



Dos Rios WRC Electrical System Improvements Project Phase 1
Solicitation Number: CO-00084
Job No.: 14-6504

ADDENDUM 5
October 5, 2016

To Bidder of Record:

This addendum, applicable to work referenced above, is an amendment to the proposal, plans and specifications and as such will be a part of and included in the Contract Documents. Acknowledge receipt of this addendum by entering the Addendum number and issue date on the space provided in submitted copies of the bid proposal.

Addendum No. 5 consists of the items as outlined in the following pages. In addition to these items Addendum No. 5 includes two (2) reissued specifications, three (3) new specifications, and four (4) re-issued drawings.

QUESTIONS

1. Addendum No 1 indicated funding may be coming from TWDB. If funding is TWDB, does this mean that all iron and steel products must be of domestic manufacture according to A.I.S.?

Response: Yes, this is a Texas Water Development Board funded project, which does include American Iron and Steel Requirements. Please reference the technical specifications, drawings, as well as the TWDB-1106 Guidance manual for additional clarification.

2. In regards with the transformers being demolished (removed) as part of contractor's responsibility, we would like to know if the transformers are filled with mineral oil or PCB?

Response: The substation transformers to be demolished do not contain PCBs.

3. Drawing AB-E-7 shows that MCC-CAB-2 is to be provided in a Two (2) High Constructions which is different from previous MV MCC's provided to SAWS. Our Electric MV MCC Starters are only provided in a Single High configurations, and to make the MV MCC fit into the allowable space within the building we would require the approval of SAWS to provide our MV Starters in Single High 20" Wide Sections.

Response: MCC-CAB-2 shall be provided in two (2) high construction as shown on Drawing AB-E-7.

CLARIFICATIONS

4. Section 17500 – Instrumentation and Controls – Distributed Control System is attached and shall become part of the contract documents.

5. Generator Paralleling Gear System: The low voltage distribution panel is used for power enclosure lights, heaters, and boiler area lights and the existing cables from the boiler area will be reused. The panel has to be at the same location as shown in the drawing in order for the existing cable to reach.

6. Specification 16232, Page 16232-16, Paragraph 2.03.B.1: PLC shall be Allen-Bradley or approved vendor developed proven platform. A redundant master controller is not required if the individual generator has its own controller.

SPECIFICATIONS

7. Bid Proposal and Solicitation Quotes Table: Remove the Bid Proposal and table in its entirety and replace with the attached Bid Proposal and Solicitation Quotes Table, which is the version that shall be used when submitting a bid for this project along with the original Bid Proposal Signature page and Proposal Certification page.

Attached revised Solicitation Quotes Table includes:

- Inserting Line Item Numbers 10 – 13 for Light Fixtures
- Inserting Line Item Number 14 for the Spike Line Relocation
- Original Line Items Numbered 10-13 have been renumbered
- Unit Bid Price and Total Price for Allowance Items have been filled in.

8. Section 02613- Pre-stressed Concrete Cylinder Pipe is attached and shall become part of the contract documents.

9. In Section 16010, Page 16010-1 Paragraph 1.01.A: Insert the following:

13. Replacement of all existing site lighting.

10. In Section 16232- Emergency Generator Paralleling Gear Systems, make the following changes:

- Page 16232-1, Paragraph 1.02.A: Delete 600V and replace with 480 volt 3-ph, 60 Hz
- Page 16232-5, Paragraph 1.05.L: Delete this paragraph in its entirety
- Page 16232-7, Paragraph 1.07.C.14: Replace UL 1558 with UL 891
- Page 16232-10, Paragraph 2.03.A.1.ii: Delete this paragraph in its entirety
- Page 16232-29, Paragraph 2.07.B: Delete this paragraph in its entirety
- Page 16232-32, Paragraph 2.10.D: Delete this paragraph in its entirety
- Page 16232-29, Paragraph 2.08.B: Delete this this paragraph in its entirety

11. In Section 16500 – Lighting System, Page 16500-1, Section 1.01 Scope of Work: Add a the following:

- B. The contractor shall provide material and labor to replace the existing street light fixtures with LED type fixtures as described below:

1. There are One hundred and Eighty Two (182) street lights with 250 W High Pressure Sodium lamp operated at 277-480 (multi tap ballast) installed on 30 feet square poles. Ninety-one (91) poles are gray and Ninety-one (91) are brown in color.
2. There are Twenty-Four (24) pole lights around the Flow Equalization Basin (FEB) area, with 1000W Metal Halide lamp operated at 277V, installed on 50-foot round pole on an 8-foot arm. Twenty-three (23) poles are metal finish and one (1) pole is brown.
3. The contractor shall be responsible to coordinate the color, voltage and distribution type before finalizing the order with the manufacturer. Furnish all necessary hardware to install the fixture.
4. The Contractor shall perform this work in the first six months from notice to proceed.

5. Refer to the Bid Proposal for price breakdown for this work.
6. The LED replacement fixtures shall be as listed below:

Fixture	Quantity	Description	Catalogue #
Street Light on 30' poles	182	Rugged low copper diecast aluminum housing with corrosion resistant treatment, LED lamps with surge protection, photocell receptacle, photocell, shorting cap, 480V, mounted on existing square pole, color shall be brown. Furnish arm to replace existing arm.	Holophane-or Approved Equal: Autobahn Series: ATBM-E- 480-R2-5K- NL-P7-SH Mounting arm to match existing pole installation. Color shall be brown.
Area Light fixture on 50' round pole	24	Same as above, except use existing arm to mount fixture.	Holophane-or Approved Equal: Mongoose Series: MGLED-9-5K-AS-M- L- H -X -NL-P7-PCS X: color to match existing pole.

12. In Section 17300 – Instrumentation & Controls – General Provisions: Delete this specification section in its entirety and replace with the attached revised Section 17300 Instrumentation and Controls - General Provisions.
13. In Section 17315 – Instrumentation and Controls – Product: Delete this specification section in its entirety and replace with the attached revised Section 17315 – Instrumentation and Controls- Product.
14. In Section 17320 – Fiber Optic Data Highway, Page 17320-1, 1.01: Delete this section in its entirety and replace with the following:
 - A. Furnish, install, test, and make ready fiber optic cables, and patch panels necessary for the Emersion Ovation Control Processor & Data Highway Interface network, Protection relay interface as indicated on the contract drawings and as specified herein.
 - B. Where shown on the drawings to terminate fiber optic cables in an existing patch panel the PCSI is responsible to verify that the type of connector as specified matches the existing enclosure and adequate space for the additions is present. If a discrepancy is found, the PCSI is to provide matching connections at no additional cost to the Owner as directed by the Engineer.
 - C. The Work includes the following:
 1. Supply and install;
 - a. A 19-inch rack mounted fiber optics patch panel (FOPP-3) in the existing Concentrator 3-4 Panel at Polymer/DAF Building no. 4 control room. The Panel FOPP-3 will be utilized to terminate fiber cable FOC-BLWR from Aeration Electrical Building.
 - b. A standard wall mounting fiber optics patch panel (FOPP-CR-US5) in Primary Control Building no.3. This will be utilized to terminate fiber cable FOC-US5 from Generator Paralleling switchgear enclosure.
 - c. A standard fiber optics patch panel inside the panel (FOPP-ODU-MAIN) being installed at Odor Control Building no.2. This will be utilized to terminate fiber cable FOC-MAIN from Main Electrical Switchgear Building.

