install the piping within the vault and the pump within the vault, the control panel and all wiring in and out of the vault and appurtenances for the pump as described on Note 1 of C1, and Specification 11388SP.
11. Sheet C7 has been updated and is attached hereto. The phrase "by others" when referencing Schedule B is a typo in detail B on C7, Schedule B is what is being bid, this has been updated on the attached drawing.
12. Specification 11388 SP has also been updated to clarify this, and is attached hereto.

Sincerely,



Robert W. Worley, P.E.
SUNRISE ENGINEERING, INC.

END

SCHEDULE B BID SCHEDULE

NOTE: The plans depict to portions of the overall job to be completed, which are denoted by Schedule A and Schedule B. This Bid Schedule shall only include those items denoted as schedule B on the plans, Items which fall under Schedule A shall be by others.

CONTRACT FOR: SPRINGVILLE FISH HATCHERY - 2009

The undersigned Bidder, having examined and determined the scope of the Contract Documents, hereby proposes to perform the work described herein for the following unit prices or lump sum amounts.

Note:

1. Bids shall include sales tax and all other applicable taxes and fees
2. All bids shall be checked for errors. If errors are made, unit prices shall govern and corrections will be made according to the unit price and totals will be revised to reflect the corrections.

No.	Meas. & Pmt. Reference	Item	Quantity	Unit	Unit Price	Amount
EXTERIOR TREATMENT PLANT BUILDING CONSTRUCTION WORK						
1	02000	Mobilization	1	L.S.	\$ -	\$ -
2	02015	Clear and Grub	1	L.S.	\$ -	\$ -
3	02201 SP	Earthwork for Treatment Plant Area	1	L.S.	\$ -	\$ -
4	02201 SP	UBC & Gravel for Treatment Plant Area	1	L.S.	\$ -	\$ -
5	02222	30" PVC C905 DR 32.5 and Fittings	340	Ln. Ft.	\$ -	\$ -
6	02511	3.5" Hot Plant Mix Bituminous Surfacing	695	Sqaure Yards	\$ -	\$ -
7	03300 SP	Concrete (4000 psi) (Ext. Slabs & Stairs)	1	L.S.	\$ -	\$ -
8	11388 SP	Recirculation Pump System	1	L.S.	\$ -	\$ -
9	11389 SP	Diversion Structure	1	Each	\$ -	\$ -

INTERIOR TREATMENT PLANT BUILDING CONSTRUCTION WORK						
10	03305 SP	Treatment Area Concrete	1	L.S.	\$ -	\$ -
11	13150 SP	Steel Building	1	L.S.	\$ -	\$ -
12	15120 SP	Treatment Plant Piping/Equipment	1	L.S.	\$ -	\$ -
13	11250 SP	Ultraviolet Disinfection System	1	L.S.	\$ -	\$ -
14	11260 SP	Drum Filter System	1	L.S.	\$ -	\$ -
15	13320 SP	Gantry Crane and Hoist	1	Each	\$ -	\$ -
16	09205 SP	Building Interior Finishes	1	L.S.	\$ -	\$ -
17	15010 SP	Mechanical & HVAC Equipment	1	L.S.	\$ -	\$ -
18	16210	Light Fixtures	1	L.S.	\$ -	\$ -
19	16400	Service Entrance	1	L.S.	\$ -	\$ -
20	16400	Grounding System	1	L.S.	\$ -	\$ -
21	16400	Power Panel or Motor Control Center	1	L.S.	\$ -	\$ -
22	16400	Dry Type Transformer	1	L.S.	\$ -	\$ -
23	16400	Lighting Panel	1	L.S.	\$ -	\$ -
24	16251SP	Service Entrance Rated Automatic-Manual Transfer Switch	1	L.S.	\$ -	\$ -
25	16815SP	Standby Generator	1	L.S.	\$ -	\$ -
26	16900SP	UPS System	1	L.S.	\$ -	\$ -
27	17000	Instrumentation & Control	1	L.S.	\$ -	\$ -
28	17100	Complete and Working Panels as listed in 17100SP-A Panel List	1	L.S.	\$ -	\$ -

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RECIRCULATION PUMP	SECTION 11388SP
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11388.1 DESCRIPTION

The contractor shall provide all equipment labor and materials to furnish and install the 480 Volt, 3 Phase, 60 Hz solids-handling, electric submersible pumps to be supplied with integral electric motor, discharge elbow, guide bar brackets and installation accessories as shown on the drawings and required by these specifications. The contractor is responsible to field verify dimension and coordinate installation of the pump and appurtenances with those to be installed by the contractor responsible for items included in schedule A.

11388.1.1 RELATED WORK

Section 01019 – Measurement and Payment
Section 11010 – Mechanical Equipment General Requirements
Section 15110 – Pipe and Piping Systems
Section 16010 – Electrical General Requirements
Section 16050 – Basic Material and Methods
Section 16150 – Electrical Control Devices
Section 16400 – Service and Distribution Systems
Section 17000 – Process Control and Instrumentation General Requirements
Section 17051SP – Control Strategies

11388.2 RECIRCULATION PUMP

11388.2.1 MANUFACTURER

11388.2.1.1 The specifications and project drawings depict ITT Flygt Pump. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials, except as allowed below.

11388.2.1.2 After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration; equipment must be pre-approved by engineer, such substitution shall be equal to or superior in construction and efficiency to that specified in the contract, and equal or higher quality must be demonstrated by service in a similar installation. Any equipment not pre-approved will not be considered.

11388.2.1.3 In event the contractor obtains Engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.

11388.2.1.4 In the event the contractor obtains engineer's approval of equipment other than that for which the station was originally laid out, the contractor shall, at his own expense, make any changes in the structures, buildings or piping necessary to accommodate the equipment, and shall provide as-built drawings to the engineer. It will be assumed that the cost to the contractor of the equipment proposed to be substituted is less than that of the equipment specified in the contract and if substitution is approved, the contract price shall be reduced by an amount equal to 50% the savings.

11388.2.1.5 A manufacturer's being named in this specification notwithstanding, all equipment approved for this project shall meet or exceed all performance, service, and warranty requirements of this specification. Submittal data shall include, but not be necessarily limited to: typical motor, as well as pump, performance curves; compliance documentation for all performance values described in Section 11388.2.4; compliance documentation for all construction details described in, and

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RECIRCULATION PUMP	SECTION 11388SP
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calculations required by, Section 11388.2.5; and service and warranty compliance documentation required by Section 11388.2.6 of this specification.

11388.2.1.6 Conditional approval by the Engineer under this section is based on a general review only of the specified pump and in no way constitutes final approval of equipment, nor waives any requirement of these specifications, nor relieves the Contractor or Manufacturer of any degree of responsibility for compliance with specific requirements of other portions of these specifications.

11388.2.2 QUALITY ASSURANCE

11388.2.2.1 GENERAL

The pumps shall be suitable for pumping fish hatchery effluent and shall be designed and fully guaranteed for this use. The fluid temperature range shall be from 40 degrees to 115 degrees F.

11388.2.2.2 STADARDS

The test code of the American Hydraulic Institute for testing pumps and sound engineering practice shall be used. All pump performance documentation, including flow/head curves, shall adhere to the Hydraulic Institute Standards and shall allow no negative tolerance on flow, head, hydraulic efficiency or any other criteria deemed by the Engineer to be necessary to evaluate pumping system performance.

11388.2.2.3 ENVIRONMENTAL CONDITIONS

11388.2.2.4 SUBMITTALS

In addition to all data required under Sec. 11388.2.1.2 Manufacturer of this specification, complete assembly, foundation support, and installation drawings, together with detailed specifications and data covering pumps, motors, material used, parts, devices and other accessories forming a part of the equipment furnished shall be submitted for approval in accordance with the procedure set forth in the General Conditions.

Data and specifications for the equipment shall include, but shall not be limited to the following:

A. Setting plans. Setting plans shall include:

1. Anchor bolt layout
2. Anchor bolt dimensions.
3. Outline dimensions and weights of pumps, bases, motors, and control enclosures.

B. Pumps. Data and drawings shall include:

1. Manufacturer, type and model number.
2. Assembly drawing, nomenclature and material list, five (5) copies of the O & M manual, and parts list.
3. Type, manufacturer, model numbers, location and spacing of bearings.
4. Impeller type, diameter, thru-let dimensions, sphere size, number of vanes and identification number.
5. Complete motor performance data including: rating, voltage/phase/frequency; design type; service factor; insulation class; motor pole number; actual rotation speed when combined with the specified pumps; current, power factor and active input power (KW) as a continuous function of shaft power from no load to at least 115 percent load; start

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- (max. inrush) current; locked rotor current; NEC code letter; and motor torque as a continuous function through the motor start cycle from no rotation to synchronous speed.
6. Complete performance test curve(s) showing full range (shutoff to run-out) head vs. capacity, NPSHR, hydraulic efficiency, motor active (KW) input power, motor total (KVA) input power (based on measured current and voltage), and shaft power (BHP). See Sec. 11388.2.3.1 Shop Tests.
 7. Location and description of Service Centers and spare parts stock.
 8. Warranty for the proposed equipment.

The manufacturer shall indicate, by arrows to points on the Q/H curves, limits recommended for stable operation, between which the pumps are to be operated to prevent surging, cavitation, and vibration. The stable operating range shall be as large as possible, and shall be based on actual hydraulic and mechanical characteristics of the units and shall meet the hydraulic performance requirements of the proposed system.

11388.2.3 TESTING

General – Equipment shall be shop tested and field tested as specified hereinafter. All costs for the tests shall be borne by the Contractor. The Contractor shall submit the complete shop test procedures to the Engineer for approval at least 30 days prior to the shop test. In the event any equipment fails to meet the performance values set forth in this specification, the equipment shall be modified and re-tested or replaced with equipment that performs in accordance with this specification.

11388.2.3.1 SHOP TEST

11388.2.3.1.1 Pumps and Motors.

Each pump and motor shall be performance tested as specified hereinafter; all pumps shall be tested with motor cables to be supplied with the pumps. Three copies of certified test reports, including actual test records, shall be submitted and approved by the Engineer prior to shipment of the equipment.

The Contractor shall submit the complete pump test procedure, a diagram of the test setup showing location of instruments, a sample of the test stand log sheet, and calibration data of all instruments and measuring devices to be used by the manufacturer to the Engineer, for approval, prior to the pump tests.

Each pump shall be tested for performance at the factory to determine the head vs. capacity, motor total electrical power draw (KVA), and motor active electrical power draw (KW) for the full speed at which the pumps are specified and shown on a performance test curve, certified by a registered professional engineer, as continuous functions throughout the pump's performance range. Tests of models, prototypes or similar units will not be acceptable.

All tests shall be run in accordance with the test code for centrifugal pumps of the Standards of Hydraulic Institute, latest edition. The motor and cable on each pump shall be tested for moisture content or insulation defects. After the test, the pump cable end shall be fitted with a shrink-fit rubber boot to protect it from moisture or water.

11388.2.3.2 FIELD TEST

Equipment shall be field tested as specified hereinafter. Field testing shall be composed of preliminary tests and acceptance tests. The Contractor shall provide the services of authorized equipment supplier's representatives to conduct all field tests.

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11388.2.3.3 PRELIMINARY TESTS

Preliminary tests shall be run on all pumps, motors, and control systems to demonstrate that they are in proper working order.

11388.2.3.4 ACCEPTANCE TESTS

Acceptance tests shall be run to demonstrate that the pumping units, motors and control system meet the following requirements:

- A. The pumping units operate as specified without excessive noise, cavitation, vibration, and without overheating of the bearings.
- B. All automatic and manual controls function in accordance with the specified requirements.
- C. All drive equipment operates without being overloaded.

11388.2.4 PERFORMANCE

Submersible pumps shall meet the following performance requirements:

11388.2.4.1 VALUE

ITEM (UNITS) VALUE [purpose]

Primary Duty Point (CFS/ft.) 6.5 / 20.1 [sets specific "design" Q/H requirement]

Secondary Duty Point (CFS/ft.) 7.8 / 14.6 [establishes min. pump curve slope and operating pressure reserve]

Minimum Shutoff Head (ft.) 40.0 [establishes min. peak pump pressure reserve]

Maximum Active Motor **Input Power**

at primary duty point (HP) 22.8 sets a minimum primary "overall" efficiency]

Maximum Active Motor **Input Power**

at secondary duty point (HP) 22.0 [sets a minimum secondary "overall" efficiency]

Maximum Pump Speed (RPM) 1160 [higher pump speed increases NPSHR]

Maximum NPSHR at primary duty point (ft.) 17.6 [sets a maximum pump cavitation proclivity]

Maximum NPSHR at secondary duty point (ft.) 18.5 [sets a maximum pump cavitation proclivity]

Minimum Motor Rating (HP) at 40 degrees C. 25 [ensures minimum continuous shaft power availability]

Voltage/Cycle/Phase 460/60/3

Motor Design Type **B**

Motor Service Factor 1.15 [specifies ratio of motor rated power to peak available power] Greater than 1.10

Motor Insulation **Class H** [sets minimum temperature that insulation system will withstand]

Maximum Motor Pole Number 6 [higher pole numbers mean lower power factor and higher current draw]

Maximum Rated (FL) Current (A) 32 [sets maximum "rated" load on power grid]

Minimum Rated (FL) Power Factor (%) 85 sets maximum "rated" load on power grid]

Maximum LR Current (A) 177 [sets maximum "load" on power grid during "pump start"]

Maximum NEC Code Letter **H** [limits electrical "start" power requirement]

Minimum Pump Discharge Size (inches) 10 [limits flow velocity and velocity head requirement]

11388.2.4.2 PROJECT SCOPE

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Furnish and install 1 submersible non-clog wastewater pump(s). Each pump shall be equipped with an 25 HP submersible electric motor, connected for operation on 460 volts, 3 phase, 60 hertz, 3 wire service, with an estimated 25 feet (length to be field verified and shall have no splices from the pump to the nearest junction box, or transfer switch or control panel) of submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and also meet with P-MSHA Approval. The pump shall be supplied with a mating cast iron 10 inch discharge connection and be capable of delivering 6.5 CFS at 20.1 TDH. An additional point on the same curve shall be 7.8 CFS at 14.6 feet total head. Shut off head shall be 40.0 feet (minimum). Each unit shall be fitted with 30 Ft (20 ft. minimum) of Flygt **Grip Eye System** for use with portable cable hoist with adequate strength to permit raising and lowering the pump.

11388.2.4.3 PUMP DESIGN

The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. **Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable.** No portion of the pump shall bear directly on the sump floor.

11388.2.4.4 PUMP CONSTRUCTION

Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Sealing design shall incorporate **metal-to-metal contact** between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

11388.2.4.5 COOLING SYSTEM

(Cooling Jacket Equipped)

Each unit shall be provided with an integral motor cooling system. A motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F. (40°C.). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

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11388.2.4.6 CABLE ENTRY SEAL

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. **The cable entry junction chamber and motor shall be separated by a terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.**

11388.2.4.7 MOTOR

The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel.

The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

11388.2.4.8 BEARINGS

The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single ball type bearing to handle radial loads. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L₁₀ bearing life shall be 50,000 hours at any usable portion of the pump curve.

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11388.2.4.9 MECHANICAL SEAL

Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide** ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber, shall contain one stationary and one positively driven rotating corrosion resistant **tungsten-carbide** seal ring. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.
Seal lubricant shall be FDA Approved, nontoxic.

11388.2.4.10 PUMP SHAFT

Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be AISI type 431 stainless steel. Shaft sleeves will not be acceptable.

If a shaft material of lower quality than 431 stainless steel is used, a shaft sleeve of 431 stainless steel is used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided in the oil housing and above. Therefore, the use of stainless steel sleeves will not be considered equal to stainless steel shafts.

11388.2.4.11 IMPELLER

The impeller shall be of gray cast iron, ASTM A-48 Class 35B, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the impeller shall be hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

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11388.2.4.12 VOLUTE / SUCTION COVER

The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have integral spiral-shaped, sharp-edged groove(s) that is cast into the suction cover. The spiral groove(s) shall provide the sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The internal volute bottom shall provide effective sealing between the multi-vane semi-open impeller and the volute.

11388.2.4.13 PROTECTION

Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.

The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

11388.2.4.14 SITE TESTS

The pump shall be tested at start-up. Voltage, current, and other significant parameters shall be recorded. The Manufacturer shall provide a formal test procedure and forms for recording data.

11388.2.4.15 PUMP TEST

The pump manufacturer shall perform the following inspections and tests on each pump before shipment from the factory:

1. Impeller, motor rating and electrical connections shall be checked for compliance to the customer's purchase order.
2. A motor and cable insulation test for moisture content or insulation defects shall be made.
3. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
4. The pump shall be run submerged a minimum of six (6) ft. under water.
5. After operational test No. 4, the insulation test (No. 2) is to be performed again.

A written report stating the foregoing steps have been done may be supplied with each pump at the time of shipment (upon request).

11388.2.4.16 PERFORMANCE CURVES

In no case shall the required horsepower at any point on the performance curve exceed the horsepower of the motor when using any of the impellers available for use with the proposed pump. All centrifugal pumps shall have a continuously rising curve.

11388.2.4.17 LOCAL PUMP SERVICE FACILITY

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At the time of bidding, there shall be a fully accredited service facility within 100 miles of the project site having factory trained technicians and a full stock of repair parts for a complete overhaul of the proposed pumps.

11388.2.4.18 ADDITIONAL PUMP MOTOR CHARACTERISTICS

For economy of sizing and operating auxiliary generator standby power, the pump motor shall have electrical power in-rush characteristics of NEC Code Letter G. NEC Code Letters H and greater will not be acceptable.

11388.2.4.19 PUMP WARRANTY

The pump manufacturer shall warrant the units being supplied to the owner against defects in workmanship and material for a period of five (5) years or 10,000 hours under the Municipal Wastewater-Permanent Installation Warranty Policy under normal use, operation and service. The warranty shall be in printed form and apply to all similar units.

11388.2.4.20 DOCUMENTATION

The manufacturer, if requested, will supply a minimum of five (5) sets of standard Submittal Drawings, Operating and Maintenance Instruction Manuals and Parts Lists. Additional sets of Drawings, Parts Lists, Manual etc. or modification to the manufacturer's standard submittal will be at an additional charge. Aperture Cards, photo or microfilming sets, if required, will be at an additional charge per set.