2. Install the fiber optic cables in accordance with the system manufacturer’s installation instructions. The work shall include furnishing, installing, testing, and landing all fiber optic cabling and connectors and providing all fiber optic patch cables as necessary as detailed in the following:
 - a. 8-Strand, Multi-Mode fiber cable (FOC-BLWR) run between RIO-FOPP-BLWR located inside panel (RIO-BLWR) at Stage-1 Aeration Electrical Building and 19” fiber optic patch panel (FOPP-3) mounted inside concentrator 3-4 panel at Polymer/DAF Building no.4. control room.
 - b. 8-Strand, Multi-Mode fiber cable (FOC-US5) run between RIO-FOPP-US5 located in panel (RIO-US5) at Generator Paralleling switchgear enclosure and panel (FOPP-CR-US5) in Primary Control Building no.3.
 - c. 12-strand, Multi-Mode fiber cable (FOC-Main) run between RIO-FOPP-MAIN located inside panel (RIO-MAIN) at Main Electrical Switchgear Building and panel (FOPP-OCU-MAIN) being installed inside Odor Control Building No.2.”

15. In Section 17320 – Fiber Optic Data Highway, Page 17320-1, 1.02: Add the following paragraph:

C. Section 17302- Instrumentation Testing and System Commissioning

16. In Section 17325 – Control Panels and Panel Mounted Equipment, Page 17325-1, 1.01.D. Delete this section in its entirety and replace with the following:

D. The following panels shall be furnished by the Process Control System Integrator (PCSI). Each panel shall be supplied with full sub-panels and side panels as required.

Panel Name	Description	Location	NEMA Rating	Material
RIO-MAIN	Main Site Remote I/O Enclosure	Main Electrical Switchgear building.	12	Painted Steel
RIO-US5	US 5 Remote I/O Enclosure	Generator Paralleling Switchgear Enclosure	12	Painted Steel
RIO-BLWR	Channel Blower Remote I/O Enclosure	First Stage Aeration Electrical Building	12	Painted Steel
FOPP-OCU-MAIN	Fiber Optics Panel for FOC-Main cable	Odor Control Unit Building no. 2	12	Painted Steel

17. In Section 17400 – Control Loop Descriptions, Page 17400-4, 3.01.E, Delete this section in its entirety and replace with the following:

E. New RIO panels installed shall be used to Control and/or Monitor equipment as described below:

1. RIO-MAIN - Switchgears status, Feeder protection relays, Electrical parameters values and sump pumps status at Site Main switchgear building. RIO-MAIN shall be communicating to existing controller 2/52.
2. RIO-BLWR - Blower controls/status, Motor Protection Relays and MCC Electrical Parameters Aeration Electrical Building. RIO-BLWR shall be communicating to existing controller 9/59.
3. RIO-US5 - Backup Generators, Automatic switch status (ATS) at Generator paralleling switchgear enclosure. RIO-BLWR shall be communicating to existing controller 8/58.”

18. In Section 17400 – Control Loop Descriptions, Page 17400-5, 3.02.B.C and D., Delete these sections and replace with the following:

B. Main Electrical Switchgear Building

General: The Main Electrical Switchgear Building has two switchgear line-ups: Switchgear-A and Switchgear-B. Each Switchgear line includes one main breaker, a tie breaker and eleven feeder Breakers. Each Breaker's status is wired to an Ovation RIO panel. The RIO-panel is also equipped with a CISCO Integrated Service Router to interface the feeder protection relays. The protection relays are interfaced to Concentrator 5-6 using Ethernet Modbus TCP protocol. The Building has two sump pumps and an Eye wash station.

1. DCS Concentrator: 5-6
2. Ovation Controller: 2/52
3. RIO name: RIO-MAIN
4. P&ID No.: SB-I-1 and SB-I-2
5. Control: No control is required.
6. Calculated Alarm: No calculated Alarms are required
7. Interlocks: No interlocks are required.
8. Field input/output: Field input and output points associated with the Site Main Switchgear building are depicted on the P & ID.
9. Plant Control System will monitor Switchgear status, sump pump status, Eye wash station status, Building intrusion and high rooms temperature alarms. The feeders Trip alarm, current, voltage and power will be monitored through feeder protection relay using MODBUS TCP protocol.

C. Stage - 1 Aeration Electrical Building

General: The Stage-1 Aeration Electrical Building is a Motor Control Center for stage-1 Chanel Aeration Blowers. The MCC is equipped with three Blower motor starters and Motor Protection relays. Each Blower status is wired to the Ovation RIO-BLWR panel. The RIO-panel is also equipped with CISCO Integrated Service Router to interface three Motor Protection relays and two Power Monitoring Meter. The protection relays and Power Monitors are interfaced to concentrator 3-4 using Ethernet Modbus TCP protocol.

1. DCS Concentrator: 3-4
2. Ovation Controller: 8/58
3. RIO name: RIO-BLWR
4. P&ID No.: AB-I-4
5. Control: The existing Blower system has a Local Control Panel, located near Blower, to control Blower operation. The Blower motors are constant speed type. The panel also has an Alarm annunciation window. The existing control panel shall be used to control the Blower. Three new local control panels (ES-1, ES-2, ES-3) are being installed in the field to provide an Emergency E-Stop and Local-Off-Auto switches to facilitate local Blower control.

a. Control

- 1) Local Manual Control: When the L-O-R switch is set in Local position the operator can Start and Stop the Blower operation from the existing Local control panel. The blower operation status is also monitored by the Plant Control System.
- 2) Local Auto Control: This does not exist
- 3) Remote Manual Control: When the L-O-R switch is set in Remote position, the operator may set Remote Manual at the HMI and Start/Stop the Blower operation from the Plant Control System HMI

display. The Blower operation and status is also monitored by the Plant Control System.

4) Remote Auto Control: No automatic control is required.

7. Calculated Alarm: Blower RUN Time is calculated by the Controller and communicated to HMI. No calculated Alarms are associated for the any of the points monitored.
8. Interlocks: The existing Blowers control panel are provided with hardwired interlocks for the motor high vibration, high temperature and high surge.
9. Field input/output: Field input and output points associated with the RIO-BLWR are depicted on the P&ID.
10. Plant Control System will monitor Blower Running status, Building intrusion and room temperature. The Motor Trip alarm and Blower motor current, voltage and power factor are monitor through Motor protection relay using MODBUS TCP protocol.

D. Standby Generator 1 & 2 System:

General: The Plant Primary Area has been provided with a 480 V Standby Generator System. This Vender package includes two Generator sets, Generator control and Generator paralleling switchgear. A Generator System Master Controller will monitor and control the Generator control functions. The Generator System will be monitored, via hardwired signals, by the new RIO-US5. The new Ovation RIO-US5 panel will be installed within the new Generator Paralleling enclosure. The RIO-US5 panel will be hardwired to receive signals from the Generator Master controller PLC provided in the Vender package. The RIO-US5 will be interfaced to Controller 9/59 which is located in the Odor Control Building.

1. DCS Concentrator: 5/6
2. Ovation Controller: 9/59
3. RIO name: RIO-US5
4. P&ID No.: EP-I-3
5. Control: No Control is required.
6. Calculated Alarm: No calculated Alarms are required.
7. Interlocks: No interlocks are required.
8. Field input/output: Field input and output points associated with the new Main Switchgear building are depicted on the P&ID.
9. Plant Control System will monitor Generator Running status, general alarm, load current, status of connected Automatic Switch Position (ATS).

19. Section 17500 – Instrumentation and Controls – Distributed Control System is attached and shall become part of the contract documents.

20. Section 17515 – Instrumentation and Controls – Communication Interface Equipment is attached and shall become part of the contract documents.

DRAWINGS

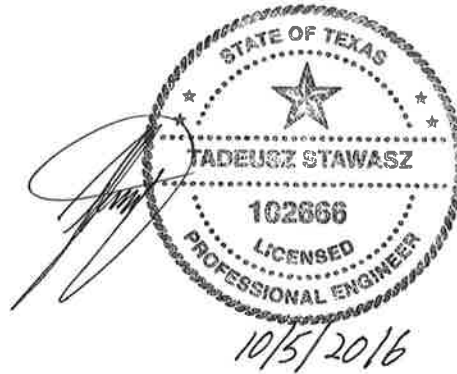
21. Drawing G-21: Delete this drawing in its entirety and replace with the attached revised drawing G-21 Revision 1.

22. Drawing S-2: Delete this drawing in its entirety and replace with the attached revised drawing S-2 Revision 1.

- 23. Drawing AB-C-1 Revision 1: Delete this drawing in its entirety and replace with the attached revised drawing AB-C-1 Revision 2.
- 24. Drawing AB-C-1A: Delete this drawing in its entirety and replace with the attached revised drawing AB-C-1A Revision 1.



Ted Stawasz
CP&Y, Inc.



END OF ADDENDUM

BID PROPOSAL

PROPOSAL OF _____, a corporation
a partnership consisting of _____
an individual doing business as _____

THE SAN ANTONIO WATER SYSTEM:

Pursuant to Instructions and Invitation to Bidders, the undersigned proposes to furnish all labor and materials as specified and perform the work required for the project as specified, in accordance with the Plans and Specifications for the following prices to wit:

(PLEASE SEE ATTACHED PDF LIST OF BID ITEMS)

TOTAL BID PRICE \$ _____

Mobilization and Prep of ROW shall be limited to the maximum percentage shown. **If the percentage exceeds the allowable maximum stated for mobilization and or preparation of ROW, SAWS reserves the right to cap the amount at the percentages shown and adjust the extensions of the bid items accordingly.**

BIDDER'S SIGNATURE & TITLE

FIRM'S NAME (TYPE OR PRINT)

FIRM'S ADDRESS

FIRM'S PHONE NO. /FAX NO.

FIRM'S EMAIL ADDRESS

The Contractor herein acknowledges receipt of the following:
Addendum Nos. _____

OWNER RESERVES THE RIGHT TO ACCEPT THE OVERALL MOST RESPONSIBLE BID.

The bidder offers to construct the Project in accordance with the Contract Documents for the contract price, and to complete the Project within **600** calendar days after the start date, as set forth in the Authorization to Proceed. **The bidder understands and accepts the provisions of the contract Documents relating to liquidated damages of the project if not completed on time.**

Complete the additional requirements of the Bid Proposal which are included on the following pages.

Solicitation Quotes Table

Line No.	Item No.	Quote Category	SOV Item	Item Description	Unit	Quantity	Unit Bid Price	Total Price
1	1	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Trench Excavation and Safety Protection: Total amount for furnishing all labor, materials, tools, equipment, and incidentals required for the development, design, and implementation of a trench safety system as required by the Occupational Safety and Health Administration (OSHA) and the assumption of responsibility for said system, in accordance with the contract documents, complete in place.	LS	1		\$ -
2	2	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	13.2 kV Feed: Total amount for furnishing all labor, materials, tools, equipment, and incidentals required for the construction and installation of two new incoming 13.2 kV feed lines, including new utility poles, foundations, manholes, 15kV cables and conduits, and demolition as required by the contract documents, complete in place.	LS	1		\$ -
3	3	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Main Electrical Switchgear Building: Total amount for furnishing all labor, materials, tools, equipment, and incidentals required for the construction and installation of the new electrical switchgear building, including grading, sodding, sidewalks, asphalt pavement, precast building, basement foundation, HVAC, electrical switchgear, instrumentation, cables, conduit, equipment, utility relocation, and demolition as required per the contract documents, complete in place.	LS	1		\$ -
4	4	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Substation #5 & 6 Alternate Feeds: Total amount for furnishing all labor, materials, tools, equip., and incidentals required for construction/installation of alternate feeds from substation #5 & 6, including ductbank and feeders, FEB-1 & 2 improvements and Sectionalizing Cabinets, equip. pads, connections to existing switchgear bldg, electrical transformers, wire, instrumentation, cables, conduit, ductbanks and other equip., and demolition as required per contract documents, complete in place.	LS	1		\$ -
5	5	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Substation #11 & 12 Alternate Feed: Total amount for furnishing all labor, materials, tools, equip. and incidentals required for construction/installation of alternate feed from substation #11 & 12, including, demolition, grading, sidewalks, equip. pads, utility relocations, precast aeration electrical bldg, foundations, electrical transformers, instrumentation, cables, conduit, ductbank, equip., conduit bridges, and demolition as required per contract documents, complete in place.	LS	1		\$ -
6	6	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Generator #1 & 2 Replacement: Total amount for furnishing all labor, materials, tools, equipment, and incidentals required for the construction and installation of two new generators and paralleling gear, including, equipment pads, grading, utility relocation, ductbanks, wire, conduit, equipment, and demolition as required per the contract documents, complete in place.	LS	1		\$ -
7	7	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Emerson (Distribution Control System [DCS]) Package - The total amount for furnishing all labor, programming, testing, incidentals, and training required in accordance with the contract documents, complete in place.	LS	1		\$ -