Standard submittals will consist of:

- a). Pump Outline Drawing
- b). Control Data
- c). Access Frame
- d). Typical Installation Guides
- e). Technical Manuals
- f). Parts List

11388.2.4.21 EXPERIENCE CLAUSE

The pump manufacturer shall have a minimum of 1,000 units of similar type pumps, installed and operating for no less than five (5) years in the United States.

11388.2.4.22 ACCES FRAME AND COVER

See 08121 SP

11388.2.4.23 GUIDE RAILS

Furnish and install upper guide holder, lower guide holder and level sensor(s) cable holder. Lower guide bar holders shall be integral with the pump discharge connection. Guide bars shall be of at least schedule 40 Stainless Steel type 304 pipe of the size indicated on drawings minimum 2 inch diameter. The guide bars shall not support any portion of the weight of the pump. Power cable shall be suspended by stainless steel kelum grip type strain relief attached to the cable holder.

11388.2.4.24 CONTROLS

Furnish and install one (1) Simplex Flygt automatic pump control center in 33"X21"X12" NEMA 4X Stainless Steel gasketed enclosure with three-point latch for 480 volts, 3 phase,

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60 hertz 3 wire power supply. For the pump motor, there shall be included: a combination circuit breaker/overload with manual reset for protection against current overloads, short-circuit protection, and disconnect for all phases; Soft-Start solid state stator; hand/off/automatic (H-O-A) pump operations selector switch; and low level alarm function. In the event of a fault/failure of the Feed Pumps, a normally closed contact in Feed Pump panel will indicate failure and initiate start of the recirculation pump when the H-O-A selector switch is in the Auto position.

The following additional options shall be included with the panel:

1. NEMA 4X Stainless Steel enclosure with 3 point latch.
2. Anti-Condensation heater & Thermostat.
3. Running time meter(s).
4. Pump run light(s).
5. Secondary Lightning arrestor.
6. 3 Phase Power Monitor Phase protection.
7. Aluminum inner dead front door
8. Incoming Power Terminals with Neutral and Ground Terminations
9. Heavy Duty Square D FAL Frame Circuit Breakers
10. NEMA Rated Square D Motor Starter w/ Overloads for each pump
11. Auxiliary Contact on Motor Starter indicating pump running.
12. Additional Contact Block on the H-O-A selector switch indicating the switch is in the "Auto" position.
13. Control Circuit Breaker
14. Control Voltage Transformer if 460 V or 230 V three phase panel
15. MiniCAS relay for seal failure and pump high temp alarms.
16. Multitrode MTRA relay for low level alarm.
17. Multitrode Relay Level Control System w/ 8" Multitrode Probe.

11388.2.4.25 LIQUID LEVEL SENSOR

Furnish and install **8 Inch** Flygt Multitrode Probe with 30 Ft of Cable, and cable holder.

11388.2.4.26 BALL CHECK VALVE SPECIFICATION

Ball check valves shall be designed to be non-clog, fully automatic, maintenance free and specifically suited for operation in sewage and storm water where solids, fibers, grit or highly viscous materials are encountered.

Ball check valves will have one moving part, the ball, which automatically rolls out of the path of flow, thus providing an unobstructed and "full flow" equal to nominal size. Upon discontinuation of flow the ball automatically rolls back to the closed position, thus providing a positive seal against back pressure or backflow.

The ball shall have an exterior coating of vulcanized nitrile rubber resistant to grease, petroleum products, animal and vegetable fats, dilute concentrations of acids and alkalis, tearing and abrasion. The body and cover shall be nodular cast iron type GGG 40/ASTM 65-45-12/SAE 4512. Ball check valves are designed to be maintenance-free and suited for installation in the horizontal or vertical position. The valve shall be so constructed that by unbolting and lifting off the cover, the ball may be removed and replaced without removing the valve from the line.

Ball check valves will be available with either a floating or sinking ball.

The valve(s) shall be equal in all respects to model **10 Inch** 5087 as manufactured by the ITT Flygt Corporation.

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11388.3 CONSTRUCTION REQUIREMENTS

The Contractor shall provide all labor, equipment, and materials required to furnish and install the fully functional Feed Pump System as shown on the Drawings and as required by these Specifications. The Contractor shall complete all work and install all equipment and components at the locations required in accordance with the equipment manufacturer's recommendations and the requirements of these specifications. The pump system supplier shall provide up to 8 hours of onsite training on his equipment and up to 8 hours of startup and calibration of the pump system at no additional cost to the Owner. It is the Contractor's responsibility to insure a fully functioning pump system, therefore, any additional startup and calibration time necessary to provide a fully functioning pump system shall be completed at no additional cost to the owner.

11388.4 METHOD OF MEASUREMENT

11388.4.1 Measurement shall be lump sum, and shall include furnishing and installing of the recirculation pump and accessories, all necessary piping within the wet well, all valves, controls, guide rails, and wiring. In short all labor and equipment necessary to provide a fully functioning recirculation pump system as shown on the plans and described in the specifications. This work does not include those items identified as part of schedule A on the plans.

See note on Drawing C1 to determine items included in schedule A and B.

11388.5 BASIS OF PAYMENT

11388.5.1 Complete compensation for this accepted work shall be included in the contract unit price on the Bid Schedule.

The accepted quantity will be paid for at the contract unit price for:

PAY ITEM	UNITS
Recirculation Pump System	L.S.

17000.1 SUMMARY

General requirements that apply to all process control and instrumentation systems for the entire project. Reference P&ID drawings and the Instrument List in 17000SP.

17000.1.1 RELATED SECTIONS:

17000.1.1.1 In addition to the responsibilities listed below, the CONTRACTOR shall be responsible for all requirements of Section 16 and Section 17.

17000.1.1.2 The CONTRACTOR shall employ the services of an INTEGRATOR as a Sub-Contractor, as part of their scope.

17000.1.1.3 The CONTRACTOR shall provide all hardware and will be responsible for delivering a complete and functioning system, as well as any support needed by the INTEGRATOR to accomplish their tasks.

17000.1.1.4 The INTEGRATOR'S primary responsibility will be for the programming of PLC's and HMI's. Other parts of the work, i.e. supplying of panel drawings, submittal submission, etc., maybe transferred to the INTEGRATOR for completion. The details of this transaction, i.e. scope and compensation, are to be worked out between the CONTRACTOR and INTEGRATOR. Ultimately it will be the responsibility of the CONTRACTOR to deliver a complete and functioning system

17000.1.1.5 The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its Sub-Contractors to review all sections to insure a complete and coordinated project.

17000.1.1.6 Items involving electrical, control, and instrumentation construction may be shown on drawings or referred to in specifications that do not apply specifically to electrical, control and instrumentation systems. Because the Contract Documents are a single integrated document, it is the responsibility of the CONTRACTOR and its Sub-Contractors to review all sections to insure a complete and coordinated project.

17000.1.1.7 Items not involving electrical, control, and instrumentation construction may be shown on drawings or referred to in specifications that do apply specifically to electrical, control and instrumentation systems. Because the Contract Documents are a single integrated document, it is the responsibility of the CONTRACTOR and its Sub-Contractors to review all sections to insure a complete and coordinated project.

17000.1.2 The Contract Drawings, Documents, and overall design has been based on non-certified information furnished by various equipment manufacturers. It is incumbent on the part of the CONTRACTOR to include in the bid all material and labor needed to install the actual equipment furnished.

17000.1.2.1 The CONTRACTOR shall note that the instrument equipment specifications and installation details are based on non-certified vendor information and indicate minimum scope of supply from the equipment manufacturer. The CONTRACTOR shall include all costs in its bid to add additional instruments, wiring, computer inputs/outputs, controls, conduit, interlocks, electrical hardware, etc., into the design based on the equipment manufacturer's final certified vendor drawings. The CONTRACTOR shall revise or produce new loop diagrams to meet the equipment manufacturer's wiring requirements. Such changes to instrumentation and electrical work shall be incorporated into the scope of work at no additional cost to the OWNER in light of the CONTRACTOR knowledge that non-certified vendor information has been used in the design.

17000.2 REFERENCES

17000.2.1 CODES AND REGULATORY COMPLIANCE.

17000.2.1.1 The equipment, materials, installation, and other work shall conform to all applicable regulations, standards, specifications, and codes which are current as of the date of the final inspection for this Contract.

17000.2.1.2 Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the referenced documents to the extent that the requirements therein are not in conflict with the provisions of this Section; provided, that where such documents have been adopted as a code or ordinance by the public agency having jurisdiction, such code or ordinance shall take precedence.

17000.2.1.3 The equipment, materials, installation, and other work shall conform to all applicable regulations, standards, specifications, and codes which are current as of the date of bidding for this Contract, including, but not limited to, those which are established by the following sources:

- A. Instrument Society of America (ISA).
- B. National Electrical Manufacturers Association (NEMA).
- C. Occupational Safety and Health Administration (OSHA).
- D. American National Standards Institute (ANSI).
- E. National Fire Protection Association (NFPA).
- F. Institute of Electrical and Electronic Engineers (IEEE).
- G. National Electrical Code (NEC).
- H. Insulated Cable Engineers Association (ICEA).
- I. Federal Communications Commission (FCC).
- J. Underwriters Laboratory (UL).
- K. Local Power and Telephone Companies.
- L. Local Authorities having jurisdiction over the work.

17000.2.2 Where the requirements set forth in these Specifications or on the Drawings are greater or more rigid than the mandatory requirements referenced above, the applicable Specifications or Drawings shall govern.

17000.2.3 In the case of conflict between any mandatory requirements and Specifications or Drawings, the mandatory requirement shall be followed in each case, but only after submitting such proposed changes to the ENGINEER for approval.

17000.2.4 Nothing contained in these Specifications or shown on the Drawings will be so construed as to conflict with any national, state, municipal, or local laws or regulations governing the installation of work specified herein, and all such acts, ordinances, and regulations, including the National Electrical Code, are hereby incorporated and made a part of these Specifications. All such requirements will be satisfied by the CONTRACTOR at no additional expense to the OWNER.

17000.2.5 The Drawings and Specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If a conflict between Drawings and Specifications is discovered, this shall be referred to the ENGINEER as soon as possible for resolution. Should a conflict exist between the Drawings, Specifications, and/or mandatory requirements (i.e., codes, ordinances, etc.), it will be assumed that the more expensive method has been estimated, unless such alternate has been agreed to prior to submission of bids.

17000.2.6 SAFETY. The ENGINEER'S site responsibilities are limited solely to the activities of the ENGINEER and ENGINEER'S employees on site. These responsibilities shall not be inferred by any party to mean that ENGINEER has responsibility for site safety. Safety in, on, or about the site is the sole and exclusive responsibility of the CONTRACTOR alone. The CONTRACTOR'S methods of work performance, superintendence of the CONTRACTOR'S employees, and sequencing of construction are also the sole and exclusive responsibilities of the CONTRACTOR alone. The OWNER warrants that: 1) The CONTRACTOR'S responsibilities will be made clear in the owner's agreement with the CONTRACTOR; 2) The owner's agreement with the CONTRACTOR shall require the CONTRACTOR to indemnify, defend, and hold OWNER and ENGINEER harmless from any claim or liability for injury or loss arising from owner's or engineer's alleged failure to exercise site safety responsibility; 3) owner's agreement with the CONTRACTOR shall require the CONTRACTOR to make OWNER and ENGINEER additional insured under the CONTRACTOR'S general liability insurance policy, which insurance protection shall be primary protection for OWNER and ENGINEER. Given the foregoing, OWNER also shall, to the fullest extent permitted by law, waive any claim against ENGINEER, and indemnify, defend, and hold ENGINEER harmless from any claim or liability for injury or loss arising from engineer's alleged failure to exercise site safety responsibility. OWNER shall also compensate ENGINEER for any time spent or expenses incurred by ENGINEER in defense of any such claim. Such compensation shall be based engineer's prevailing fee schedule and expense reimbursement policy.

17000.2.6.1 The term "any claim" used in this provision means "any claim in contract, tort, or statute alleging negligence, errors, omissions, strict liability, statutory liability, breach of contract, breach or warranty, negligent misrepresentation, or other acts giving rise to liability."

17000.2.6.2 The term ENGINEER used in this provision means the prime engineer and all sub-engineers, sub-consultants, Electrical Engineers, and the Instrumentation Engineers.

17000.3 DEFINITIONS

17000.3.1 DEFINITIONS: Definitions of terms and other electrical considerations as set forth in the:

- NEC: National Electrical Code.
- IEEE: Institute of Electrical and Electronic Engineers.
- ISA: Instrument Society of America.
- NFPA: National Fire Protection Association.
- NETA: National Electrical Testing Association.

17000.3.2 SPECIFIC DEFINITIONS:

- MTU: Master Terminal Unit.
- RTU: Remote Terminal Unit.
- FAT: Factory acceptance test.
- HMI: Human Machine Interface.
- LCP: Local Control Panel containing operator interface devices operators, etc. without a PLC.
- LAN: Local Area Network.
- WAN: Wide Area Network.
- PC: Personal Computer.
- PLC: Programmable Logic Controller.
- RIO: Remote I/O.
- SCADA: Supervisory Control and Data Acquisition system incorporating and including all parts of the PLCs, PCs, RIOs, MTUs, etc

17000.4 SYSTEM DESCRIPTION

In accordance with Section 17050 Control Strategies

17000.5 SUBMITTALS

In accordance with Section 01300 Submittals. In addition, CONTRACTOR will furnish the following:

17000.5.1

GENERAL. Submit shop drawings, product data, operating manuals and all other required submittals. Submittals shall show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers and all other pertinent details. Submittals shall be organized and delivered for review by specification section. There may be more than one submittal for an individual specification section.

- A. Single submittals covering multiple specification sections will be returned without review. The ENGINEER will be reimbursed by the OWNER for all subsequent reviews and the OWNER will deduct the amount of the reimbursement from the CONTRACTORS' contract. The ENGINEER'S reimbursement will be on a time and expense basis and at the current billing rate of the ENGINEER. The ENGINEER will be the sole source for determining the suitability of any submittal.
- B. Submittals shall be fully indexed with a tabbed divider for each and every component. Pages within the tabbed sections shall be sequentially numbered. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review. The ENGINEER will be reimbursed by the OWNER for all subsequent reviews and the OWNER will deduct the amount of the reimbursement from the CONTRACTOR'S contract. The ENGINEER'S reimbursement will be on a time and expense basis and at the current billing rate of the ENGINEER. The ENGINEER will be the sole source for determining the suitability of any submittal.
- C. Submittal Organization.
 - 1. First Page.
 - a. Specification Section Reference.
 - b. Name and telephone number of individual who reviewed submittal prior to delivery to ENGINEER.
 - c. Name and telephone number of individual who is primarily responsible for the development of the submittal.
 - d. CONTRACTOR'S review stamp and comments.
 - 2. Second Page.
 - a. If a re-submittal, this page shall contain a response to each of the engineer's comments, and/or questions.
 - b. In the order that the comments and/or questions were presented throughout the submittal.
 - c. Referenced by index section and page number on which the comment appeared,
 - d. Shall list any and all exceptions to the specifications, any items not excepted will be expected to be furnished as per the plans and specifications.

3. Remaining pages.
 - a. Actual submittal data.
 - b. Indexed.
 - c. Pages sequentially numbered.
 4. Submittal organization shall be in the exact same order as the items are referenced, listed, and/or organized in the specification section.
- D. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is intended to be used.
- E. **EXCEPTIONS TO SPECIFICATIONS.** The CONTRACTOR shall include a list of proposed exceptions to the specifications and drawings along with a brief explanation of each. Acceptance of the exceptions is at the sole discretion of the ENGINEER. All items not listed as exceptions shall be furnished in accordance with the specifications and drawings. All items that do not meet the requirements of the specifications, and were not previously accepted as exceptions, shall be replaced by the CONTRACTOR at no additional cost to the OWNER, even if the submittals contained information indicating the failure to meet the requirements.
1. Any exceptions to the specifications must be noted, and the reason for the exception delineated. If there is no back up for the deviation the submittal will be returned requiring revision and re-submit.

17000.5.2

SHOP DRAWINGS: It is incumbent upon the CONTRACTOR to coordinate the work specified in these Sections so that a complete electrical power, instrumentation, computer and control system for the facility will be provided and will be supported by accurate shop and record drawings.

- A. As a part of its responsibility the CONTRACTOR shall prepare and submit complete and organized shop drawings, as specified herein.
- B. All drawings developed for the control system shall be generated utilizing Autodesk AutoCAD Version 2008 or later, shall be delivered on CDROM, as well as hard copies on 11 inch by 17 inch plain bond paper.
- C. Manuals written specifically for this project shall be generated utilizing Microsoft Word or HTML and shall be delivered on CDROM, as well as hard copies on 8.5 inch by 11 inch plain bond paper.
- D. The organization of the initial shop drawing submittal required above shall be compatible to eventual inclusion with the Technical Manuals submittal and shall include final alterations reflecting record conditions.
 1. Accordingly, the initial multiple-copy shop drawing submittal shall be separately bound in a standard size, 3-ring, loose leaf, vinyl plastic, hard cover, binder suitable for bookshelf storage.
 2. Binder ring size shall not exceed 2 inches.
- E. Interface between instruments, vendor control panels, motor controls, motor starters, variable speed drives, control valves, flow meters and other equipment related to the CONTROL SYSTEM shall be included in the shop drawing submittal.