8	8	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Standby-power generator as required per Specification 01015 for Headworks MCC.	LS	1		\$ -
9	9	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Subsurface Utility Investigation: This item includes all the labor, equipment, tools, materials and incidentals required to complete the task of utility location and depth verification to identify all underground tie-in locations/utility conflicts with proposed improvements. CONTRACTOR shall be required to hydro vacuum extract, hand dig, or otherwise perform the excavation in a manner that does not harm the existing utilities.	LS	1		\$ -
10	10	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Light Fixtures: Total amount for furnishing all labor, materials, tools, equipment, and incidentals required for the replacement of 250 watt High Pressure Sodium light fixtures with LED light fixtures, as required per the contract documents, complete in place. Total of one hundred eighty two (182) light fixtures.	LS	1		\$ -
11	11	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Light Fixtures: Total amount for furnishing all labor, materials, tools, equipment, and incidentals required for the replacement of 1,000 watt Metal Halide light fixtures with LED light fixtures, as required per the contract documents, complete in place. Total of twenty four (24) light fixtures.	LS	1		\$ -
12	12	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Light Fixtures: Total amount for furnishing all labor, materials, tools, equipment, and incidentals required for the replacement of 250 watt High Pressure Sodium light fixtures with LED light fixtures, as required per the contract documents, complete in place. Price for one (1) light fixture.	EA	1		\$ -
13	13	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Light Fixtures: Total amount for furnishing all labor, materials, tools, equipment, and incidentals required for the replacement of 1,000 watt Metal Halide light fixtures with LED light fixtures, as required per the contract documents, complete in place. Price for one (1) light fixture	EA	1		\$ -
14	14	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Relocation of 42" Spike Line: Total amount for furnishing all labor, materials, tools, equipment, and incidentals required for the relocation of the 42" Spike Line as shown on the drawings. Total amount shall include dewatering of the line, removal of existing pipe and thrust blocks as shown on the drawings and installation of the new segment of 42" Prestressed Concrete Cylinder Pipe (PCCP) pipe and restraint joints as required per the contract documents, complete in place	LS	1		\$ -
15	15	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Subsurface Utility Relocation: \$50,000 allowance to relocate unforeseen subsurface utilities (not included in project scope). This shall include all labor, equipment, tools, materials and incidentals of task to relocate all underground utility tie-ins/conflicts with proposed improvements and are to be negotiated under contract terms and conditions, complete in place. CONTRACTOR shall be required to hydro vacuum extract, hand dig, or otherwise perform excavation as to not harm existing utilities.	LS	1	\$ 50,000.00	\$ 50,000.00
16	16	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Permitting Fees: Allowance for \$20,000.00 permitting fees associated with the project. This shall include furnishing all labor, materials, tools, equipment and incidentals required to obtain all necessary permits. Contractor to pay and be reimbursed actual amount by SAWS.	LS	1	\$ 20,000.00	\$ 20,000.00

17	17	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Pre-startup/Construction Items: \$100,000.00 allowance for unforeseen construction related items (not included in project scope) associated with pre-startup, startup services necessary to provide for an operational and functional system. This shall include furnishing all labor, materials, tools, equipment and incidentals required to construct these project related items at SAWS' request and to be negotiated under contract terms and conditions for complete in place.	LS	1	\$ 100,000.00	\$ 100,000.00
18	18	General Sanitary Sewer Bid Items	01.4600.00.0002 - Construction	Mobilization and Demobilization: This item includes project move-in and move-out of personnel and equipment, for work shall include furnishing all labor, materials, tools, equipment and incidentals required to mobilize, demobilize, bond and insure the Work for the Project, in accordance with the contract documents, complete in place. Maximum of 3% of the total of Line Items 1 through 14.	LS	1		\$ -

SECTION 02613
PRESTRESSED CONCRETE CYLINDER PIPE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This Section sets forth the requirements for prestressed concrete cylinder pipe. Only the embedded steel cylinder type will be allowed for this Project.
- B. Furnish, test, and install labor, materials, equipment and incidentals necessary to furnish and install prestressed concrete cylinder pipe. The pipe shall consist of a welded sheet steel cylinder within a dense concrete core and around which there is placed high tensile strength wire, wound helically under measured tension, with a dense mortar coating covering the core and wire, and with steel joint rings of the bell and spigot type for rubber gasket.
- C. The pipeline shall be suitable to carry raw sewage with some suspended solids and chemicals used for water treatment process.

1.02 QUALITY ASSURANCE

A. EXPERIENCE REQUIREMENTS

- 1. Finished pipe shall be the product of a Manufacturer which has had not less than five (5) years successful experience manufacturing pipe of the type and size indicated on drawings.
- 2. Pipe manufacturing operations (pipe, lining, coating) shall be performed at one (1) location. Fittings may be manufactured at a separate location so long as one Manufacturer is completely responsible for all pipe and fittings.
- 3. All pipe shall be new, and not supplied from inventory.
- 4. All pipe and fittings shall be manufactured in the continental USA and shipping over salt waterways will not be allowed.
- 5. Pipe Manufacturer shall be certified through the American Concrete Pressure Pipe Association, Lloyd's Register or through ISO 9001. Approved manufacture is Forterra Pressure Pipe.
Additional Manufacturers will not be evaluated or substitutes allowed.

B. FACTORY TESTING

- 1. The Owner will require the Manufacturer to furnish mill test certificates on steel coil, bar stock, reinforcing steel or wire, steel plate, and cement. The Manufacturer shall perform the tests described in AWWA C301, for all pipe, fittings, and specials, with the additional tests described below.
 - a. The Manufacturer shall perform Hydrogen Embrittlement Sensitivity test in accordance with ASTM A1032 and ASTM A648 for wire.
 - b. Absorption Test of Coating: A water absorption test shall be performed on Samples of cured mortar coating taken from each working shift. The mortar coating Samples shall have been cured in the same manner as the pipe. A test value shall consist of the average of a minimum of three Samples taken from the same working shift. The test method shall be in accordance with ASTM C497, Method A. The average absorption value for any test shall not exceed 8

percent and no individual Sample shall have an absorption exceeding 10 percent. Tests for each working shift shall be performed on a daily basis until conformance to the absorption requirements has been established by 10 consecutive passing test results, at which time testing may be performed on a weekly basis for each working shift. Daily testing shall be resumed for each working shift with failing absorption test results and shall be maintained until conformance to the absorption requirements is re-established by 10 consecutive passing test results.