- 17000.5.3 During the period of preparation of this submittal, the CONTRACTOR shall authorize direct, informal liaison between the INTEGRATOR and the ENGINEER for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the systems as specified may be authorized informally by the ENGINEER, but these shall not alter the scope of work or cause increase or decrease in the contract price. During this informal exchange, no oral statement by the ENGINEER shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant formal exception to, or variation from these Contract Documents.
- 17000.5.4 Should an error be found in a shop drawing during installation or startup of equipment, the correction, including any field changes found necessary, shall be noted on the drawing and submitted as final "RECORD DRAWINGS" prior to acceptance of the project.
- 17000.5.5 The CONTRACTOR shall submit detailed shop drawings and data prepared and organized by the INTEGRATOR.
- A. All shop drawings shall include the letterhead and/or title block of the approved INTEGRATOR responsible for this project.
- B. The title block shall include, as a minimum:
1. The INTEGRATOR'S registered business name.
 2. Address.
 3. Project name.
 4. Drawing name.
 5. Revision level.
 6. Personnel responsible for the content of the drawing.
 7. Date.
- 17000.5.6 The CONTRACTOR shall respond to all comments on shop drawing re-submittals made by the ENGINEER either by making the noted correction or stating why it was not revised.
- A. Any re-submittal received by the ENGINEER, which does not contain responses to the engineer's previous comments, shall be returned to the CONTRACTOR marked "REJECTED."
- B. No further review by the ENGINEER shall be performed until a response for these comments has been received.
- 17000.5.7 The ENGINEER has allowed for up to and including two reviews of each submittal. The ENGINEER shall be reimbursed for all reviews after the first two reviews by the OWNER, and the OWNER will deduct the amount of the reimbursement from the contractor's contract. The engineer's reimbursement shall be on a time and expense basis and at the current billing rate of the ENGINEER. The ENGINEER shall be the sole source for determining the suitability of any submittal.
- 17000.5.8 The submittal shall be presented in nine distinct and complete parts in the following order, each in a separate bound set. Any incomplete submittal will be rejected and returned without comments.
- A. Cost Loading and Cash Flow.
- B. The complete system hardware items shall be submitted for review.
- C. After successful review of the hardware items, the Loop Drawing submittal showing: control, interconnection, and loop drawings shall, be submitted for review.
- D. Loop Description Submittal.

- E. Testing and Start-up procedures.
- F. Technical Manuals.
- G. Training Submittals.
- H. Record Drawings.

17000.5.9 **COST LOADING AND CASH FLOW.** The CONTRACTOR shall develop a schedule, schedule of values, and cash flow summary for inclusion in the submittals. Failure to submit the schedule, schedule of values, or cash flow summary shall be cause for withholding any progress payment due for process control and instrumentation system work under sections in this Division.

A. Cash Flow Summary:

- 1. The cash flow summary shall be based on the submitted Schedule and equal in total to the contractor's process control and instrumentation system bid price plus approved contract modifications.
- 2. Expected payment requests for each month shall be included, as well as the cumulative payment requests to date for each month of the project.
- 3. The net payment requests for each month after deducting retainage and the cumulative payment requests to date shall also be shown.

17000.5.10 **SYSTEM HARDWARE SUBMITTAL.** This submittal shall be included in a singular, all-inclusive submittal which shall include but not be limited to:

- A. A complete index appearing in the front of each bound submittal volume which lists each device by Tag and Loop number, type, and manufacturer. System groups shall be separated by labeled tags.
- B. Complete grounding requirements for each system component including any requirements for PLCs, process LANs, and other control equipment.
- C. Requirements for physical separation between control system components and 120 VAC and 480 VAC power cables.
- D. UPS and battery calculations to show that the backup capacity and time meet the specified requirements.
- E. Complete and detailed bills of materials:
 - 1. A bill of material list, including quantity, description, manufacturer, and part number, shall be submitted for each field mounted device or assembly, RTU, MTU, LCP, cabinet assemblies and sub-assemblies.
 - 2. A bill of material list identifying all items within an enclosure, including:
 - a. Quantity.
 - b. Description.
 - c. Manufacturer.
 - d. Part number.
 - 3. Data sheets shall be included for each control system component together with a technical product brochure or bulletin. These data sheets shall show:
 - a. The component name as used within the Contract Documents.
 - b. The manufacturer's model number or other identifying product designation.
 - c. The project tag number.
 - d. The project system of which it is a part.
 - e. The project site to which it applies.

- f. The input and output characteristics.
 - g. The requirements for electric power.
 - h. The specifications for ambient operating conditions
 - i. Details on materials of construction.
4. Fully executed data sheets according to ISA-S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves, for each component, together with a technical product brochure or bulletin. The technical product brochures shall be complete enough to verify conformance to all Contract Document requirements, and shall be edited to reflect only those features supplied with the device. The data sheets shall show:
- a. Component functional description used herein and on the Drawings.
 - b. Manufacturers model number or other product designation.
 - c. Project tag number used herein and on the Drawings.
 - d. Project system or loop of which the component is a part.
 - e. Project location or assembly at which the component is to be installed.
 - f. Input and output characteristics.
 - g. Scale range and units and multiplier.
 - h. Requirements for electric supply.
 - i. Materials of construction and of component parts to be in contact with, or otherwise exposed to, process media, and or corrosive ambient air.
 - j. Special requirements or features, such as specifications for ambient operating conditions.
 - k. Features and options which are furnished.
5. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, multiple data sheets, one per instrument, with one brochure or bulletin may cover all identical uses of that instrument in that system.
6. Control Panel Hardware Engineering submittal Refer to Section 17100.
7. A priced list of recommended spare parts covering items which are furnished under this Contract with the name, address, and phone number of manufacturer and manufacturer's local service representative of these parts.

17000.5.11 SHOP DRAWINGS

- A. A complete set of control system drawings which depict:
- 1. All PLCs, workstations, printers, communication devices, and communication links.
 - 2. All PLCs shall be shown with their current I/O allocation, and future I/O allocation, current plus spares provided under this project, and maximum potential I/O based on available slots.
 - 3. All cables required to support the communication requirements.
 - 4. A separate diagram shall be submitted for each component fully annotated with conduit size and number associated with the power source.
- B. Site-specific arrangement and construction drawings for all equipment cabinets, including dimensions, identification of all components, preparation and finish data, nameplates, and the like.
- 1. All drawings shall be scaled, and shall show the position of the equipment at its intended installation location.

2. All drawings must show a scaled representation of the placement of all equipment being provided under this Contract and its spatial relationship to all other equipment located in the abutting and adjoining areas.
 3. All required access and clearances associated with the equipment must be shown with a statement of compliance to manufacturer's recommendations, NEC, and other applicable codes.
- C. Loop Drawing Submittal: The CONTRACTOR shall furnish a Loop Drawing Submittal which completely defines and documents the contents of each monitoring, alarming, interlock, and control loop associated with equipment provided under Section 17, Section 16, as well as equipment provided under sections in other Divisions, existing, and OWNER furnished equipment which is to be incorporated into the control system.
1. The submittal shall be a singular complete bound package.
 2. A complete index in the front of each bound volume.
 3. The loop drawings shall be indexed by systems or process areas.
 4. All loops shall be tagged in a manner consistent with the Contract Documents.
 5. I/O shall be submitted for every analog and discrete monitoring and control loop.
 6. Drawings showing definitive diagrams for every instrumentation loop system.
 - a. These diagrams shall show and identify each component of each loop or system using legend and symbols from ANSI/ISA S5.4 -Instrument Loop Drawings, as defined by the most recent revision in ISA.
 - b. Each system or loop diagram shall be drawn on a separate drawing sheet.
 - c. Loop drawings shall be developed for all equipment associated with this project including vendor supplied packages, equipment provided under Divisions 16 & 17, and OWNER furnished equipment.
 - d. The loop drawings shall also show all software modules and linkages.
 7. In addition to the expanded ISA S5.4 requirements the loop diagrams shall also show the following details:
 - a. Functional name of each loop
 - b. Reference name, drawing, and loop diagram numbers for any signal continuing off the loop diagram sheet.
 - c. MCC panel, circuit, and breaker numbers for all power feeds to the loops and instrumentation.
 - d. Designation, and if appropriate, terminal assignments associated with every manhole, pull-box, junction box, conduit, and panel through which the loop circuits pass. a) Use conduit numbers as found in Division 16 for identification of conduits.
 - e. Vendor panel, instrument panel, conduit, junction boxes, equipment and SCADA System terminations, termination identification wire numbers and colors, power circuits, and ground identifications.
 8. A complete system block diagram.
 9. Panel and cabinet layout drawings shall be prepared and they shall include the following information:
 - a. Front, side, and plan views to scale.
 - b. Dimensions.
 - c. Arrangement (interior and exterior).
 - d. Mounting information, including conduit entrance location.
 - e. Finish data.
 - f. Tag number and functional name of items mounted in and on panel, console and cabinet.

- g. Nameplate legend which includes text, letter size, and colors to be used.
- 10. Panel wiring and/or piping diagrams shall be prepared and integrated into the field wiring. They shall include the following information;
 - a. Name of panel.
 - b. Wiring and piping sizes and types.
 - c. Terminal strip numbers.
 - d. Functional name and manufacturer's designation for items to which wiring and piping are connected.
 - e. Electrical control schematics in accordance with ANSI standards.
- 11. Field wiring and piping diagrams shall be prepared and be integrated with the panel wiring diagram. They shall include the following information:
 - a. Wire and piping sizes and types.
 - b. Conduits in which wiring is to be located.
 - c. Panel (e.g., RTU, MTU, LCP, PLC, etc.) termination strip numbers.
 - d. Location, functional name and manufacturer's designation of items to which wiring and piping are connected.
- 12. Drawings showing schematic diagrams for control circuits. Complete details on the circuit interrelationship of all devices within and outside each control panel shall be submitted using schematic control diagrams. The diagrams shall show numbered terminals on components together with the unique number of the wire to be connected to each terminal. The diagrams shall also show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as samplers, pumps, valves and chemical feeders. The CONTRACTOR shall furnish all necessary equipment identified in the supplier's shop drawings to facilitate inclusion of this information by the System Supplier.
- 13. If necessary, interface with existing control and monitoring system. This shall include any and all modifications made to existing measurement and control circuits, equipment and wiring. It is the responsibility of the System Supplier to ascertain actual field conditions of the existing circuits, equipment and wiring. The OWNER will provide to the CONTRACTOR copies of all drawings and data that the OWNER can find that show such existing conditions.
 - a. The OWNER makes no representation as to the completeness nor correctness of any such drawings and data and cannot guarantee that complete or partial data exists for any of the facilities included in this contract.
 - b. Lack of such drawings shall not alleviate the contractual responsibility to ascertain and implement interfaces and modifications to existing measurement and control circuits, equipment and wiring.
- 14. Control Panel Wiring Diagram Submittal refer to Section 17100.

17000.5.12 LOOP DESCRIPTIONS.

For all items specified by a functional description, the CONTRACTOR shall furnish, as a minimum, a functional description at least as detailed as a functional description in the Specifications, P&ID'S, and elementary wiring drawings. The ENGINEER will review the functional description for conformance with the Specifications. Any additional costs which are caused by failure of the equipment to operate as stated in the functional description shall not be reason for a change in contract time or amount.

17000.5.14 FACTORY ACCEPTANCE TEST PROCEDURES. The CONTRACTOR shall prepare and submit a factory test procedure which incorporates:

- A. Test sequences.
- B. Test forms.
- C. Samples of database lists.
- D. Control system testing block diagram.
- E. Estimated test duration which complies with the requirements of the factory test specified herein.

17000.5.15 **TESTING, CALIBRATION, AND START-UP SUBMITTAL.** System test and start-up procedures and sequences shall be developed by the INTEGRATOR in conjunction with the CONTRACTOR and other requirements as identified in these Contract Documents, and shall be submitted to the ENGINEER for review. An approved submittal shall be required prior to the commencement of system testing. Procedures shall be prepared for each process system.

- A. The procedures shall, in narrative form, describe sequentially the operational steps to be followed in verifying the correct operation of each process system, including all features described in the control strategies contained in Specifications Section 17050, and those reflected in the P&IDs.
- B. All equipment, constituting the complete control system and its various workstation displays, which function together to form a complete process system shall be tested together, including interlocks between devices. Test procedures for all process orientated systems shall be developed and performed.
- C. Test Procedure Submittals. Submit the proposed procedures to be followed during tests of the control system and its components.
- D. Preliminary Submittal: Outlines of the specific proposed tests and examples of proposed forms and checklists.
- E. Detailed Submittal: After approval of the Preliminary Submittal, submit the proposed detailed test procedures, forms, and checklists. This submittal shall include a statement of test objectives with the test procedures.
- F. Provide certified and witnessed test and calibration checklists for each of the following tests:
 - 1. Factory Acceptance Tests.
 - 2. Loop Validation Tests.
 - 3. Pre-commissioning Test.
 - 4. Performance Test.

17000.5.15 **TECHNICAL MANUALS.** Seven (7) final sets of technical manuals shall be supplied for the OWNER as a condition of acceptance of the project.

- A. Information in the Technical Manuals shall be based upon the approved shop drawing submittals as modified for conditions encountered in the field during the work.
- B. Each set shall consist of 1 or more volumes, each of which shall be bound in a standard size, 3-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage.
- C. Binder ring size shall not exceed 2 inches.
- D. Initially, 2 sets of these manuals shall be submitted to the ENGINEER for review after return of favorably reviewed shop drawings and data required herein.

1. Following the engineer's review, one set will be returned to the CONTRACTOR with comments.
 2. The sets shall be revised and/or amended as required and the requisite final sets shall be submitted to the ENGINEER 15 days prior to startup of systems.
 3. The ENGINEER will distribute the copies.
- E. The Technical Manuals shall have the following organization for each process:
- Section A - Process and Instrumentation Diagrams.
 - Section B - Loop Descriptions.
 - Section C - Loop/I/O Drawings.
 - Section D - Instrument Summary.
 - Section E - Instrument Data Sheets.
 - Section F - Instrument Installation Details.
 - Section G - Test Results.
 - Section H - Control and SCADA System Software.
 - Section I - Control System Hardware
- F. Signed results from Loop Testing, Pre-commissioning, and Performance Testing shall be included in Section H - Test Results.
- G. In addition to updated shop drawing information reflecting actual installed conditions, each set of technical manuals shall include:
1. Installation, connection, operating, calibration, setpoints (e.g., pressure, pump control, time delays, etc.), adjustment, test, troubleshooting, maintenance and overhaul instructions in complete detail.
 2. This shall provide the OWNER with comprehensive information on all systems and components to enable operation, service, maintenance and repair.
 3. Exploded or other detailed views of all instruments, assemblies and accessory components shall be included together with complete parts lists and ordering instructions.
- H. Control and SCADA System Software. In addition to the information required under the specification section entitled "Contractor Submittals", this manual shall include complete documentation of all of the software programs provided for both the control and SCADA systems, including:
1. Listings of all application software on both hard copy and magnetic media.
 2. Database both hard copy and CDROM.
 3. Source codes.
 4. Communication protocols.
 5. All as necessary to maintain, troubleshoot, modify, or update the software system.
- I. Control System Hardware. Technical manuals for the PLCs, workstations, printers, and all other control system hardware components.

17000.5.16 TRAINING SUBMITTALS. Operator and Maintenance Training plan which includes:

- A. A submittal of the training plan overview along with prerequisites for the OWNER'S personnel.
- B. Schedule of training courses including dates, durations, and locations of each class.

- C. Proposed training material, including a resume, and a detailed outline of each lesson.
- D. Resumes for the proposed instructors, indicating previous instructional experience.
- E. Course Outline.

The ENGINEER will review the submitted data for suitability and provide comments that shall be incorporated into the course.

17000.5.17 **RECORD DRAWINGS.** The CONTRACTOR shall keep current a set of complete loop and schematic diagrams which shall include all field and panel wiring, piping and tubing runs, routing mounting details, point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and instrument elements. Two hard copies shall be submitted after completion of all commissioning tasks but prior to performance testing. All such drawings shall be submitted for review prior to acceptance of the completed work by the OWNER.

17000.6 QUALIFICATION REQUIREMENTS OF SYSTEMS INTEGRATOR

The CONTRACTOR shall include as part of his submittals a Qualifications Submittal for the INTEGRATOR. It shall include the following:

- 17000.6.1 Systems Integrator's office address, phone number and two office contacts.
- 17000.6.2 A list of at least five (5) successfully completed projects for a water and/or wastewater system of similar scope and complexity. The list shall include names and phone numbers for contact information.

17000.7 DELIVERY, STORAGE AND PROTECTION

- 17000.7.1 All equipment and materials delivered to the job site shall be stored in a location which will not interfere with the operations of the CONTRACTOR, other contractors on the site, or the OWNER.
- 17000.7.2 Storage and handling will be performed in manners which will afford maximum protection to the equipment and materials. Instruments shall be stored in complete conformance with the manufacturer's recommendations. Any instruments stored in variance with the manufacturer's recommendations shall be replaced at the engineer's discretion at no additional cost to the OWNER.
- 17000.7.3 It is the CONTRACTOR'S responsibility to assure proper handling and on-site storage of instrumentation and control equipment.
- 17000.7.4 **SHIPPING PRECAUTIONS:** After completion of shop assembly, factory test, and approval, all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.
 - A. Dehumidifiers shall be placed inside the polyethylene coverings.
 - B. The equipment shall then be skid-mounted for final transport.
 - C. Lifting rings shall be provided for moving without removing protective covering.

- D. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

17000.7.5 **SPECIAL INSTRUCTIONS.** Special instructions for proper field handling, storage, and installation required by the INTEGRATOR shall be securely attached to each piece of equipment prior to packaging and shipment.

17000.7.6 **TAGGING.** Each component and/or instrument shall be tagged to identify its location, instrument tag number, and function in the system.

- A. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the control system.
- B. Instruments shall be tagged immediately upon receipt in the field.
- C. Identification shall be prominently displayed on the outside of the package.
- D. Tags shall utilize the Tag and Loop Number identifications shown of the P&IDs.

17000.7.7 **STORAGE**

- A. Equipment shall not be stored outdoors.
- B. Equipment shall be stored in dry permanent shelters, including in-line equipment, and shall be adequately protected against mechanical injury.
- C. If any apparatus has been damaged, such apparatus shall be replaced and/or repaired at no additional cost to the OWNER.
- D. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through tests as directed by the ENGINEER.
- E. Such tests shall be at no additional cost to the OWNER, and if the equipment fails the tests, it shall be replaced at no additional cost to the OWNER.

17000.8 SEQUENCING AND SCHEDULING

17000.8.1 **FACTORY ACCEPTANCE TEST (FAT).** Prior to the delivery and installation of the SCADA system at the job site, but after the procurement, assembly, and configuration of all components, the System Supplier shall conduct a factory test.

- A. The CONTRACTOR shall schedule the factory test after receiving approval of the factory test procedures submittal.
- B. A copy of the test procedures shall be submitted to the ENGINEER at least 21 working days before the scheduled test date.
- C. Notify the ENGINEER of scheduled tests a minimum of 15 working days prior to the date of the test.
- D. Transmit completed PLC I/O Test Checklist forms 5 working days prior to the FAT.

- 17000.8.2 LOOP VALIDATION TEST. The CONTRACTOR shall notify the ENGINEER of scheduled tests a minimum of 30 working days prior to the estimated completion date of installation and wiring of the control system.
- A. Testing shall be completed 5 working days prior to the Pre-commissioning phase of the project.
 - B. Loop Validation Certifications. After the field device loop tests have been successfully completed for all individual instruments, all separate analog control networks, all valves all motors, all local operator interface panels, all motor control centers etc. a certified copy of all test forms signed by the INTEGRATOR and the OWNER'S representative as a witness, with test data entered, shall be submitted to the ENGINEER together with a clear and unequivocal statement that all instrumentation has been successfully calibrated, inspected, and tested.
- 17000.8.3 PRE-COMMISSIONING TEST. The INTEGRATOR shall furnish the services of an on-site commissioning engineer to supervise and coordinate installation, adjustment testing, pre-commissioning and start-up of the control system.
- A. The commissioning engineer shall be present during the total period required to affect a complete operating system. The commissioning engineer must be the individual responsible for the programming of the PLC'S.
 - B. Shall commence after acceptance of all training, wire test, calibration tests and loop validation tests, and all inspections have demonstrated that the instrumentation and control system complies with all Contract requirements.
 - C. Acceptance of the control system pre-commissioning testing must be provided in writing by the ENGINEER before the performance testing may begin.
- 17000.8.4 TRAINING. Training shall be completed before the pre-commissioning phase of the project may start. The training sessions shall be scheduled a minimum of 3 weeks in advance of when the courses are to be initiated. The ENGINEER will review the course outline for suitability and provide comments that shall be incorporated.
- A. Documentation. Training manuals shall be submitted to the ENGINEER a minimum of 10 working days prior to starting the training session. Within 10 days after the completion of each session the System Supplier shall submit through the CONTRACTOR the following:
 - 1. A list of all OWNER personnel that attended the session.
 - 2. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.
- 17000.8.5 PERFORMANCE TESTING. Pre-commissioning test must be completed a minimum of 5 working days prior to the performance test.
- 17000.8.6 After pre-commissioning tests have been completed, the control system will be given a final 90-day performance test.
- 17000.8.7 ACCEPTANCE: For the purpose of this project, the following conditions shall be fulfilled before the WORK is considered substantially complete:
- A. All submittals have been completed and approved.

- B. The control system has been loop tested and pre-commissioned.
- C. The OWNER training has been performed.
- D. The performance test has been successfully completed.
- E. All debris associated with installation of instrumentation has been removed.
- F. All probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

17000.9 WARRANTY

- 17000.9.1 The CONTRACTOR shall guarantee the performance and the hardware of all the instrumentation, control, telemetry and SCADA equipment and associated installation, as specified herein, for a period of one (1) year following the date of completion and formal acceptance of the WORK.
- A. To fulfill this obligation, the CONTRACTOR shall utilize technical service personnel designated by the OWNER.
 - B. Service shall be performed within 3 calendar days after notification by the OWNER.
- 17000.9.2 Equipment, software, and materials which do not achieve design requirements after installation shall be replaced or modified by the CONTRACTOR to attain compliance, at no additional cost to the OWNER. Following replacement or modification, the CONTRACTOR shall retest the system and perform any additional procedures needed to place the complete system in satisfactory operation and attain design compliance approval from the ENGINEER.
- 17000.9.4 All parts, material, labor, travel, subsistence, or other expenses incurred in providing all the services and service visits during the warranty period shall be by the CONTRACTOR under the guarantee.
- 17000.9.5 The warranty period shall start upon final acceptance of the complete control system work and successful completion of the performance test.
- 17000.9.6 The complete SCADA system (and associated software) included therein shall be guaranteed to meet or exceed the design requirements set forth in the Contract Documents.
- 17000.9.7 Equipment, software, and materials which do not achieve design requirements after installation shall be replaced or modified by the CONTRACTOR to attain compliance, at no additional cost to the OWNER. Following replacement or modification, the INTEGRATOR shall retest the system and perform any additional procedures needed to place the complete SCADA system in satisfactory operation and attain design compliance approval from the ENGINEER.
- 17000.9.8 The CONTRACTOR warrants the materials and workmanship used for the SCADA system equipment and materials furnished under the Contract, and further guarantees the materials and workmanship used for any equipment and materials produced and furnished hereunder as a part of the work of this Contract to be as herein specified and agreed upon, free from injurious defects, and in all respects satisfactory for the service required.
- 17000.9.9 The CONTRACTOR shall warrant/guarantee the satisfactory performance of the equipment and materials under operating conditions. In the event that tests and inspections disclose latent defects or failure to meet the specified requirements, the CONTRACTOR upon notification by the ENGINEER shall proceed at once to correct or repair any such defects or non-conformance or to furnish, at the delivery point named in the Contract, such new equipment or parts as may be necessary for conformity to the specified requirements, and shall receive no additional compensation.

17000.9.10 The CONTRACTOR shall guarantee that the completed system shall perform all of the data acquisition, control, and reporting functions as shown and specified.

17000.10 MATERIALS

17000.10.1 All materials and equipment furnished under this contract shall be new, free from defects, and shall be standard products produced by manufacturers regularly engaged in the manufacture of these products.

17000.10.2 Where there is more than one item of similar equipment being furnished under this contract, all such similar equipment shall be the product of a singular manufacturer.

17000.10.3 All meters, instruments, and other components shall be the most recent field proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise specified to match existing equipment.

17000.10.4 **SIGNAL LEVELS:**

- A. Analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable.
- B. Electrical analog signals outside control panels shall be 4 to 20 mA DC.
- C. All electric signals shall be electrically or optically isolated from other signals.
- D. Discrete input signal shall be 24VDC, unless otherwise noted.
- E. Discrete output signals shall be:
 - 1. 24VDC dry contact with interposing relays, unless otherwise noted.
 - 2. Pilot lights within RTU's may be 24 VDC and driven by 24 VDC discrete.
 - 3. All discrete outputs without exception shall be routed through an external terminal block mounted fuse with blown fuse indication.

17000.10.5 All instrumentation shall be suitable for operation in the ambient conditions at the equipment installation locations.

17000.11 SOURCE QUALITY CONTROL

17000.11.1 The CONTRACTOR shall arrange with all Manufacturers of the equipment and fabricators of panels and cabinets, supplied under this project to allow the OWNER and ENGINEER to inspect and witness the testing of the equipment at the site of fabrication.

- A. Equipment shall include the cabinets, special control systems, flow measuring devices, and other pertinent systems and devices.
- B. A minimum of 15 working days notification shall be provided to the ENGINEER prior to testing.
- C. No shipments shall be made without the ENGINEER'S approval.

17000.11.2 **FACTORY ACCEPTANCE TESTS (FAT):** Prior to shipment, the complete control system including all MTUs, RTUs, PLCs, LCPs, peripherals, communications equipment, and other

equipment, shall be assembled, connected, and all software loaded for a full functional test of the integrated system.

- A. Test procedures shall be developed and submitted by the CONTRACTOR to show that the integrated system hardware and software is fully operational and in compliance with the requirements of the Contract Documents.
- B. All hardware test procedures shall follow the guidelines of the applicable portions of Sections 3 through 8 in ISA's recommended practice ANSI/ ISA RP.1-1975(R1983).
- C. A copy of the test procedures shall be submitted to the ENGINEER in conformance with Section 17000.5 of this section.
- D. The factory test will be witnessed by the OWNER and ENGINEER.
- E. The factory test shall make use of hardware simulators that contain switches, pilot lights, variable analog signal generators, and analog signal level displays, that shall be connected to the I/O points within the control system. All inputs and outputs shall be simulated and proper control system operation shall be validated. Each switch, pilot light, display, etc. shall be labeled in accordance with the P&ID'S so that a timely and thorough test of the complete system can be conducted.
 - 1. The use of jumper wires, terminal block mounted pilot lights, and loose meters to act as or supply the functionality of a simulator will not be allowed.
 - 2. The hardware simulator may consist of a PLC; operating under a SCADA software package that has its I/O points hardwired to the control system PLC's I/O points. The SCADA software operating on a PC may then act as the switches, pilot lights, variable analog signal generators, and analog signal level displays.
- F. Factory Acceptance Test.
 - 1. PLC I/O Test:
 - a. Test shall be conducted prior to the arrival of the OWNER and ENGINEER for the witness FAT.
 - b. ENGINEER and OWNER shall review the test checklists.
 - c. ENGINEER and OWNER shall at random pick points to be tested. a) If any of the randomly selected points fail the test the entire FAT shall be considered failed and all costs for the re-test, including engineer's and owner's time and travel expenses shall be by the CONTRACTOR.
 - d. PLC I/O Test Checklist Form:
 - 1) Forms shall be organized by:
 - i) PLC.
 - ii) I/O type.
 - 2) Test methodology:
 - i) Discrete inputs: Apply appropriate input and panel terminal, observe input card indicator, observe data value at each indicated data address.
 - ii) Discrete outputs: Toggle bit in output buffer, observe data point, output card indicator light and measure response at field wiring terminals.
 - iii) Analog inputs: Apply appropriate analog input signal at panel terminals, observe data value at each indicated data address.

- iv) Analog outputs: Enter scaled values in the output buffer file, observe the output data file value, and measure appropriate response at panel wiring terminals.
- 3) Test form shall identify:
 - i) Panel.
 - ii) I/O Type.
 - iii) I/O tag name.
 - iv) Panel terminal block number.
 - v) I/O file.

17000.11.3 LOOP TEST

A. Test Forms will list:

- 1. Initial of individual performing test.
- 2. Date test was performed.

B. Loop Test:

- 1. Test shall be conducted by the individual responsible for the actual programming.
- 2. ENGINEER and OWNER shall witness the tests.
- 3. The submitted and approved system simulator shall be used for the test.
- 4. Any changes and/or corrections shall be noted on the test forms.
 - a. Corrections shall be made after a complete system test.
 - b. ENGINEER and OWNER shall witness the revisions and/or corrections prior to leaving the FAT.
 - c. If the corrections and/or revisions are too extensive to made in a timely manner the FAT shall be considered failed and all costs for the re-test, including engineer's and owner's time and travel expenses shall be borne by the CONTRACTOR.
- 5. Changes and corrections shall be made at no additional cost to the OWNER.
- 6. Test methodology: Using the simulator prove the functional operation of each and every loop, based upon the approved Loop Descriptions.
- 7. Loop Test Checklist Form. Forms shall be organized by:
 - a. Loop Number.
 - b. First page in loop numbered group shall contain the appropriate portions of the P&IDs for the loop being tested.
 - c. Second page shall include the fully revised and approved Loop Description for the loop being tested.
 - d. Remaining pages shall identify the Cause and Effect as each I/O point is toggled through the simulator.
 - e. Check boxes shall be provided to track proper and/or improper operation of the loop.

17000.12 INSTALLATION

17000.12.1 GENERAL: Under the supervision of the INTEGRATOR and as part of the role as CONTRACTOR, and in accordance with the manufacturer's instructions, and in coordination with the ENGINEER and the OWNER, all systems specified and/or required shall be:

- A. Installed.**
- B. Connected**

- C. Tested.
 - D. Started to place the system in operation.
 - E. This shall include final calibration in concert with equipment specified elsewhere in these Contract Documents.
- 17000.12.2 It is the intent of these specifications that the CONTRACTOR shall accomplish the physical installation of all elements, instruments, accessories or assemblies specified in these contract documents.
- A. The CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all elements, instruments, accessories and assemblies.
 - B. Electrical work shall be performed as specified in the applicable sections of Division 16.
- 17000.12.3 The monitoring and control system configurations are diagrammatic. The locations of equipment are approximate unless dimensioned. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Where job conditions require reasonable changes in approximated locations and arrangements, the System Supplier shall make such changes without extra cost to the OWNER, in accordance with the requirements of Division 16.
- 17000.12.4 All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The OWNER reserves the right to require minor changes in location of equipment prior to roughing in without incurring any additional costs or charges.
- 17000.12.5 **INSTALLATION AND CONNECTION.** The System Supplier shall install and connect all field-mounted components and assemblies under the criteria imposed by these specifications. The installation personnel shall be provided with a final reviewed copy of the shop drawings and data.
- 17000.12.6 **CONDUIT, CABLES, AND FIELD WIRING.** All conduit shall be provided under Division 16 without delay to the WORK of Division 17. All 4-20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, PLC input and output wiring and other field wiring and cables shall be provided under Division 16. All SCADA System equipment cables, and process LAN communication networks shall be provided under Division 17. All terminations and wire identification at control system equipment furnished under this or any other Division shall be provided as identified in Section 16.
- 17000.12.7 **COMMUNICATIONS CABLES.** Ethernet: Communications cables that will be used for Ethernet connectivity will meet Category 6 specifications as per EIA/TIA 568A. All Ethernet patch cables are to meet Category 6 specifications as well. In spaces with common air the cable needs to be plenum rated. Video: Camera cabling will be RG6 coax with 95% copper braid. In spaces with common air the cable needs to be plenum rated. Power conductors can be included within the jacket covering.
- 17000.12.8 **EQUIPMENT TIE-DOWNS.** All instruments, control panels, and equipment shall be anchored by methods which comply with seismic and wind bracing requirements which apply to the site. All control panels, VCPs, LCPs, etc., must be permanently mounted and tied down to structures.
- 17000.12.9 The ENGINEER has based the drawings and design on non-certified information furnished by various equipment manufacturers. It is incumbent on the part of the CONTRACTOR to include in the bid all material and labor needed to install the actual equipment furnished.

- A. The instrument equipment specifications, ladder logic diagrams, and installation details are based on non-certified vendor information and indicate minimum scope of supply from the equipment manufacturer.
- B. The System Supplier shall include all costs in its bid to add additional instruments, wiring, computer inputs/outputs, controls, conduit, interlocks, electrical hardware, etc., into the design based on the equipment manufacturer's final certified vendor drawings.
- C. The CONTRACTOR shall revise or produce new loop diagrams to meet the equipment manufacturer's wiring requirements.
- D. Such changes to instrumentation and electrical work shall be incorporated into the scope of work at no additional cost to the OWNER in light of the contractor's knowledge that non-certified vendor information has been used in the design.
- E. The CONTRACTOR shall be responsible for providing any additional or different type connections as required by the instruments and specific installation requirements at no additional cost to the OWNER.
- F. All such additions and all such changes, including the proposed method of installation, shall be submitted to the ENGINEER for approval prior to commencing the work.
- G. Such changes shall not be a basis of claims for extra work or delay.

17000.12.10 INSTALLATION CRITERIA AND VALIDATION. All field-mounted components and assemblies shall be installed and connected according to the requirements below:

- A. Installation personnel have been instructed on installation requirements of the Contract Documents.
- B. Technical assistance is available to installation personnel at least by telephone.
- C. Installation personnel have at least one copy of the approved shop drawings and data.
- D. All flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.
- E. All power and signal wires have been properly terminated.
- F. All connectors shall be, as a minimum, water tight.
- G. All wires shall be mounted clearly with an identification tag that is of a permanent and reusable nature.
- H. All wire and cable shall be arranged in a neat manner and securely supported in cable groups and connected from terminal to terminal without splices unless specifically approved by the ENGINEER. All wiring shall be protected from sharp edges and corners.
- I. All mounting stands and bracket materials and workmanship shall comply with requirements of the Contract Documents.
- J. Verify the correctness of each installation, including polarity of electric power and signal connections, and making sure all process connections are free of leaks. The System

Supplier shall certify in writing that for each loop or system, all discrepancies have been corrected.

- K. The OWNER will not be responsible for any additional cost of rework attributable to actions of the CONTRACTOR or the System Supplier.

17000.13 FIELD QUALITY CONTROL

17000.13.1 LOOP VALIDATION. All instruments, devices, valves, feeders, and systems shall be verified and adjusted after installation, in conformance with the component manufacturer's instructions.

- A. Loop Validation Test. Each instrument shall be field verified and/or calibrated by the CONTRACTOR.
 - 1. During the test procedure the instrument loop shall be validated. The output from the instrument shall be varied and the associated PLC register, HMI display, and/or SCADA screen value shall be observed to confirm output value, scale, range, and units from the device through the final control system element.
 - 2. Instrument and Instrument Component Validation: Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance its Manufacturer's specifications and instructions.
 - 3. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the ENGINEER at no additional cost to the OWNER.
- B. All control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the SCADA System. Actual signals shall be used wherever available.
- C. Following any necessary corrections, the loops shall be retested.
- D. Specified accuracy tolerances for each analog network are defined as the square root of the sum of the squares of individual component accuracy requirements.

17000.13.2 Individual component accuracy requirements shall be as indicated by Contract requirements or by published manufacturer accuracy specifications, whenever Contract accuracy requirements are not indicated.

- A. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network.
- B. For networks which incorporate analog elements, simulated sensor inputs corresponding to 0, 10, 50, 90 and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated network accuracy tolerance requirements.
- C. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices.
- D. Provisional settings shall be made on controllers and alarms during analog loop tests.