- c. Strength of Coating: Tests shall be made of cured mortar coating for the purpose of qualifying the mortar coating machine and the mortar mix design. One inch (1") cubes shall be tested in accordance with ASTM C109. The equivalent cylinder compressive strength of the mortar (0.8 times the cube strength) shall be not less than 5,500 psi in 28 days.
- d. Charpy V-Notch Test: Each heat of steel for plate or coil used 0.25" and thicker shall be tested to verify minimum impact values of 25 ft-lbs at 30°F per ASTM A370. Minimum Charpy values for sub-size samples shall be as defined in ASTM A370.
- e. Hydrostatic Test: Each steel cylinder shall be factory tested by the Manufacturer in accordance with AWWA C301. Repair or reject cylinders revealing leaks or cracks. Fittings shall be fabricated from hydrostatically tested pipe or from plate steel. All welds on fittings shall be tested by hydrostatic test, ultrasonic test, air test, or magnetic particle test. Air test shall be made by applying air to the welds at 10 pounds per square inch pressure and checking for leaks around and through welds with a soap solution. In addition, five percent of welds on fittings shall be checked with x-ray or ultrasonic testing by an independent third party Certified Welding Inspector paid for by the Pipe Manufacturer.
- f. Elongation Tests: For the tensile test specified in ASTM A370, 2-inch test specimens shall show elongations not less than 22 percent for each heat of steel. When 8-inch test specimens are used in lieu of 2-inch test specimens, the specimens shall show elongation not less than 18% for each heat of steel.

C. MANUFACTURER'S TECHNICIAN FOR PIPE INSTALLATION

During the construction period, the Pipe Manufacturer shall furnish the services of a factory trained, qualified, job experienced technician for assistance as necessary in pipe laying and pipe jointing. This technician shall assist and advise the Contractor in his pipe laying operations and shall instruct construction personnel in proper joint assembly and joint inspection procedures. The technician is required to be on-site full-time.

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01300 - SUBMITTALS and shall include:

A. SHOP DRAWINGS

- 1. Prior to the fabrication of the pipe, submit fabrication and laying drawings to the Engineer. Shop Drawings shall include a schematic location-profile and a tabulated layout schedule, both of which shall be appropriately referenced to the stationing of the proposed pipeline on the plan and profile sheets. Shop Drawings shall be based on the Drawings and Specifications and shall incorporate changes necessary to avoid conflicts with existing utilities and structures. Shop Drawings shall also

include full details of reinforcement, and dimensions for pipe and fittings. Details for the design and fabrication of all fittings and specials and provisions for thrust restraint shall be included.

2. The Contractor's Proposed Field Welding Procedure in accordance with AWWA C206 and AWS D1.1.
3. Line layout and marking diagrams which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; the station and invert elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained and/or welded joints, or of concrete encasement.
4. Full and complete information regarding location, type, size, and extent of all welds shall be shown on the shop drawings. The Shop Drawings shall distinguish between shop and field welds. Where welded joints are required, Shop Drawings shall include welding requirements, welding procedures, provisions for thermal stress control, and provisions for control of coating damage. Welded joints and minimum cylinder thickness for thrust restraint shall also be included in Shop Drawing submittal. Shop Drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them. Joints or groups of joints in which welding sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.

B. CERTIFICATE OF COMPLIANCE WITH CONTRACT DOCUMENTS

Prior to delivery of the pipe to the Site, the Manufacturer shall furnish an affidavit certifying that all pipe, fittings, and specials, and other products and materials furnished, comply with all applicable requirements of AWWA C301, AWWA C304, and the Engineer's design required by the Contract Documents. Affidavit to include that PCCP's:

1. Cylinder assembly has been hydrostatically tested at factory for two (2) minutes minimum in accordance with Section 2.03 C and AWWA C301.
2. Mortar coatings and linings were applied or allowed to cure at temperature above 32 degrees F.

C. CERTIFIED TEST REPORTS

During pipe manufacturing, the following certified test reports shall be submitted monthly:

1. Certified test reports for factory welds from the Pipe Manufacturer.
2. Certified test reports for factory welds from an independent third party Certified Welding Inspector paid for by the Pipe Manufacturer.
3. Certified test reports for cement mortar tests.
4. Copies of results of factory hydrostatic tests and tests of fittings.
5. Certified test reports for welder certification for factory and field welders.
6. Mill certificates, including chemical and physical test results for each heat of steel used for cylinders, prestressing wire, joint rings, v-notch tests, and elongation tests.
7. Physical properties of rubber used in the gaskets.
8. Copies of all of Manufacturer's factory quality control tests.

D. RECORD DATA

1. Within 30 calendar days following Notice to Proceed and before initiation of manufacture of prestressing wire, submit following:
 - a. Name and location of Prestressing Wire Manufacturer.
 - b. General description of quality control procedures used by Wire Manufacturer. Include physical and chemical property tests utilized, testing frequency and test records; and description of methods employed to assure compliance with AWWA C301 regarding wire surface temperature, type of thermometer, location of temperature measurement, frequency of temperature tests and test records.
 - c. Approximate dates when wire will be manufactured for use in pipe.
 - d. Hydrogen embrittlement sensitivity test report for wire.
2. Prior to pipe fabrication, submit following:
 - a. Manufacturer's Welding Procedure Specifications per AWS D1.1.
 - b. Submit inspection procedures to be used by Manufacturer and for quality control and assurance for materials and welding. Submit standard repair procedures that describe in detail shop and field work to be performed.
 - c. Certification showing calibration within last 12 months for equipment such as scales, measuring devices, and calibration tools used in manufacture of pipe. Each device used in manufacture of pipe is required to have tag recording date of last calibration. Devices are subject to inspection by Owner.
 - d. Submit all Manufacturer's design calculations signed and sealed by a Professional Engineer in the State of Texas. Include all calculations showing methods and processes used to satisfy the pipe and fittings design criteria specified by the Engineer in the Contract Documents. This includes, but it is not limited to calculations of pipe and fitting reinforcement, material's thicknesses, shop and field welds, linings and joint details.
 - e. Submit a sealed letter from the Manufacturer's engineer. The American Concrete Pressure Pipe Association computer model shall be used by the Pipe Manufacturer to verify the soil pipe structural design. Submittal of the model's detailed output summary, accompanied by a sealed letter from the Manufacturer's engineer stating that the modeled pipe structure design fulfills all requirements in the Contract Documents is acceptable. The Manufacturer's engineer shall be licensed in the State of Texas.
3. Prior to pipe delivery, submit following:
 - a. Copies of "Release for Manufacture" layout sheets.
 - b. Welder Qualifications Records (WQR) in accordance with AWWA C206, AWWA C301, and AWS D1.1 for both factory and field welders.
 - c. For nonshrink grout for special applications:
 - (i) Manufacturer's technical literature including specifications for mixing, placing, and curing grout.
 - (ii) Results of tests performed by certified independent testing laboratory showing conformance to ASTM C 1107, Nonshrink Grout and requirements of this specification.
 - (iii) Certification product is suitable for use in contact with potable water.
4. Every month, submit daily welding reports for field welding showing welder and joint welded.
5. Submit following within 45 days after manufacturing of pipe and fittings:
 - a. Prestressing wire records.
 - (i) ASTM A648 for wire.