- E. All analog loop test data shall be recorded on test forms which include calculated network system accuracy tolerance requirements for each output.
- F. Each field device requiring an analog output shall be exercised through the control system. During this validation process the output from the PLC shall be varied and the end device position, speed, etc. shall be measured to confirm the proper operation of the device for the supplied analog signal from the control system.
- G. Each field device providing a discrete input to the control system shall be exercised in the field and the proper operation shall be observed at the control system.
 - 1. Limit switches shall be tested and limits set mechanically and then proper operation shall be observed as reported to the control system.
 - 2. Starters, relay contacts, switch contacts shall be exercised and proper operation shall be observed as reported to the control system.
 - 3. Instrument supplying discrete inputs to the control system shall be calibrated and tested, and the proper operation shall be observed as reported to the control system.
- H. Each field device accepting a discrete output signal from the control system shall be exercised in the field and proper operation shall be confirmed by correlating the control system signal with the actual response in the field.
 - 1. Valves shall be stroked through outputs from the control system and proper directional operation shall be field confirmed, as well as limits, and reports back the control system.
 - 2. Motors starters shall be exercised from the control system and proper operation verified through direct field observation.
 - 3. Solenoids and other field devices shall be exercised from the control system and proper operation verified through direct field observation.
- I. Instrument validation sheets shall be completed for each and every field instrument and/or analyzer that provide the following information and a space for sign-off on individual items and on the completed unit:
 - 1. Project name.
 - 2. Loop number.
 - 3. Tag number.
 - 4. Manufacturer.
 - 5. Model number.
 - 6. Serial number.
 - 7. Analog input devices:
 - a. Calibrated range
 - b. Analog input associated PLC register address.
 - c. Value in PLC register at 0, 10%, 50%, 90% and 100% of span.
 - d. Value in SCADA database at 0, 10%, 50%, 90% and 100% of span.
 - 8. Analog output devices:
 - a. Calibration range.
 - b. Analog output associated PLC register address.
 - c. Control variable value at field device at 0, 10%, 50%, 90% and 100% of span.
 - d. Physical device response 0, 10%, 50%, 90% and 100% of span.
Response to be actual valve position, or motor speed, etc.
 - 9. Discrete instrument input devices:

- a. Switch setting, contact action, and dead band.
 - b. Valve position switches:
 - 1) Response in the PLC as the valve is stroked from the PLC.
 - 2) Field observed actual valve position, and valve indicator position as the valve is stroked from the PLC.
 - c. Operator interface switches and associated response.
 - d. Starter and drive auxiliary device contact response.
 - e. Response of all other discrete inputs to the PLC.
10. Discrete output devices:
Documented observed response of field device to the discrete output from the PLC.
Observe the proper operation of Open, Close, Start, Stop, On, Off, etc.
11. Utilize the Factory Acceptance Test, PLC I/O Test form format modified to become the Loop Validation Test Checklist.
12. Space for sign-off by INTEGRATOR and date.
13. Test equipment used and associated serial numbers.

17000.13.3 PRE-COMMISSIONING TEST.

- A. General. Pre-commissioning test shall commence as specified in paragraph 17000.8 of this Section. Pre-commissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.
- B. Pre-commissioning Procedures and Documentation. All pre-commissioning and test activities shall follow detailed test procedures and check lists accepted by the ENGINEER. All test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the ENGINEER, which include calculated tolerance limits for each step. Completion of all system pre-commissioning and test activities shall be documented by a certified report, including all test forms with test data entered, delivered to the ENGINEER with a clear and unequivocal statement that all system pre-commissioning and test requirements have been satisfied.
- C. Operational Validation. Where feasible, system pre-commissioning activities shall include the use of water or air as applicable to establish service conditions that simulate, to the greatest extent possible the normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic control circuits. The stable steady-state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.
- D. Loop Tuning. All electronic control stations incorporating proportional, integral or derivative control circuits shall be optimally tuned, experimentally, by applying control

signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response.

- E. If excessive oscillations or system instability, as determined by the ENGINEER, occur the INTEGRATOR, in conjunction with the ENGINEER, shall develop and implement any additional control algorithms needed to achieve an optimal control loop operation, at no additional cost to the OWNER.
- F. Measured final control element variable position/speed setpoint settings shall be compared to measured final control element position/speed values at 0, 10, 50, 90 and 100% of span and the results checked against indicated accuracy tolerances.
- G. Pre-commissioning Validation Sheets. Pre-commissioning shall be documented on one of two types of test forms as follows:
 - 1. For functions which can be demonstrated on a loop-by-loop basis, the form shall include:
 - a. Project name.
 - b. Loop number.
 - c. Loop description.
 - d. Tag number, description, manufacturer and data sheet number for each component.
 - e. Space for sign-off and date by both the INTEGRATOR and ENGINEER.
 - f. Use the FAT Loop Test Checklist forms modified to meet these specific testing conditions.
 - 2. For functions which cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description the following information shall be included:
 - a. Specification page and paragraph of function demonstrated.
 - b. Description of function.
 - c. Space for sign-off and date by both INTEGRATOR and ENGINEER.
 - d. Use the FAT Loop Test Checklist forms modified to meet these specific testing conditions.
- F. Functional Performance
 - 1. General. The complete control system including all SCADA screens, reports, trends, etc. shall be functional throughout the pre-commissioning test. The complete control system shall perform all specified functions within the time frames listed below, based on the ultimate system expansion. Tests or calculations shall be developed to extrapolate from the initial system measured performance to the expanded system performance.
 - 2. Data Update Times. Data received from RTUs shall be displayed on the operator's console within 1 second of receipt of such data at the workstation, regardless of originating RTU, state of the data received, and the number of stations that require the data. Alarm printouts, when required, shall be initiated within the same 1 second time frame.
 - 3. Screen Displays. Any specified screen display, except trend displays, shall be drawn complete on any furnished CRT, including all real-time data, within 3 seconds from an operator request for the displays.
 - 4. Trend Displays. Any specified trend display containing up to three trend lines and any time interval, both real-time and historical, shall be drawn complete on

any furnished CRT within 10 seconds from an operator request for the trend display.

5. Reports. Any specified report shall be compiled and printing initiated on any furnished printer within 30 seconds from an operator request for the report.

- G. Pre-commissioning Certification. The CONTRACTOR shall submit an instrumentation and control system pre-commissioning completion report which shall state that all Contract requirements have been met and shall include a listing of all instrumentation and control system maintenance and repair activities conducted during the pre-commissioning testing.

17000.13.4 PROOF OF CONFORMANCE. The burden of proof of conformance to specified accuracy and performance is on the CONTRACTOR. The CONTRACTOR shall supply necessary test equipment and technical personnel if called upon to prove accuracy and/or performance, at no separate additional cost to the OWNER, wherever reasonable doubt or evidence of malfunction or poor performance may appear.

17000.13.5 TESTING. All systems shall be exercised through functional and operational tests in the presence of the owner's representative in order to demonstrate achievement of the specified performance. Operational tests depend upon completion of work specified elsewhere in these Contract Documents. The scheduling of tests shall be coordinated by the CONTRACTOR among all parties involved so that the tests may proceed without delays or disruption by uncompleted work.

17000.13.6 ADJUSTING. At no separate additional cost to the OWNER, the CONTRACTOR shall include the following services of qualified technical representative.

- A. Make all necessary adjustments, calibrations and tests.
- B. Control Valves: All control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to insure that no changes have occurred since the bench calibration.

17000.13.7 CLEANING. All control panels and enclosures shall be vacuumed clean prior to start-up and again after final completion of the project. All panel surfaces shall be cleaned, any scratches and/or defects shall be repaired to "new" condition. If in the engineer's opinion the panel repairs do not constitute "new" condition, they shall be replaced with new panels at no additional cost to the OWNER.

- A. All instrument faces and enclosures shall be wiped and/or vacuumed clean.
- B. Removal of Abandoned Equipment: All existing instrumentation and control equipment that is no longer required after the new system has been put into service shall be removed and delivered to the OWNER by the CONTRACTOR.

17000.13.8 DEMONSTRATION

- A. Performance Test. After successful completion of the pre-commissioning test as accepted by the ENGINEER and OWNER, the performance test and system startup by the OWNER'S operating personnel can follow.

- B. General. Completed in conformance with this Section. The performance test is part of the work that must be completed as a condition of substantial completion for the entire project. The complete PLC control and SCADA system must run continuously for the duration of the performance test. During this period, all system functions shall be exercised, and any system interruption and accompanying component, subsystem, or program failure shall be logged for cause of failure, as well as time of occurrence and duration of each failure. The INTEGRATOR shall provide a competently trained technician or programmer on call for the project site during all normal working days and hours from the start of the performance test until final acceptance of the system. Response time to the project site shall be within 24 hours of a major failure.
- C. Process Control System Testing. The entire process control system shall be tested and used under standard operating conditions.
- D. SCADA System Testing. The systems to be tested on-line will include the Display Generator Programs, the Report Generator Programs, high level language Compiler, the Editor, the Debugging Program, and the PLC driver software.
1. Each system function, e.g., status report, alarms, logs, and displays shall be exercised several times at a minimum, and in a manner which approximates "normal" system operation.
 2. At least four displays will be specified and generated during the test, which may also be specified as reports to be printed automatically, the programs generated, and the resulting data entered into the database.
 3. Failure of the system during the above program testing shall be considered as indicating that the programs and operating system do not meet the requirements of the specifications and corrective action shall be required before restarting the acceptance test.
 4. Only those components, sub-systems, and systems covered in this specification and supplied under this contract shall be considered for this acceptance test.
 5. Problems and failures of other systems shall not be considered as part of this test, except as they display the capabilities of this system to detect failures.
- E. Failures. Failures shall be classified as either major or minor.
1. A minor failure would be a small and non-critical component failure or software problem which can be corrected by the owner's operators. This occurrence shall be logged but shall not be reason enough for stopping the test and shall not be grounds for non-acceptance. Should the same or similar component failure occur repeatedly, this may be considered as grounds for non-acceptance. Failure of one printer, or CRT display shall be considered a minor failure providing all functions can be provided by backup equipment, ie. alternate printers and CRT's, and repairs can be made and equipment returned to service within 3 working days.
 2. A major failure shall be considered to have occurred when a component, subsystem, software control, or program fault causes a halt in or improper operation of the system and/or when a technician's work is required to make a repair or to re-initiate operation of the system.
 - a. A major failure shall cause termination of the performance test.
 - b. When the causes of a major failure have been corrected, a new acceptance test shall be started.
 - c. Failure of a control loop to maintain stability or function properly resulting in a process disturbance.

- d. Failure of any control system that results in an overflow, underflow, overdose, or underdose condition shall be considered as a major failure.
- F. Technician Report. Each time a technician is required to respond to a system malfunction he or she must complete a report which shall include details concerning the nature of the complaint or malfunction and the resulting repair action required and taken.
 - 1. If a malfunction occurs which clears itself or which the operator on duty is able to correct, no report shall be required or logged as specified above.
 - 2. If a technician has performed work but no report is written, then a major failure shall be considered to have occurred.
 - 3. Each report shall be submitted within 24 hours to the ENGINEER or its representative, and the OWNER.

17000.14 TRAINING

17000.14.1 GENERAL: The CONTRACTOR shall provide system maintenance and operator training courses by a qualified instructor for all the instrumentation, control, and computer monitoring and control systems furnished for this project.

- A. All instruction training material shall be provided by CONTRACTOR.
- B. One of the individuals conducting the course must be the same individual responsible for the majority of the programming that was performed for the instrumentation and control system.

17000.14.2 SCHEDULE: In conformance with the requirements of paragraph 17000.8 Sequencing and Scheduling of this Section.

17000.14.3 Agenda: The training shall include operation and maintenance procedures, trouble shooting with necessary test equipment, and changing set-points, and calibration for that specific piece of equipment.

17000.14.4 Maintenance/Operator Training. A maintenance/operator training course shall be provided for up to eight (8) designated personnel and representatives of the OWNER.

- A. This course shall be designed to provide the operations, maintenance and supervisory personnel with training in routine and preventive maintenance of all items in the instrumentation, control and the computer monitoring and control systems.
- B. The training course shall include instruction on the use of all maintenance equipment provided under Section 17.
- C. During the course, hands-on experience with the system equipment shall be provided.
- D. Course duration. PLC-based control system training shall be a minimum of 1 day with a total of 8 hours of training. SCADA system training shall be a minimum of 1 additional day with 8 hours of training.
- E. Special emphasis shall be given to the following:
 - 1. Locating of problems by software techniques and correcting the problems by replacement at the module level.

2. Use of the report generator program and display generator program with the object of making changes and additions to existing reports and displays as well as adding further reports and displays in the future.
3. Method to be used for scheduling and changing the scheduling of reports.
4. Conversion of engineering units.
5. Hardware and/or software of the PLCs, enabling adding or deleting analog and status points.

F. How to interpret the LCD displays, alarm reports, and other reports.

17000.15 METHOD OF MEASUREMENT

17000.15.1 INSTRUMENTATION & CONTROL INSTALLATION

Provide all components required in enclosures; mounted, wired, and acceptable Factory Acceptance Test. Installed in their final location. All communications equipments installed and in working condition. Provide, install and wire any field instrumentation specified. Any other appurtenances as required, and as shown on the drawings and as defined in the applicable sections of the specifications required for a complete and fully functioning system.

17000.16 BASIS OF PAYMENT

17000.16.1 No separate payment shall be made for furnishing or installing control systems, components, or materials required to be installed within the pay limits for a building or enclosure identified in the BID schedule to be furnished by the CONTRACTOR.

17000.16.2 When control systems, components, or materials are measured for a new building or enclosure as shown on the Bid Schedule, separate payment will be made as listed below.

17000.16.3 When initial installation or replacement of control systems, components, or materials is made in an existing building as shown on the Bid Schedule, the accepted quantity will be paid for at the contract price listed below:

<u>PAY ITEM</u>	<u>UNIT</u>
Instrumentation & Control	Lump Sum

17100.1 GENERAL

17100.1.1 SUMMARY

- A. This section sets the general specifications and requirements for all the control panels and enclosures being provided under this contract.
1. Included but not limited to all:
 - a. All custom built and designed control panels including RTU's, LCP's.
 - b. Control panels furnished as part of equipment systems including VCP's.
 2. The Electrical Contractor shall furnish, supply and install all custom control panels for this project in accordance with the CONTRACT documents.
 3. This section also covers requirements for local control panels being supplied by the Equipment Manufacturers as part of the packaged equipment.
 4. This specification covers the requirements for the fabrication of instrument boards, mounting, finishing, piping and wiring of instrument equipment.
- B. RELATED SECTIONS
1. The CONTRACT Documents are a single integrated document, and as such Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its Sub-Contractors to review all sections to insure a complete and coordinated project.
 2. This section shall be used in conjunction with the following specification sections:
 - a. General Electrical Requirements – Section 16010.
 - b. Instrumentation & Control, General – Section 17000.
 - c. Instrumentation & Control, General-Instrument List – Section 17000SP.

17100.1.2 SYSTEM DESCRIPTION

- A. Scope: The Electrical & Controls Contractors shall furnish the following custom control panels:
- See Section 17100SP for Instrumentation Control Panels, General - Panel List
- B. General requirements that apply to all control panels.
1. The control voltage within the control panel controls shall be 120 VAC or less. Where the electrical power supply to the control panel is 240 VAC single phase or 480 VAC 3-Phase, as shown on the electrical drawings, the control panel shall be provided with a control power transformer or power supply.
 2. The control panel shall be the source of power for all 120 VAC or less devices interconnected with the control panel including, but not limited to:
 - a. Solenoid valves
 - b. Instruments and transmitter both mounted in the control panel and remotely connected to the control panel.
 3. Source power for control panels.
 - a. All control panels shall be supplied with a maximum of 480 VAC, 3 phase, 60 Hz. power.

- b. Each control panel that has supply power greater than 120VAC single phase shall have a flange mounted disconnect, interlocked with the enclosure door, to be used to isolate the control panel from the supply power.
 - c. Supply all transformers, protection, and power supplies needed to convert the supply voltage to the needed utilization voltage within each control panel.
 - d. If the control power transformer and primary circuit breaker is located in an adjacent motor control center or panel board, then the requirement for a flanged mounted disconnect is waived in lieu of a nameplate attached to the control panel identifying the location of the source of power for the control panel.
 - e. The panel must have a nameplate identifying the circuit breaker feeding the panel and a warning statement requiring that the feeder breaker be turned off before opening the door to the enclosure.
4. Enclosure general requirements.
- a. Control panels shall have enclosures that meet the area classifications as specified on the drawings.
 - b. For those areas not specified:
 - 1) Installed indoors NEMA 12 enclosures with gasketed doors shall be used.
 - 2) Control panels installed outdoors shall be housed in NEMA 4X enclosures.
 - c. Control panels shall be either freestanding, wall mounted, pedestal-mounted, or equipment skid-mounted, as specified or shown.
 - d. Internal control components shall be mounted on an internal back-panel.
 - 1) Devices may be mounted on the side-panel only by special permission from the Engineer.
5. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front.
6. Motor starters, where required, shall be provided to meet the requirements specified in Section 16150, "Electrical Control Devices".
7. Discrete outputs from the control panel shall be provided by electrically isolated contacts rated for 5 amps at 120 VAC. Either through the use of an interposing relay or relay output card associated with the PLC.
8. Analog inputs and outputs shall be an isolated 4-20 mA 2-wire signal with power supply.
9. All control panel mounted operator interface devices shall be mounted between:
- a. A minimum of 3 feet above finished floor elevation.
 - b. A maximum of 6 feet above finished floor elevation.

17100.1.3 SUBMITTALS

- A. In accordance with Section 17000.5 Process Control & Instrumentation General Requirements.
- B. Control Panel Engineering Submittals: Submit a control panel engineering submittal for each control panel and enclosure being provided for this project.
 - 1. Control Panel Hardware submittal that shall include but not be limited to:
 - a. Enclosure construction details and NEMA type.

- b. Finish, including color chart for ENGINEER selection of color.
 - c. Layout.
 - d. Power circuits.
 - e. Signal and safety grounding circuits.
 - f. Fuses.
 - g. Circuit breakers.
 - h. Signal circuits.
 - i. Internally mounted instrumentation.
 - j. PLC's.
 - k. Systems Integrator components.
 - l. Face plate mounted instrumentation components.
 - m. Internal panel arrangements.
 - n. External panel arrangements.
 - o. Construction drawings drawn to scale that define and quantify:
 - 1) The type and gauge of fabrication steel to be used for panel fabrication.
 - 2) The ASTM grade to be used for structural shapes and straps.
 - 3) Panel door locks and hinge mechanisms.
 - 4) Type of bolts and bolt locations for section joining and anchoring.
 - 5) Details on the utilization of "UNISTRUT" and proposed locations.
 - 6) Stiffener materials and locations.
 - 7) Electrical terminal box and outlet locations.
 - 8) Electrical access locations.
 - 9) Print pocket locations.
 - 10) Writing board locations.
 - 11) Lifting lug material and locations.
 - p. Physical arrangements drawings drawn to scale that define and quantify the physical groupings comprising:
 - 1) Control panel sections.
 - 2) Auxiliary panels.
 - 3) Sub-panels.
 - 4) Racks.
 - 5) Cutout locations with nameplate identifications shall be provided.
 - q. A bill of material that enumerates all devices associated with the control panel.
2. Control Panel Wiring Diagram submittal that shall include but not be limited to:
- a. Schematic/Elementary diagrams shall depict all control devices and circuits and their functions.
 - b. Wiring/Connection diagrams shall locate and identify:
 - 1) Electrical devices.
 - 2) Terminals.
 - 3) Interconnecting wiring.
 - 4) These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
 - c. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.