- (ii) Steel reports as required in AWWA C301, Section 4.4.7.
- (iii) Records of testing accomplished to measure wire surface temperature as required in AWWA C301, Section 4.4.8.
- (iv) Results of other tests of steel reinforcement required in AWWA C301, Section 4.4.
- (v) Wire tension records required in AWWA C301, Section 4.4.8. Indicate heat and coil of prestressing wire used.
- b. Test results.
 - (i) Hydrostatic testing, acid etching, dye penetration, ultrasonic, magnetic particle and x-ray weld test reports as required.
 - (ii) Compressive strength (28 day) test results for each type of coating, lining and core mix design
- 6. After construction, submit following:
 - a. The Contractor installing the pipe shall provide top of pipe survey every 100 feet along the pipeline and at horizontal and vertical intersections.
 - b. Electronic copies of AutoCAD drawings of the pipe plan and profile layout sheets showing each joint of pipe, all appurtenances, fittings, and specials on the same coordinate system as used on the Drawings.

E. SAMPLES

- 1. The Manufacturer shall provide test specimens cut from each shipments of steel for cylinders, joint rings, and prestressing wire.
- 2. At least four weeks prior to mixing concrete or mortar for production, the Manufacturer shall provide Samples of each aggregate to be used in the manufacturing of pipe and fittings.

1.04 STANDARDS

Except as modified or supplemented herein, prestressed concrete cylinder pipe, coatings, linings, fittings and specials shall conform to the applicable requirements of the following standard specifications, latest edition, except where otherwise noted.

- AASHTO H-20 Live Load Specification
- ANSI/NSF 61 Drinking Water System Components – Health Effects
- ASTM A36 Standard Specification for Carbon Structural Steel
- ASTM A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
- ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- ASTM A370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products
- ASTM A497 Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
- ASTM A648 Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Pipe
- ASTM C33 Specifications for Concrete Aggregates
- ASTM C94 Standard Specification for Ready-Mixed Concrete

ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or Cube Specimens)
 ASTM C144 Standard Specification for Aggregate for Masonry Mortar
 ASTM C150 Standard Specification for Portland Cement
 ASTM C497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
 ASTM E709 Standard Guide for Magnetic Particle Testing
 ASTM E1444 Standard Practice for Magnetic Particle Testing
 AWS D1.1 Structural Welding Code - Steel
 AWWA C200 Steel Water Pipe--6 In. and Larger
 AWWA C206 Field Welding of Steel Water Pipe
 AWWA C207 Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In.
 AWWA C208 Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In.
 AWWA C301 Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
 AWWA C304 Design of Prestressed Concrete Cylinder Pipe
 AWWA M9 Concrete Pressure Pipe
 AWWA M11 Steel Water Pipe: A Guide for Design and Installation

1.05 DELIVERY AND STORAGE

A. GENERAL

Deliver, handle, and store pipe in accordance with the Manufacturer's recommendations. Upon delivery of the pipe, notify the Engineer, so that an inspection can be made.

B. PACKING

1. The pipe shall be prepared for shipment to permit acceptance by the carrier for transportation which will afford maximum protection from normal hazards of transportation and allow pipe to reach the Site in an undamaged condition. Pipe damaged in shipment shall not be delivered to the Site unless such damaged pipe is properly repaired and approved by the Engineer.
2. After the completed pipe and fittings have been removed from the final cure at the manufacturing plant, the pipe lining shall be protected from drying by means of plastic end covers banded to the pipe ends. Covers shall be maintained over the pipe ends at all times until ready to be placed in the trench. Moisture shall be maintained inside the pipe by periodic addition of water as necessary.
3. Pipes shall be carefully supported during shipment and storage. Pipe, fittings, and specials shall be separated so that they do not bear against each other, and the whole load shall be securely fastened to prevent movement in transit. Ship pipe on padded bunks with tie-down straps approximately over bunks. Store pipe on padded skids, sand or dirt berms, tires, or other suitable means to protect the pipe from damage. Pipe shall be supported so that pipe ends do not contact the ground or other structures during storage.

C. MARKING FOR IDENTIFICATION

Each length of pipe and each fitting shall have plainly marked on both the bell and spigot ends, the class for which it is designated, the date of manufacture, and the identification number as shown on the Shop Drawings. Mitered pipe shall be marked with the amount of bevel and point of maximum miter. Top centerline shall be marked on all specials.

D. POINT OF DELIVERY

Pipe shall be hauled direct from pipe plant to Dos Rios WRC, thus avoiding rehandling of pipe and the possibility of damage thereto. The Contractor shall be responsible to ensure that pipe is undamaged at the time of installation. Shipment by rail will be unacceptable.

PART 2 PRODUCTS

2.01 MATERIALS

A. CEMENT

Cement for use in concrete and mortar shall conform to ASTM C150, Type I or II. Pozzolanic materials may not be used as a substitute for cement.

B. AGGREGATES

Aggregates for concrete lining and coating shall conform to ASTM C33 and shall be washed silica base. Aggregate shall not leach or react with the water in the pipeline.

C. SAND

Sand used for inside and outside joints shall be of silica base, conforming to ASTM C144. Sand shall not leach or react with the water in the pipeline.

D. STEEL

Steel shall meet the requirements of AWWA C301. Steel shall be homogeneous and shall be suitable for field welding, fully killed and fine austenitic grain size.

E. PRESTRESSING WIRE

Wire for circumferential reinforcement shall conform to the chemical, mechanical, dimensional and test requirements of ASTM A648 and AWWA C301.

F. SHORTING STRAPS

Two 24 gauge min. x 1" shorting straps are required for each pipe joint. Shorting straps are to be welded to the pipe cylinder at each end. The proposed method of attaching the straps is to be approved by the Engineer.

G. TEST BULKHEADS

Contractor shall furnish test bulkheads as needed to perform field hydrostatic tests. Each test plug or bulkhead shall be designed to withstand the test pressure on either side with only atmospheric pressure on the opposite side. Two plugs may be used in lieu of one plug if needed to meet testing on both sides of plug. Each test plug or bulkhead specified shall have a 30-inch access manhole in one side of the plug and a 12-inch flanged outlet on the other side of the plug.

2.02 CEMENT MORTAR

A. Cement mortar lining shall be dense and smooth without bumps, blisters, ridges or spalling to the satisfaction of the Engineer. All rough spots shall be smoothed out with a rubbing stone to the satisfaction of the Engineer.

B. Cement mortar used for joints shall consist of one (1) part Portland Cement to two (2) parts clean, fine, sharp silica sand, mixed with water. Exterior joint mortar shall be mixed to the consistency of thick cream. Interior joint mortar shall be mixed with as little water

as possible so that the mortar is very stiff, but workable. Cement shall be ASTM C150, Type I or II. Sand shall conform to ASTM C144. Cement mortar used for patching shall be mixed as for interior joints.

- C. Bonding agent for pipe patching and interior joints which are welded shall be Probond Epoxy Bonding Agent ET-150, parts A and B; Sikadur 32 Hi-Mod, or approved equal.

2.03 PIPE, FITTINGS, AND SPECIALS

A. GENERAL

The pipe manufacture shall comply with AWWA C301, AWWA M9, AWWA C304 and the modifications contained herein. Only the embedded steel cylinder type will be allowed for this project. Sizes, pressure classes (working pressure), and pipe design shall be as shown in the Drawings.

The American Concrete Pressure Pipe Association computer model shall be used by the Pipe Manufacturer to verify the soil pipe structural design. Submittal of the model's detailed output summary, accompanied by a sealed letter from the Manufacturer's engineer stating that the modeled pipe structure design fulfills all requirements of the Contract Documents is acceptable. The Manufacturer's engineer shall be licensed in the State of Texas.

B. DESIGN CRITERIA

1. EXTERNAL DEAD LOAD

The depth class of the pipe is shown on the drawings. The external load shall be determined by Marston's formula for positive projecting conduits provided the trench width equals or exceeds the transition width. If the trench width is less than the transition width Marston's formula for trench conditions shall be used. The following soil characteristics shall be used:

- a. Unit weight of backfill = 130 lbs. per cubic foot
- b. Settlement Ratio = 0.35
- c. $K_u = 0.19$
- d. $K_u' = 0.15$

2. EXTERNAL LIVE LOAD

The live load shall be based upon AASHTO HS-20. Trench depths indicated shall be verified after existing utilities are located. In no case shall pipe be installed deeper than its design allows. The minimum depth class shall be 10 feet.

3. INTERNAL PRESSURE

Sizes and pressure classes (working pressure) shall not be less than 50 psi. For the purposes of pipe design, working pressure plus transient pressure shall be equal to 1.5 times the pressure class specified. Fittings, specials and connections shall be same class as the associated pipe. The maximum internal field test pressure shall be the maximum of 1.2 times the pressure class. Pipe shall also be designed for full vacuum conditions without damage to pipe, lining or joints.

4. CONSTRUCTION LOADS

Construction Loading Design will be considered transient load and shall be 1.5 times the pressure class specified.

C. PROVISIONS FOR THRUST

- 1. Thrusts at bends, tees, plugs, or other fittings shall be resisted by restrained joints.

2. Restrained joints shall be used for a sufficient distance from each side of the bend, tee, plug, or other fitting to resist thrust which will be developed at the design pressure of the pipe. For the purpose of thrust restraint, design pressure shall be 1.5 times pressure class (working pressure). Restrained joints shall consist of joint harness assemblies. In areas where restrained joints are used for thrust restraint, the pipe shall have adequate cylinder thickness to transmit the thrust forces.
3. The length of pipe with joint harness assemblies, the pipe cylinder thickness to resist thrust forces, and all other provisions necessary for thrust restraint shall be determined by the Pipe Manufacturer in accordance with the following design criteria:
 - a. Use the latest AWWA M9 design standards
 - b. Use the latest edition of the Thrust Restraint Design Procedure (TRDP) software program
 - c. Soil Type is Class IV
 - d. Unit weight of soil = buoyant weight of 60 pcf
 - e. Soil stiffness = 1100 lb/in/in
 - f. Angle of internal friction = 20 degrees
 - g. Pipe to soil coefficient of friction = 0.25
 - h. Limit longitudinal stress in the steel cylinder to 1/2 of the specified yield strength of the material for design pressure.
 - i. Design pressure shall be 1.5 times the working pressure (specified pressure class)
 - j. Joint type is joint harness assembly
 - k. Use the minimum soil cover over the entire restrained area

D. FITTINGS

1. Bend fittings over 15 degrees, shall meet the requirements of AWWA C200, SAWS Standard Specifications, and have the following minimum steel wall thickness of 0.375"
2. Steel fitting cylinder shall be the same diameter as the PCCP standard joint cylinder diameter. Fittings with mortar lining shall have a finished inside diameter equal to the nominal diameter of the pipe. Fittings with mortar coating shall have a minimum thickness of one inch over reinforcing. Bend fittings shall have a minimum radius of 2.5 times the nominal diameter. Buried PCCP fittings shall have a cement mortar lining and coating.

E. INSIDE DIAMETER

The inside diameter, including the cement mortar lining, shall be a minimum of the nominal diameter specified.

F. HYDROSTATIC TEST OF CYLINDER

Conform to AWWA C301, Section 4.6.4.3, at point of manufacture. Hold test for minimum 2 minutes for thorough inspection of cylinder. Repair or reject cylinders revealing leaks or cracks.

PART 3 EXECUTION

3.01 INSTALLATION

A. GENERAL

1. Install concrete pressure pipe, fittings, specials, and appurtenances at locations shown on the Drawings and as specified and required for the proper functioning of the completed pipe line. Install pipe, fittings, and specials in accordance with the Manufacturer's recommendations and AWWA M9.
2. All of the requirements of Section 02217 EXCAVATING, BACKFILLING AND COMPACTION OF UTILITIES govern for the excavation and backfilling of trenches for laying concrete pressure pipe, fittings and specials.

B. LINE, GRADE AND COVER OVER TOP OF PIPE

1. It is intended that the pipe be laid to the depth specified or shown on Drawings. Cover shall be defined as the distance from the top of the pipe barrel to the final ground surface. The Contractor shall be required to lay the pipe, to conform to the profiles shown on the approved Shop Drawings within three inches vertically and three inches horizontally.
2. The grades shall be constructed so as to provide a uniform grade between low points and high points, and intermediate high and low points shall be eliminated. No additional compensation shall be made for extra trench depth required to meet these conditions.

C. PIPE HANDLING

1. Haul pipe, fittings, and other accessories to the Site. At all times handle the pipe with care to avoid damage. Load and unload pipe using hoists or cranes as specified below. Under no circumstances shall they be dropped.
2. At all times handle pipe with wide nonabrasive slings, belts or other equipment designed to prevent damage to the coating, and keep this equipment in such repair that its continued use is not injurious to the coating. The use of tongs, bare pinch-bars, chain slings, canvas or composition belt slings with protruding rivets, pipe hooks without proper padding or any other handling equipment which the Engineer deems to be injurious to the coating shall not be permitted. Provide adequate spacing of pipe supports to prevent cracking or damage to the cement mortar lining.
3. Carefully observe the pipe for cracking and check the lining and coating, and should cracking occur, take immediate steps to protect the pipe. Have the Pipe Manufacturer repair any joint of pipe that has shrinkage cracks with a maximum width of 1/8" in the lining by using an approved method. If, in the opinion of the Engineer, the pipe is not suitable for repair, reject, plainly mark, and remove the pipe from the project site.
4. Have the Pipe Manufacturer repair any joint of pipe that has coating cracks larger than 0.005" (a hairline) by using an approved method. If, in the opinion of the Engineer, the pipe is not suitable for repair, reject, plainly mark, and remove the pipe from the Site.
5. Remove, replace or reject any disbonded lining or coating. A patch larger than 100 square inches or 12 inches in greatest dimension shall not be accepted. Adequately cure patches.
6. Provide the proper implements, tools, equipment and facilities for safe and convenient prosecution of the work. Lower pipe, fittings, specials, etc. into the trench by means of a crane or other machine. Do not roll or dump into the trench. The crane shall be of a sufficient size for handling the pipe, and shall lift and lower the pipe at a slow rate of speed. The crane shall be capable of stopping the lifting

operation at any point without producing a shock or otherwise jerking or vibrating the pipe.