- d. Control sequence diagrams shall be submitted to portray the contact positions or connections required to be made for each successive step of the control action.
- e. Input/Output (I/O) Diagrams for PLC I/O cards.
- 3. All panel drawings shall be 22" x 34" reduced to and fully legible at 11" x 17" submitted at 11" x 17" format size, with all data sheets and manufacturer specification sheets being 8.5" x 11".
- 4. The submittal shall be in conformance with NEMA Standard ICS-1-1.01, and each phase shall be submitted as a singular complete bound volume or multi-volume package and shall have the following contents.
 - a. A complete index shall appear in the front of each bound volume.
 - 1) All drawings and data sheets associated with a panel shall be grouped together with the panels being indexed by systems or process areas.
 - 2) All panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.
 - b. A listing of spare parts as specified in the drawings.

17100.1.4 QUALITY ASSURANCE

- A. All indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents.
- B. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices to within a range equal to 20% above the minimum and 20% below the maximum of the rated environmental operating ranges.
- C. Provide all power wiring for these devices.
- D. Enclosures suitable for the environment shall be furnished.
- E. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.
- F. All control panels and assemblies shall be labeled and listed by a nationally recognized testing laboratory.
 - 1. U.L. 508 or approved equal.

17100.1.5 DELIVERY, STORAGE AND HANDLING

- A. All panels are to be crated for shipment using a heavy framework and skids. The panel sections shall further be cushioned satisfactorily to protect the finish of the instruments and panel during shipment. All instruments that are shipped with the panel shall further have suitable shipping stops and cushioning material installed in a manner to protect instrument parts that could be damaged due to mechanical shock during shipment. Each separate panel unit shall be provided with removable lifting lugs to facilitate handling.
- B. All shipments shall be by dedicated air ride van, unless otherwise specified or approved.

17100.1.6 WARRANTY

All equipment in control panels shall be under warranty for a period of one year from the date of completion of the control system start up.

17100.2 PRODUCTS

17100.2.1 MANUFACTURERS

- A. Standard manufactured panel shall be used, whenever, possible.
 - 1. As manufactured by:
 - a. Hoffman Engineering.
 - b. Rob Roy.
 - c. Control Engineering.
 - d. Rittal
- B. Stainless steel control panels shall be standard manufactured panels whenever possible.
 - 1. As manufactured by:
 - a. Hoffman Engineering.
 - b. Rittal
- C. Water tight corrosion resistant non-metallic enclosures shall be standard manufactured panels whenever possible.
 - 1. As manufactured by:
 - a. Hoffman Engineering.
 - b. Rittal

17100.2.2 MATERIALS

- A. Materials:
 - 1. Panel section faces shall be:
 - a. No. 10 gauge minimum thickness steel for custom built freestanding panels.
 - b. No 14 gauge minimum thickness steel for smaller panels.
 - c. All materials shall be selected for levelness and smoothness.
 - 2. Relay rack high density type panels shall:
 - a. Utilize standard relay racks.
 - b. With No. 14 gauge steel frame and supports.
 - 3. Structural Shapes and Strap Steel:
 - a. ASTM A-283.
 - 4. Bolting Material:
 - a. Commercial quality carbon steel bolts, nuts and washers, shall all be ½ inch diameter with UNC threads.
 - b. Carriage bolts shall be used for attaching end plates.
 - c. All other bolts shall be hex head machine bolts.
 - d. All nuts shall be hot pressed hex, American Standard, heavy.
 - e. Standard wrought washers shall be used for foundation bolts and attachments to building structures.
 - f. All other bolted joints shall have S.A.E. standard lock washers.

5. Dimension:
 - a. It is the responsibility of the ISCS and/or VCP manufacture to design and size all panels based upon:
 - 1) Available space in area as shown on the plans.
 - 2) Device and equipment requirements for component located within the control panel.
 - b. The ENGINEER has based the size of the control panels as reflected on the plans on non-certified information and as such these sizes are to be used as a general guideline.
 - 1) Panel sizes that substantially deviate (+3 inches) from the sizes shown on the plans, must be approved by the ENGINEER.

17100.2.3 MANUFACTURED UNITS

A. Enclosure

1. NEMA 12
 - a. Enclosure designed to house electrical controls, terminals, and instruments, providing protection from:
 - 1) Dust
 - 2) Dirt.
 - 3) Oil.
 - 4) Water.
 - b. Seams continuously welded and ground smooth.
 - c. Door and body stiffeners as needed to make a rigid enclosure.
 - d. Heavy gauge continuous hinge.
 - e. Rolled lip around three sides of the door and all sides of the enclosure opening to prevent migration of liquids and contaminants into enclosure.
 - f. Oil-resistant gasket attached to door with oil-resistant adhesive. Gasket to seal against roll lip on the enclosure opening.
 - g. Internal mounting panel held in place by collar studs welded to enclosure.
 - h. Door window when shown on the drawings.
 - 1) Safety plate glass.
 - 2) Held in place by rubber locking seal.
 - 3) To allow full view of numeric display, PLC I/O, LED display, and keyboard, etc.
 - i. When shown on the plans a lockable door latching and handle mechanism to allow easy access to interior of enclosure and keyboard.
 - j. Panel cutouts for instruments, devices, and windows shall be cut, punched, or drilled and smoothly finished with rounded edges. Reinforce around all cutouts with steel angles or flat bars.
 - k. Finish.
 - 1) Interior, smooth, white polyester powder coating.
 - 2) Exterior polyester powder coating color to be determined by ENGINEER.
 - 3) Exterior brushed stainless for stainless steel panels.
 - l. Manufacturer's standard gauge steel.

- m. Each door to have a three-point latching mechanism and padlocking handle, with rollers on the ends of the latch rods.
 - n. With print pocket inside door.
 - o. With heavy duty lifting eyes.
 - p. With 15" floor stands or legs when shown on the drawings.
 - q. With flange mounted disconnect.
 - r. Conform to:
 - 1) NEMA Type 12.
 - 2) JIC EGP-1-1967.
 - 3) JIC EMP-1-1967.
 - 4) U.L. Listed.
 - s. Hinges: steel piano-type running full length of doors.
 - t. Mounting panel.
 - 1) 10 gauge steel.
 - 2) With stiffeners.
2. Water tight corrosion resistant stainless steel.
- a. NEMA 4X in design, dust tight, water tight, and corrosion-resistant.
 - b. Minimum 14 gauge, Type 304 Stainless Steel.
 - c. Captive stainless steel cover screws threaded into sealed wells.
 - d. Oil resistant neoprene sealing gasket and adhesive to seal cover to enclosure.
 - e. Finish. Cover surface and sides, unpainted, brushed finish.
 - f. Door fronts ground smooth.
 - g. Specifically designed for use with flange mounted disconnect switches.
3. Watertight corrosion resistant non-metallic.
- a. Shall meet the applicable requirements of the stainless steel enclosures plus the following additional requirements.
 - b. When specifically indicated on the plans and in the specifications, molded fiberglass reinforced polyester resin with 10 gauge plate steel reinforcing on the sides, top and bottom. Meeting the following minimum standards:

<u>Physical Properties</u>	<u>Value</u>	<u>ASTM METHOD</u>
Flexural Strength	29,000 PSI	D-790
Water Absorption	.07%	D-570
Tensile Strength	17,500	D651
Heat distortion	400 Deg. F	D-648
Specific Gravity	1.35	D-792
Dielectric Strength	400 V.PM.	D-149
Arc resistance	180 Sec	D-495
Flammability	94V-O	UL-94

- c. All seams sealed
- d. Hinges fiberglass with no exposed metal parts.
- e. Only exposed metal parts are to be captive stainless steel door screws that are easily replaced.
- f. Provisions for mounting panels must be an integral part of the enclosure whether by way of internal mounting channels welded to the interior or by way of spot-welded collar studs.
- g. Mounting panels to be constructed of aluminum plate.
- h. Panel finish.
 - 1) Gray exterior.
 - 2) White interior.
 - 3) White enamel aluminum mounting plate.

17100.2.4 ACCESSORIES

- A. Flange Mounted Main Disconnect.
1. The control panels shall have an integrally mounted main disconnect switch consisting of a thermal magnetic circuit breaker when specified on the drawings.
 - a. Minimum 22 KAIC.
 - b. If the control panel is supplied at 120 VAC or less then the disconnect requirement may be waived: however, a nameplate must be furnished on the cover of the control panel identifying all sources of supply and foreign voltages within the control panel.
 2. The main disconnect shall disconnect all power sources within the control panel.
 3. The main disconnect shall be lockable in the off position.
 4. The main disconnect shall be interlocked with the door of the control panel so that the door of the panel cannot be opened with the disconnect switch in the closed position.
 - a. With defeater.
 5. Flange mounted disconnects shall be used, door mounted disconnects are not acceptable.
 6. Flange mounted disconnects as manufactured by:
 - a. Allen Bradley 1494
 - b. Cutler Hammer C361/C371
 - c. ITE FH011
 - d. Square D Class 94222

17100.2.5 FABRICATION

- A. FRAMEWORKS AND SUPPORTS:
1. The rear of each panel section shall have a steel framework assembled to it for supporting conduit, wire ways, switches, piping and all instrument accessory items such as relay or terminal enclosures, transducers, pressure switches, valves and air relays.
 - a. The mainframe work shall be constructed of standard structural shapes.
 - b. Special shapes such as "UNISTRUT" may be used for secondary supports.
 - c. Framework must neither interfere with instrument connections nor interfere with access needed for maintenance or adjustments.
 2. Steel framework shall extend 2-feet 4-inches back from the panel face, or as shown on the drawings.
 - a. Where specified, individual adjustable leg supports shall be provided at the back of the framework so that the entire panel shall be self-supporting.
- B. PREPARATION OF PANEL SURFACE:
1. The surface of the panel shall be prepared for finishing in a manner equal to that described below. The entire surface shall comprise the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cutouts.
 - a. All high spots, burrs, and rough spots shall be ground smooth.
 - b. The surfaces shall be sanded or sandblasted to a smooth clean bright finish.

- c. All traces of oil shall be removed with a solvent.
- d. The first coat of primer shall be applied immediately.

C. PANEL FINISHING:

- 1. A thin coat primer surface shall be applied over the entire panel surface.
- 2. Wet sand, dry, then quick glaze spot putty on the front of the panel only. Dry, then wet sand again and dry.
- 3. A primer surface shall be applied on the front of the panel only.
- 4. Wet sand to smooth clear finish, and then dry.
- 5. At least 2 coats of polyester powder coating shall be applied over the entire surface.
- 6. Supply 2 one-pint containers of air-drying, matching paint for field touch-up of the panel face.

D. INSTRUMENT FINISHING:

- 1. The final coats applied to painted surface of instrument cases, doors, or bezels that are visible from the front of panels shall be manufacturer's standard unless otherwise specified.
- 2. Black Japan or "crinkle" finishes on instrument cases are not acceptable.

E. MOUNTING OF INSTRUMENTS:

- 1. Provide cut-outs, and mount all instrument items shown or specified to be panel mounted, including any instruments specified to be furnished by other vendors but installed in panel (if applicable).
- 2. Mount, behind the panels, other instrument accessory items as required and/or specified.
- 3. The rear of panel mounted equipment shall be installed with due regard to commissioning adjustments, servicing requirements and cover removal.
- 4. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

F. ELECTRICAL REQUIREMENTS

- 1. Each terminal connection shall have a plastic plate with a terminal and instrument tag number.
- 2. All wiring shall be identified with permanent machine imprinted wire markers.
- 3. Freestanding panels shall be provided with switched fluorescent back-of-panel lights. One light shall be provided for every 4-feet of panel width and shall be mounted inside and in the top of the back-of-panel area.
- 4. Freestanding panels shall be provided with a 15-amp, 120-volt service outlet circuit within the back-of-panel area. The circuit shall be provided with 3-wire, 120-volt, 15-ampere, GFCI duplex receptacles one for every 4 feet of panel width (1 minimum per panel) and spaced evenly along the back-of-panel area.
- 5. Smaller panels shall be so sized as to adequately dissipate heat generated by equipment mounted in or on the panel.
- 6. Panel mounted outdoors, or in shaded areas, or in high humidity areas shall have the following accessories:
 - a. Thermostatically controlled heaters that shall maintain the inside temperature above 40 Deg. F min or 10 Deg. F above ambient which ever is greater.

7. Smaller panels shall have the following accessory devices:
 - a. Thermostatically controlled heaters that shall maintain the inside temperature above 40 Deg. F min or 10 Deg. F above ambient which ever is greater.
8. Smaller panels shall have the following accessory devices:
 - a. Hand switch controlled 50-watt incandescent light.
 - b. Breaker protected 120-volt, 15-amp duplex, GFCI receptacle.
9. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the N.E.C. requirements for General Purpose (no open wiring) unless otherwise specified. Open wiring in close cabinet type panels is allowed when specified in the material specifications.
10. Signal and Control Circuit Wiring:
 - a. Wire type and sizes:
 - 1) Conductor shall be flexible stranded copper machine tool wire.
 - 2) These shall be UL listed Type MTW flexible or type SIS and shall be rated 600-volts.
 - 3) Wires for instrument signal circuits and alarm input circuits shall be No. 14 AWG.
 - 4) Wires connecting to PLC wiring arms shall be multi-conductor No. 20 AWG.
 - 5) All other wires, including shielded cables, shall be No. 16 AWG, minimum.
 - b. Wire Insulation Colors:
 - 1) Conductors supplying 120-volts AC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor.
 - 2) 120VAC grounded circuit conductors shall have white insulation.
 - 3) Insulation for ungrounded 120-volt AC control circuit conductors shall be red.
 - 4) 120VAC switched legs shall also have white or black color 'tick' on the insulation.
 - 5) Insulation for all positive DC conductors shall be blue.
 - 6) Insulation for all negative DC conductors shall be yellow.
 - 7) All switched DC legs shall also have white or black color 'tick' on the insulation.
 - 8) All wires energized by a voltage source external to the control panels shall conform to the above standards, but shall also be wrapped with purple electrical tape.
 - c. Wire Marking:
 - 1) Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number, preferably the instrument loop number, which shall be shown on all shop drawings.
 - 2) These numbers shall be marked on all conductors at every terminal.
 - d. Fused disconnect:
 - 1) Each signal and control circuit to have a fused disconnect.
11. For case grounding, panels shall be furnished with a ¼ - inch by 1 – inch copper ground bus complete with solderless connectors for all equipment ground conductors.
12. Electrical Locations:

- a. Terminal boxes for incoming and outgoing signal leads shall be located at the top or bottom of the panel.
13. Power Supply Wiring:
 - a. Unless otherwise specified, all instruments, alarm systems and motor controls shall operate on 115 VAC.
 - b. At a location near the top of the panel, or bottom, furnish terminal box connections for the main power supply entry.
 - 1) Unless the main power connection can be made directly to the control panel disconnect behind a barrier.
 - c. Each and every loop and instrument requiring 120 VAC shall be protected by individual DIN rail-mounted circuit breakers.
 - 1) The number of circuits depends on the circuit load as noted herein.
 - 2) A 15 amp, 2 pole circuit breaker shall be provided in each branch circuit.
 - 3) The circuit load shall not exceed 10 amps.
 - 4) Different panel sections or different process units must not use common branch circuits.
 - 5) Furnish and install DIN rail mounted circuit breakers for all individual instruments.
 - a) Circuit breakers shall be mounted on the back of the panel.
 - b) Identified by a service nametag.
 - c) Each potentiometer type instrument, electronic transducer, controller or analyzer shall have an individual DIN rail mounted circuit breaker located within the control panel.
 - i. Circuit breakers shall have plastic tags indicating instrument tag numbers.
 - ii. Individual plug and cord set power supply connections require DIN rail mounted circuit breakers ahead of the receptacle.
 14. Alarm Wiring:
 - a. Install and wire all alarms including light cabinets, audible signal units, test and acknowledge switches and remote logic units as specified.
 - b. Interconnecting wiring to panel mounted initiating devices shall also be wired.
 - c. Where plug and cord sets are provided for component interconnection, harness and support the cables in neat and orderly fashion. Where separate wire is required, install No. 16 AWG with MTW or TFFN insulation between all components.
 15. Signal Wiring:
 - a. Signal Wire – Non Computer or PLC Use
 - 1) Signal wire shall be twisted pair or triads in conduit or troughs. Cable shall be constructed of No. 16 AWG copper signal wires with 90 Deg. C, 600 V insulation.
 - 2) Color code for instrument signal wiring shall be as follows:
 - i. Positive (+) – Black.
 - ii. Negative (-) – White.
 - 3) Multi-conductor cables where specified shall consist of No. 18 AWG copper signal wires twisted in pairs, pairs, with 90 Deg. C, 600 V insulation.

- i. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.
 - 4) Use for connections between field terminal blocks and the PLC wiring arms for analog inputs and outputs.
 - b. Signal Wire – Computer or PLC Use
 - 1) Signal wires shall be similar to those for non-computer use but each pair shall be triplexed with a copper drain wire and aluminum polyester tape shall be applied over the triplexed group.
 - 2) All cable shields, including thermocouple extension leads shall be terminated at a single point within the control panel.
 - 3) Continuity of the shield is to be maintained throughout the cable runs.
 - c. Multi-conductor cables, wire ways and conduit shall be sized to allow for 20 percent spare signal wire.
- 16. Wiring Installation:
 - a. All wires shall be run in plastic wire ways.
 - b. Exception:
 - 1) Field wiring.
 - 2) Wiring run between mating blocks in adjacent sections.
 - 3) Wiring runs from components on a swing-out panel to components on a part of the fixed structure.
 - i. Wiring run from components on a swing-out or front panel to other components on a fixed panel shall be made up in tied bundles.
 - ii. These bundles shall be tied with nylon wire ties, and shall be secured to panels at both sides of the “hinge loop” so that conductors are not strained at the terminals.
 - c. Signal and low voltage wiring shall be run separately from power and 120 VAC control wiring.
 - 1) 120 VAC circuits shall be run through gray colored plastic wire ways.
 - 2) 24 VDC circuits shall be run through white colored plastic wire ways.
 - d. Wiring to rear terminals on panel-mount instruments shall be run in plastic wire ways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.
 - e. Provide an empty wire way for all field-wiring connections.
 - 1) 120 VAC circuits shall be run through gray colored plastic wire ways.
 - 2) 24 VDC circuits shall be run through white colored plastic wire ways.
 - 3) Wire ways shall be no more than 50% full.
 - 4) The distance from the terminals to the wire way shall be at least 3.0 inches.
 - f. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the ENGINEER’s review.
- 17. Wire Terminal Configuration. All panels shall be provided with one terminal per field wire including shield wire. PLC panels shall have each PLC I/O card wires bundled and routed to terminal blocks that are grouped and labeled for each I/O card, including spare cards.

18. Grounding. Furnish equipment ground bus with lugs for connection of all equipment grounding wires.

17100.2.6 SOURCE QUALITY CONTROL

- A. LABOR AND WORKMANSHIP: All panels shall be fabricated, piped and wired by fully qualified workmen who are properly trained, experienced and supervised.
- B. GENERAL: Verification, testing, and instruction shall be provided in accordance with the applicable requirements of Section 17000, "Process Control & Instrumentation General Requirements."
- C. TESTING:
 1. The systems integrator shall conduct the following tests prior to arrival of the OWNER and/or OWNER's representative:
 - a. All alarm circuits rung out to determine their operability.
 - b. All electrical circuits checked for continuity and where applicable, operability.
 - c. All nameplates checked for correct spelling and size of letters.
 - d. The PLC I/O test.
 2. It shall be the responsibility of the systems integrator to furnish all necessary testing devices and sufficient manpower to perform the tests required by the OWNER and/or OWNER's representative.
 3. If the above tests have not been performed prior to the arrival of the OWNER and/or OWNER's representative, the CONTRACTOR shall be liable for back charges by the OWNER for the extra time required for the witnessing services.

17100.3 EXECUTION

17100.3.1 EXAMINATION. Control Panel fabricator shall notify Engineer two weeks before shipment of panel to jobsite for testing and inspection.

17100.3.2 INSTALLATION

- A. Control panels that are adjacent to motor control centers shall be fully wired to the motor control centers by the Electrical Contractor, using wire ways integral to the motor control center or additional conduits as needed. These interconnections are not shown or reflected on the conduit schedule, but will be shown on the loop drawings.
- B. Control panels that are not adjacent to motor control centers shall be fully wired to the motor control centers by the Electrical Contractor. The Electrical Contractor shall furnish and install all necessary conduits and wire between the control panel and MCC based on the contract drawings.

17100.3.3 FIELD QUALITY CONTROL

- A. In accordance with Section 17000 Instrumentation & Control, General.

- B. The Electrical Contractor shall install control panels. Termination wiring shall be done in accordance with the drawings and under the supervision of the Engineer's on site inspector.
- C. All holes for field conduits, etc. shall be cut in the field, there shall be no additional holes, factory cut holes, or holes closer allowed. Incorrect holes, additional holes, or miss-cut holes shall require that the entire enclosure be replaced.

17100.3.4 ADJUSTING

All enclosures shall be mounted so that their surfaces are plumb and level to within $\pm 1/16''$ over the entire surface of the panel.

17100.3.5 CLEANING

In accordance with Section 17000 Instrumentation & Control, General.

17100.3.6 DEMONSTRATION

In accordance with Section 17000 Instrumentation & Control, General.

17100.3.7 PROTECTION

Protect all surfaces from damage, any surface damage, shall be repaired and/or replaced as directed by the ENGINEER.

17100.3.8 SCHEDULES

All control panel testing shall be performed prior to shipping.

17100.3.9 TRAINING

In accordance with Section 17000 Process Control & Instrumentation General Requirements.

17100.4 METHOD OF MEASUREMENT

Complete working MTU, RTU and Control Panels as specified in Specification 17100SP Panel List.

17100.5 BASIS OF PAYMENT

Completely installed, tested and working Panels as outline in Specification 17100SP Panel List.

<u>PAY ITEM</u>	<u>UNIT</u>
Complete and Working Panels as listed in 17100SP-A Panel List	Lump Sum

SECTION SP17100
INSTRUMENTATION CONTROL PANELS, GENERAL
Attachment A - Control Panel List

Panel Name	Service/Location	Description	Specification	Drawing	Notes
MTU-01	Main Building	Data collector and report	17100	I-2 - I-3.3	

17211.1 DESCRIPTION

The Contractor shall furnish, test, install, and place into satisfactory operation the insertable electromagnetic flowmeters (insertion mag meters) with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

17211.1.1 RELATED WORK

Section 17000 – Instrumentation & Control, General

17211.1.2 SUBMITTALS

The Contractor shall provide descriptive information which indicates the model number, manufacturer's name, dimensions, measuring range and manufacturer's certification of performance in accordance with the requirements of Section 01300.

17211.2 MATERIALS**17211.2.1 INSERTABLE ELECTROMAGNETIC FLOWMETERS**

1. Device identification: See Section SP17000.
2. The Flow meter system shall consist of a flow element and an indicating signal converter remotely mounted. The flow meter shall use an electromagnetic method.
3. The system shall have a range of -5 to +20 ft/s.
4. Accuracy shall be +/-2% of reading +/- zero stability at -3 to + 10 ft/s.
5. Sensor shall be 1" with stainless steel exposed to flow. Contractor to provide necessary installation materials.
6. Contractor shall ensure proper cable length between sensor and remote transmitter without cable splicing.
7. Signal Converter/Transmitter:
 - a) The signal converter/transmitter shall include the driver and the converter electronics. The flow converter shall be remote mounted with cabling furnished by the electromagnetic flow meter manufacturer. The signal converter shall be supplied in a NEMA 4X housing. The converter shall operate on a 120 VAC input.
 - b) The electronics shall contain a three line display, programming keypad and a 9-digit internal totalizer.
 - c) Input and output signals shall be fully isolated. The converter shall output 4-20mA DC into a load range from 0-800 ohms at 24 VDC. The unit will also output one Pulse Frequency for flow rate and one for Totalization.
 - d) The Transmitter shall provide two dual alarms (2 separate outputs) that are fully programmable for high/low flow rates, empty pipe, fault conditions, forward/reverse polarity, analog over-range, pulse over-range and pulse cut-off.
8. Manufacturers:
 - a) McCrometer Multi-Mag Model 285 w/Remote Transmitter
 - b) or approved equal.

17211.3 CONSTRUCTION REQUIREMENTS

The Contractor shall provide all materials needed to install equipment in accordance with the manufacturer's recommendations and at the locations shown on the Drawings.

17211.4 METHOD OF MEASUREMENT

Separate measurement of this equipment will not be made. Measurement will be included as per Section 17000.

17211.5 BASIS OF PAYMENT

Separate payment for this equipment will not be made.

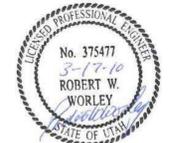


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PROJECT NAME:

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WILDLIFE
RESOURCES
SPRINGVILLE
FISH HATCHERY
TREATMENT PLANT
2009

ENGINEER'S STAMP



MARK	DATE	DESCRIPTION
ISSUE TYPE: 100%		

ISSUE DATE: November 1, 2009

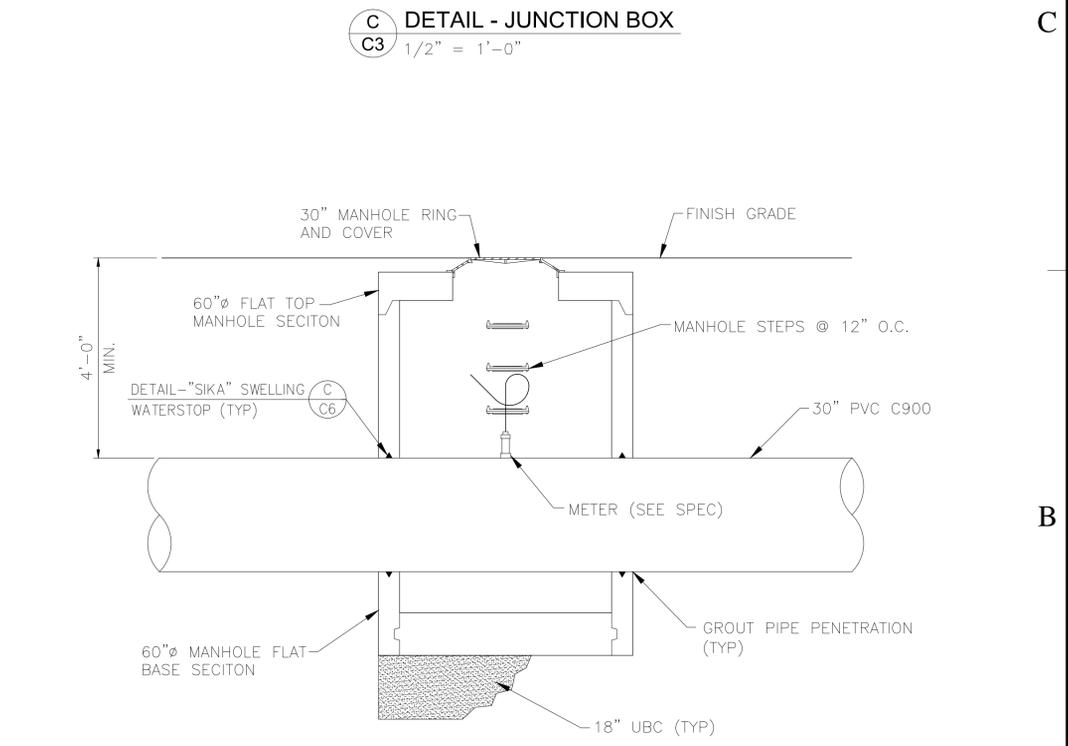
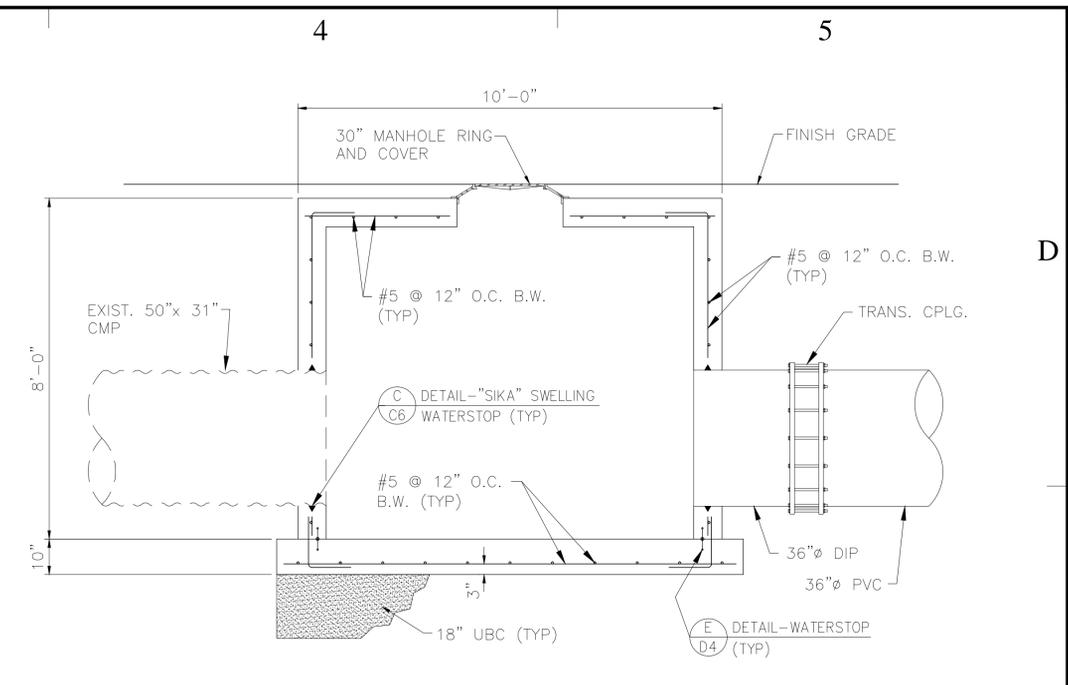
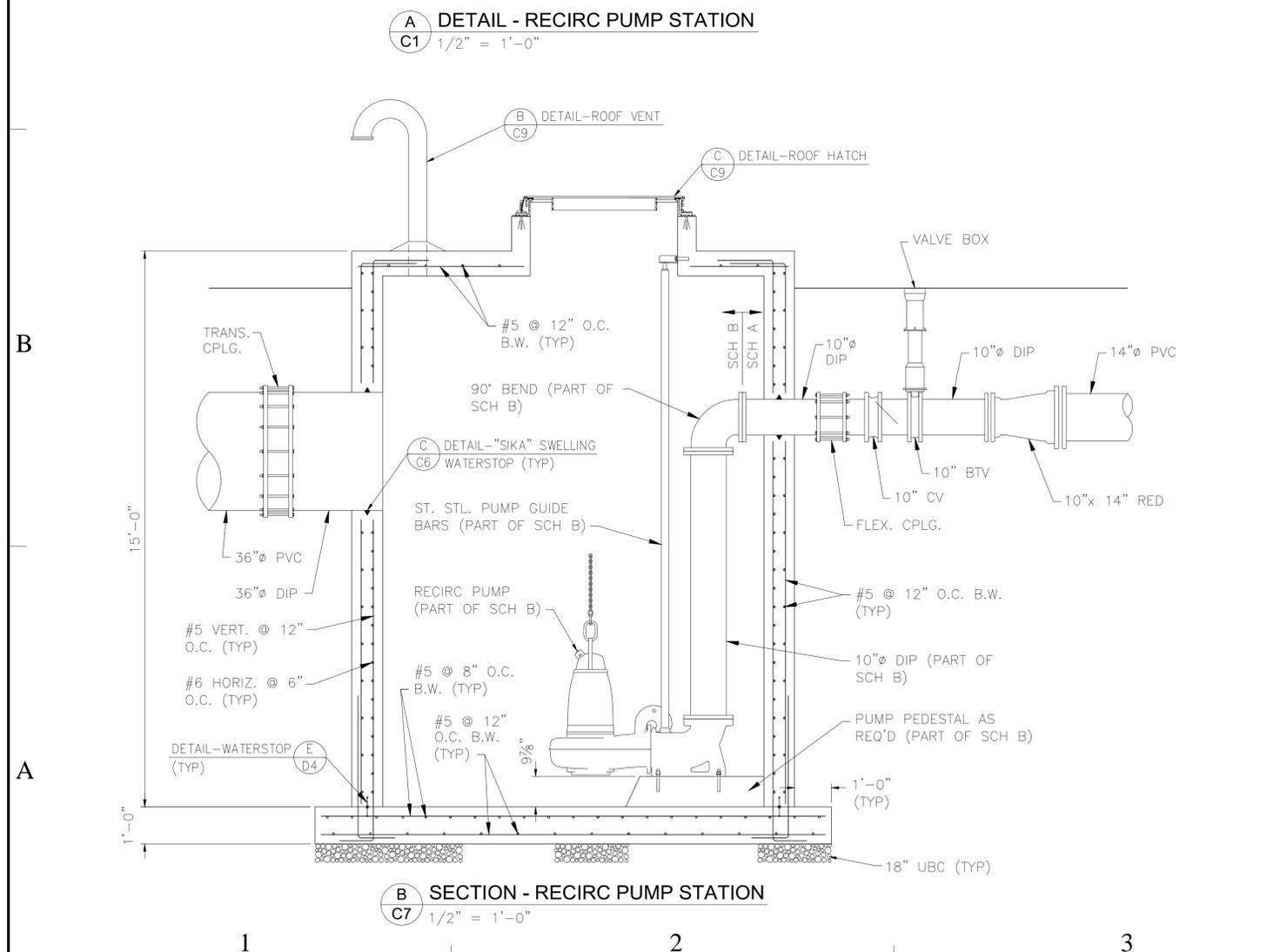
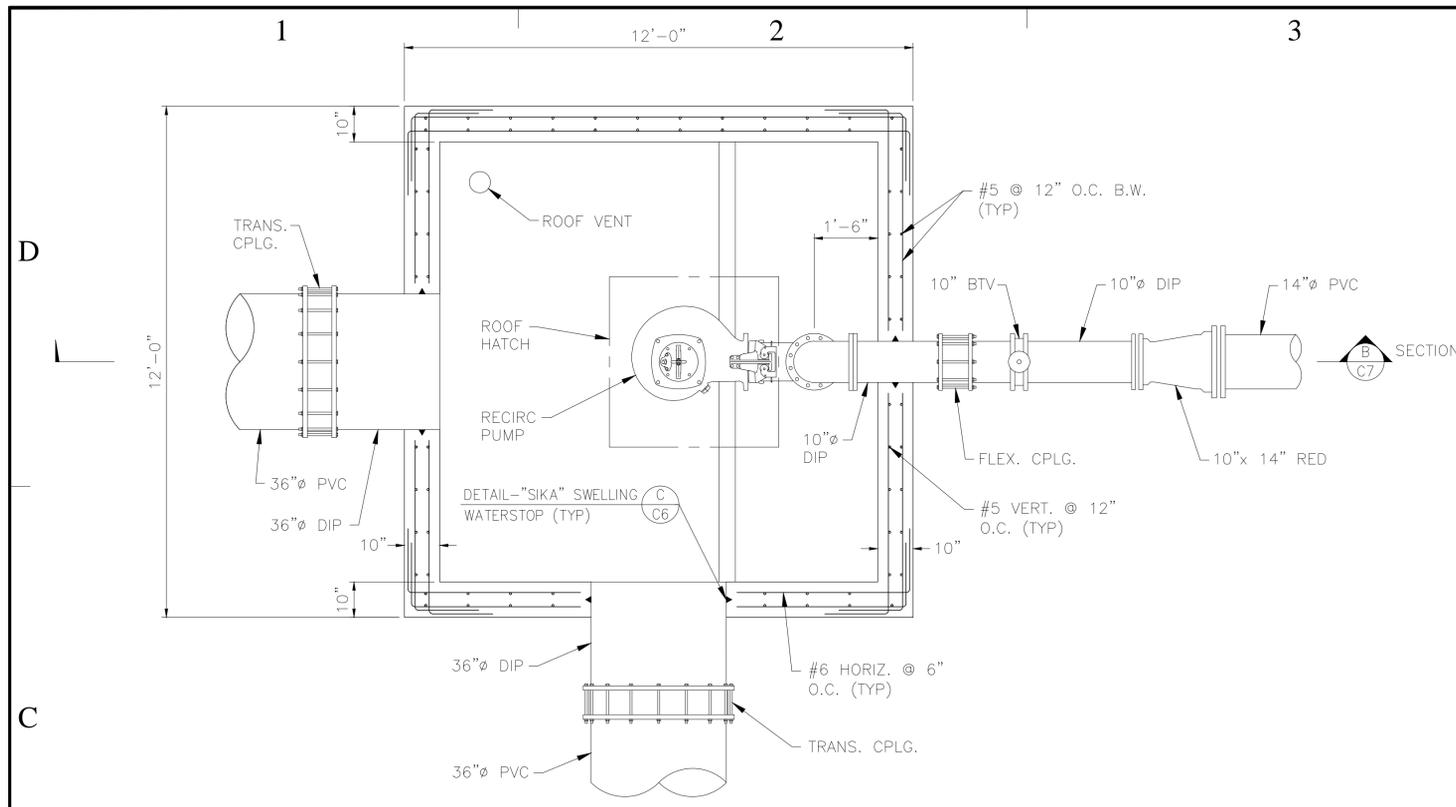
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SEI PROJECT NO: 03388
CAD DWG FILE: sprgvl-C07-09
DRAWN BY: CJC
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DRAWING TITLE

RECIRC PUMP STATION,
JUNCTION BOX, &
METERING MANHOLE

DRAWING NUMBER

C7



1

2

3

4

5

DESIGNED BY:



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MARK DATE DESCRIPTION

ISSUE TYPE: .

ISSUE DATE: .

DFCM PROJECT NO: .

SEI PROJECT NO: 03388

CAD DWG FILE: .

DRAWN BY: JSS

CHK'D BY: DEL

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DRAWING TITLE

PANEL SCHEDULES

DRAWING NUMBER

E-2.2

SHEET 30 OF 46

PP1

PP1 480/277 3Ø, 4 WIRE													
35 KA SC (RMS) Rating													
SPRINGVILLE FISH HATCHERY													
PANEL SCHEDULE CIRCUIT													
400A MAIN CB													
CKT. NO.	AMPS	POLE	DESCRIPTION	AMPS			VOLT AMPS	DESCRIPTION	POLE	AMPS	CKT. NO.		
				A	B	C							
01			UPS #1/UV BANK A SYSTEM	37	-	-	15224	UPS #2/UV BANK B SYSTEM	3	100	02		
03	100	3		-	37	-			15224	3	100	04	
05				-	-	37							06
07			UPS BYPASS/UV BANK C SYSTEM	52	-	-	15224	RECIRCULATION PUMP PANEL	3	70	08		
09	100	3		-	52	-			28234	3	70	10	
11				-	-	52							12
13			SPACE	0	-	-		SPACE			14		
15				-	0	-							16
17				-	-	0							18
19			DRUM FILTER PUMP CONTROL PANEL #1	12	-	-	4983	DRUM FILTER PUMP CONTROL PANEL #2	3	20	20		
21	20	3		-	12	-			4983	3	20	22	
23				-	-	12							24
25			DRUM FILTER PUMP CONTROL PANEL #3	12	-	-	4983	UV AIR COMPRESSOR	3	20	26		
27	20	3		-	12	-			4983	3	20	28	
29				-	-	12							30
31	20	1	BAY AREA FIXTURES	1840	13	-	1840	BAY AREA FIXTURES	20	1	32		
33	20	1	OUTDOOR LIGHTING CONTROL PANEL	1050	-	6.4	736	ELECTRICAL ROOM FIXTURES	20	1	34		
35	20	1	SPARE	0	-	0	0	SPARE	20	1	36		
37			50 KVA DT XMFR	104	-	-	50000	SPACE	2	40	38		
39	100	2		-	104	-							40
41	20	1	SPACE	0	-	0	0	SPACE	20	1	42		
				230	224	113							
Subtotal Watts				93304			56000			Subtotal Watts			
Total Watts				149304			180			Average Amps			

PP2

PP2 480/277 3Ø, 4 WIRE													
35 KA SC (RMS) Rating													
SPRINGVILLE FISH HATCHERY													
PANEL SCHEDULE CIRCUIT													
100A MAINS													
CKT. NO.	AMPS	POLE	DESCRIPTION	AMPS			VOLT AMPS	DESCRIPTION	POLE	AMPS	CKT. NO.		
				A	B	C							
01			UV BANK A	30	-	-	12456	UV BANK B	3	50	02		
03	50	3		-	30	-			12456	3	50	04	
05				-	-	30							06
07			UV BANK C	16	-	-	12456	OUTLET GATE	3	20	08		
09	50	3		-	16	-			1000	3	20	10	
11				-	-	16							12
07			SPACE	-	-	-		SPACE			14		
09				-	-	-							16
11				-	-	-							18
				46	46	46							
Subtotal Watts				24912			13456			Subtotal Watts			
Total Watts				38368			46			Average Amps			

LP1

LP1 120/240 1Ø												
22 KA SC Rating (RMS)												
SPRINGVILLE FISH HATCHERY												
PANEL SCHEDULE CIRCUIT												
225A MAIN CB												
CKT. NO.	AMPS	POLE	DESCRIPTION	LOAD			VOLT AMPS	DESCRIPTION	POLE	AMPS	CKT. NO.	
				A	B							
01	20	1	RECEPTACLES GFCI BREAKER	1800	30	-	1800	RECEPTACLES GFCI BREAKER	1	20	02	
03	20	1	HEAT TRACE	0	-	24	2880	MTU	1	30	04	
05	20	1	SPARE	0	3	-	360	OUTDOOR RECEPTACLES GFCI	1	20	06	
07	20	1	ICA UV DISINFECTION SYSTEM	1200	-	15	600	DRYER UV DISINFECTION SYSTEM	1	30	08	
09	20	1	AUTO DRAIN UV DISINFECTION SYSTEM	1200	20	-	1200	GENERATOR BATTERY CHARGER	1	20	10	
11	20	2	GENERATOR BLOCK HEATER	3000	-	23	2500	GENERATOR JACKET WATER HEATER	2	20	12	
13				0	-	-					14	
15	20	1	(R-1) RADIANT HEATER	120	-	3	240	EXHAUST FAN #1	1	20	16	
17	20	1	(R-2) RADIANT HEATER	120	3	-	240	EXHAUST FAN #2	1	20	18	
19	20	2	SPLIT SYSTEM A/C	3600	-	17	240	INTAKE FAN #1	1	20	20	
21				17	-	240		INTAKE FAN #2	1	20	22	
23			SPACE	-	0	-		SPACE			24	
25	30	2	UV SYSTEM SUMP PUMP 2 HP	2880	12	-		SPACE	-	-	26	
27				-	12	-		SPACE	-	-	28	
29	-	-	SPACE	0	-	-		SPACE	-	-	30	
1st Leg Amps =				85	94	=		2nd Leg Amps				
1st Leg WATTS				13920			10300			2nd Leg WATTS		
Total Watts				24220			101			Average Amps		

PANEL SCHEDULES

1

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DESIGNED BY:

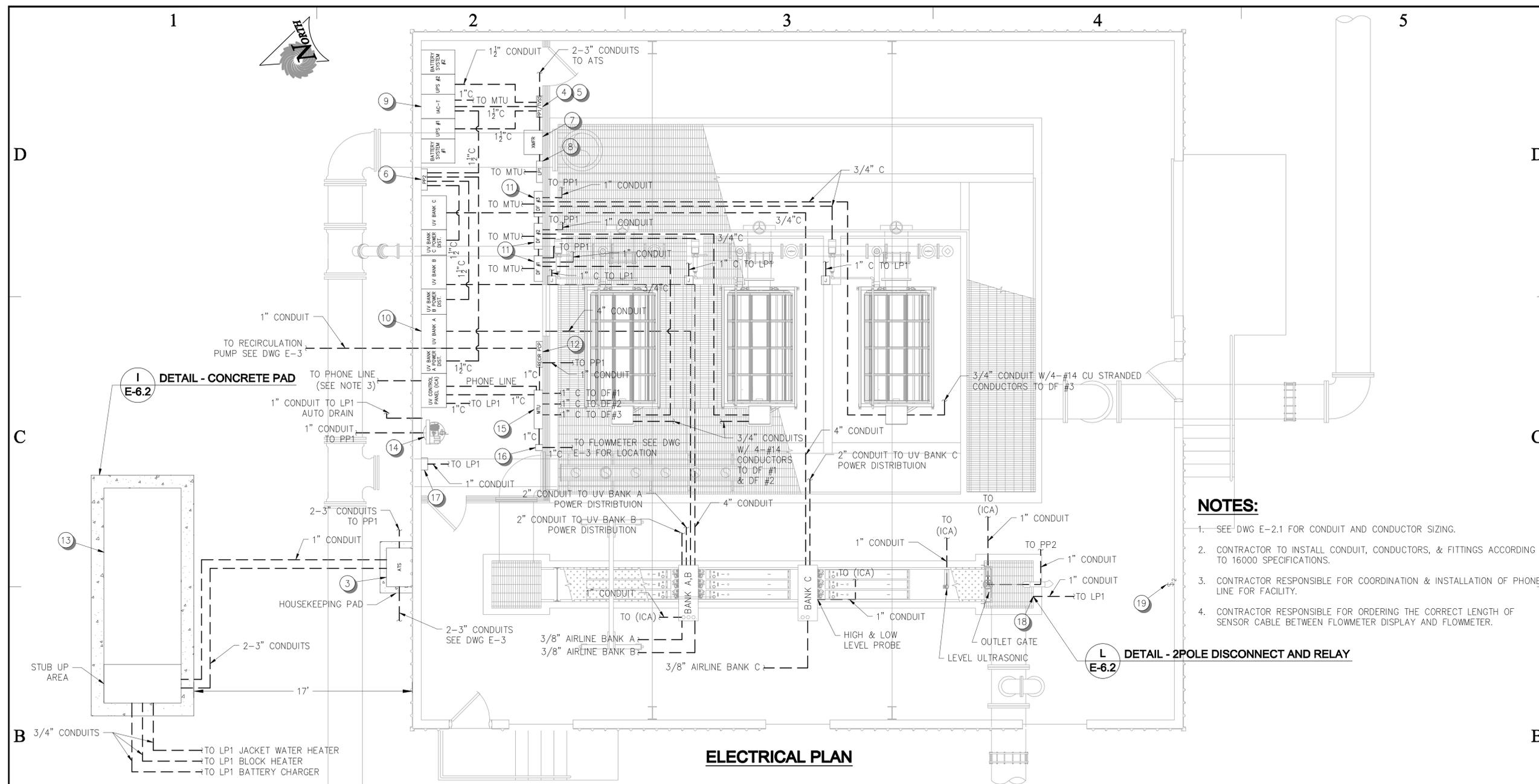


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TREATMENT PLANT
2009

ENGINEER'S STAMP



ELECTRICAL EQUIPMENT SCHEDULE

ITEM #	DESCRIPTION	QUANTITY	MODEL #	MANUFACTURER	COMMENTS
1					
2					
3	(ATS) AUTOMATIC TRANSFER SWITCH 4 POLE 480/277V 400A NEMA 3R SERVICE ENTRANCE RATED FREE STANDING	1	TS884A0400B1AM2ENKAA	THOMSON TECHNOLOGY	OR APPROVED EQUAL
4	(PP1) POWER PANEL #1 400A MAIN CB CU BUS 35 KAIC	1	PRL3a	CUTLER HAMMER	OR APPROVED EQUAL
5	(TVSS) 250KA BUSS MOUNTED IN PP1	1	CPS 250 480Y S	CUTLER HAMMER	OR APPROVED EQUAL
6	(PP2) POWER PANEL #2 100A MAIN CU BUS 35 KAIC	1	PRL2a	CUTLER HAMMER	OR APPROVED EQUAL
7	(XMR) 50 KVA DT TRANSFORMER NEMA 3R CU WINDINGS	1	TT48M11S50CU	CUTLER HAMMER	OR APPROVED EQUAL
8	(LP1) LIGHTING PANEL #1 225A MAIN CB NEMA 3R CU BUS 22 KAIC	1	PRL1a	CUTLER HAMMER	OR APPROVED EQUAL
9	(UPS) 50KVA/45KW PARALLEL REDUNDANT UPS SYSTEM W/BATTERY BACKUP & BYPASS 480V 3ø	1	9390-50kVA/45KW	POWERWARE	BY CONTRACTOR SEE SPEC 16900SP
10	(UV) UV DISINFECTION SYSTEM 480/277V 3ø, 4 WIRE	1			BY CONTRACTOR SEE SPEC 11250SP
11	(DF) DRUM FILTER CONTROL PANELS	3			BY CONTRACTOR SEE SPEC 11260SP
12	RECIRCULATION PUMP CONTROL PANEL	1			BY CONTRACTOR SEE SPEC 11388SP SEE DWG E-3 FOR PUMP LOCATION
13	250KW DIESEL STANDBY GENERATOR 480/277V 3ø, 4 WIRE WEATHERPROOF/SOUND ATTENUATED W/SUBBASE TANK	1	250JRC6DT3	MTU	OR APPROVED EQUAL SEE SPEC 16815SP
14	UV SYSTEM COMPRESSOR 480V 3ø	1	2340L5	INGERSOLL RAND	BY CONTRACTOR SEE SPEC 11250SP
15	MTU	1			SEE DWG I-3.1-3.3
16	MULTI-MAG FLOWMETER "INSERTION TYPE" W/DISPLAY MOUNTED IN ELECTRICAL ROOM SEE NOTE 4	1	285L	McCROMETER	BY CONTRACTOR SEE SPEC 17211, SEE DWG E-3 FOR LOCATION
17	UV SYSTEM DRYER - MODULAR DESICCANT AIR DRYER	1	D25IM	INGERSOLL RAND	BY CONTRACTOR SEE SPEC 11250SP
18	SUMP PUMP 2 HP	1	KS2610MT.	FLYGT	BY CONTRACTOR
19	OPERATOR BYPASS MOTOR RATED SWITCH	1	FW2	SQUARE D	OR APPROVED EQUAL

MARK	DATE	DESCRIPTION

ISSUE TYPE: .

ISSUE DATE: .

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DRAWING TITLE

ELECTRICAL PLAN

DRAWING NUMBER

E-4

EXHAUST FAN SCHEDULE

ID	MANUFACTURER AND MODEL NUMBER	TYPE	AIRFLOW RATE (CFM)	STATIC PRESSURE DROP (IN H2O)	FAN SPEED (RPM)	DRIVE TYPE (BELT /DIRECT)	WHEEL DIAMETER (IN)	FAN SIZE (HP)	VOLT/PH/HZ	LENGTH/ WIDTH/ HEIGHT (IN)	NOTES
EF-1	LOREN COOK, 150C5B	DOWN BLAST	2,500	0.125	1320	BELT	15	1/2 HP	120/1/60	33/33/29	PROVIDE WITH MANUFACTURES ROOF CURB RCG-22 AND MOTORIZED DAMPER BDM-18

HOODED INTAKE FAN SCHEDULE

ID	MANUFACTURER AND MODEL NUMBER	TYPE	AIRFLOW RATE (CFM)	STATIC PRESSURE DROP (IN H2O)	FAN SPEED (RPM)	DRIVE TYPE (BELT /DIRECT)	WHEEL DIAMETER (IN)	FAN SIZE (HP)	VOLT/PH/HZ	LENGTH/ WIDTH/ HEIGHT (IN)	NOTES
IH-1	LOREN COOK, 150ASP	FILTERED INTAKE	2,500	0.375	478	DIRECT	15	1/2 HP	120/1/60	45/45/36	PROVIDE WITH MANUFACTURES ROOF CURB RCG-30 AND MOTORIZED DAMPER BDMI-26

INFRARED HEAT SCHEDULE

ID	MANUFACTURER AND MODEL NUMBER	LOCATION	TYPE	INPUT CAPACITY (BTUH)	OUTPUT CAPACITY (BTUH)	LENGTH (FT)	FUEL TYPE	VACUUM PUMP ELECTRICAL				NOTES
								MOTOR SPEED (RPM)	HP	AMPS	VOLT/PH	
IR-1	SUPERIOR RADIANT PRODUCTS,UA10N4A	FILTRATION BUILDING	TUBE & REFLECTOR	100,000	89,000	40	NATURAL GAS	NA	FRAC	20	120/1	SUPPLY WITH MANUFACTURERS SILKOTE FINISH, HIGH EMISSIVITY CORROSIAN RESITANT COATING.
IR-2	SUPERIOR RADIANT PRODUCTS,UA04N2A	ELECTRICAL ROOM	TUBE & REFLECTOR	40,000	27,000	20	NATURAL GAS	NA	FRAC	20	120/1	SUPPLY WITH MANUFACTURERS SILKOTE FINISH, HIGH EMISSIVITY CORROSIAN RESITANT COATING.

AIR CONDITIONING SPLIT SYTEM SCHEDULE

ID	MANUFACTURER AND MODEL NUMBER	LOCATION	TYPE	AIR		COOLING						ELECTRICAL		PHYSICAL	NOTES
				SUPPLY AIRFLOW RATE (CFM)	EXTERNAL STATIC PRESSURE DROP (IN H2O)	COOLING TYPE	COOLING CAPACITY (BTUH)	TEMPERATUR E DROP (° F)	RATED EFFICENCY (SEER)	REFRIGERAN T TYPE	COOLING CAPACITY (TONS)	VOLT/PH/HZ	MAXIMUM AMPERAGE (AMP)	LENGTH/ WIDTH/ HIEGHT (IN)	
SS-1	AND PUY-A18NHA3	ELECTRICAL ROOM	DX	320-370-425	0.75	ELECTRIC	18,000	25°	15.3	R-410A	1.5	240/1/60	15	35/12/10	SUPPLY WITH MANUFACTURERS MOUNTING HARDWARE

DESIGNED BY:



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PROJECT NAME:

UTAH DIVISION OF
WILDLIFE
RESOURCES
SPRINGVILLE
FISH HATCHERY
TREATMENT PLANT
2009

ENGINEER'S STAMP



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MECHANICAL EQUIPMENT SCHEDULES

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M-5

SHEET 40 OF 46