D. PIPE JOINTING - GENERAL

1. Before laying each joint of pipe, thoroughly clean the bell and spigot rings by brushing and wiping.
2. Tightly fit together the sections of pipe. Take care to secure true alignment and grade. When a joint of pipe is being laid, place the gasket on the spigot ring and enter the spigot end of the pipe into the bell of the adjoining pipe and push into position. Lubricate the gasket and the inside surface of the bell with an approved lubricant (flax soap) which will facilitate the telescoping of the joint. Pulled joint deflection shall not exceed 75% of Manufacturers recommended allowable. The inside joint recess between ends of the pipe in straight pipe sections shall have a maximum opening of 7/8 inch and a minimum of 3/8 inch. For minor deflections, the joint may be "pulled" such that the inside joint recess between end of pipe sections shall have no more than 1-1/2 inches of metal showing on the inside surface of the bell ring at the point of maximum pull. This measurement will be made after completion of trench backfilling. No "blocking up" of pipe or joints shall be permitted, and if the pipe is not uniformly supported or the joint not made up properly, remove the joint and properly prepare the trench. After joining, check the position of the gasket with a feeler gauge. If the gasket is out of position, disassemble the joint and repeat the joint laying procedure. Upon completion of pipe jointing, the interior of the pipeline shall be left broom clean.

E. EXTERIOR JOINT

1. Make the exterior joint by placing a joint wrapper around the pipe joint which will be securely held in place by means of two (2) metal straps. The joint wrapper shall be 9 inches wide and hemmed on each side. The wrapper and straps shall be of such length that it will encircle the pipe, leaving enough opening between the ends to allow the mortar to be poured inside the wrapper. The wrapper shall be as specified in SAWS Standard Specifications.
2. Fill the joint with grout from one side in one continuous operation until the grout has flowed entirely around the pipe. During the filling of the joint, rod with flexible wire to settle the grout. Top off the grout inside the diaper after it settles.
3. Do not backfill the joint for at least two hours to allow the joint mortar to cure. All joints shall be uncovered to verify the joint mortar does not have shrinkage cracks.

F. INTERIOR JOINTS

1. Upon completion of backfilling of the pipe trench, fill the inside joint recess with a stiff cement mortar. The above description is intended to mean that all work which requires heavy equipment to be over the pipeline shall be complete before inside joints are made with the exception of motor graders or very light dozers used in dressing up the right-of-way for final inspection and the necessary travel of vehicles such as pickups.
2. Prior to the placing of mortar, clean out dirt or trash which has collected in the joint, and moisten the concrete surfaces of the joint space by spraying or brushing with a wet brush. Ram or pack the stiff mortar into the joint space. Take extreme care to insure that no voids remain in the joint space.

3. After the joint has been filled, level the surfaces of the joint with the interior surfaces of the pipe with a steel trowel so that the surface is smooth.
4. Make careful inspection of every joint to insure a smooth continuous interior surface. Following completion of pipe line progressively or in sections, including completion of inside joints and inspections, keep the pipe filled with water.
5. Under no conditions shall the inside joints be made until the ditch has been consolidated and cleanup work is completed over the pipe. After making the joints, remove dirt, trash, excess cement and mortar and any other construction material. The pipe shall be left broom clean.

G. PROVISION FOR RESTRAINED PIPE

1. Use restrained joints to resist thrust. Restrained joints shall consist of joint restraint harness assembly.

H. PROTECTION OF BURIED METAL

1. Buried ferrous metal shall be protected by a minimum of 1 inch coating of Portland Cement Mortar as specified for inside joints. Buried surfaces such as, but not limited to, flanges, bolts, caulked joints, threaded outlets, closures, etc., shall be protected with mortar that is reinforced with galvanized wire mesh.
2. Thoroughly clean the surface receiving a cement mortar coating, and wet with water just prior to placing the cement mortar coating. After placing, take care to prevent cement mortar from drying out too rapidly by covering with damp earth or burlap. Do not apply cement mortar coating during freezing weather.

I. PATCH

1. Excessive patching of lining or coating shall not be permitted. Patching of lining or coating will be allowed where area to be repaired does not exceed 100 square inches and has no dimensions greater than 12 inches. In general, there shall not be more than one (1) patch on either the lining or the coating of any one (1) joint of pipe.
2. Wherever necessary to patch the pipe, make the patch with a mortar specified for pipe patching. Do not install patched pipe until the patch has been properly and adequately cured and unless approved for laying by the Manufacturer's technician and by the Engineer.

J. PIPE BEDDING AND BACKFILL

Pipe bedding and backfill shall be as specified in Section 02217 EXCAVATING, BACKFILLING AND COMPACTION OF UTILITIES. Remove sheeting and shoring in a manner such that a good bond is achieved between the backfill material and the undisturbed trench walls. Buried PCCP fittings and straight pipe segments shall be encased in flowable fill a minimum of 16 feet on each end of the fitting segment. The flowable fill shall completely fill the trench excavation.

3.02 FIELD QUALITY CONTROL

- A. Perform a hydrostatic test as specified in SAWS Standard Specifications.
- B. For additional quality control testing requirements, see Schedule 02613-A.

END OF SECTION

SECTION 17300

INSTRUMENTATION AND CONTROLS - GENERAL PROVISIONS

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This section specifies the requirements, for the Process Control System Integrator (PCSI), of the DOS RIO WRC Electrical System Improvement Project Phase I for the SAWS DOS RIO WRC facility. The requirements outlined in this section address general hardware, software, and services necessary to provide the control functions specified. The scope associated with the control system consist of furnishing all labor, services, equipment, tools, software and appurtenances necessary to construct and make operational an expanded Process Control system to monitor and control the DOS RIO WRC Electrical System Improvement under the project.
- B. Substitution of functions or type of equipment specified shall not be acceptable. In order to ensure interchange ability of parts, maintain quality, interface between the various subsystems, and establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained.
- C. Equipment shall be fabricated, assembled, installed and placed in proper operating condition in full conformity with the Contract Documents and drawings, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the ENGINEER.
- D. The work shall include furnishing, installing and testing the equipment and materials detailed in the following Sections:
- | <u>Section No.</u> | <u>Title</u> |
|--------------------|---|
| 17300 | Instrumentation and Controls - General Provisions |
| 17302 | Instrumentation Testing and System Commissioning |
| 17303 | Instrumentation System Training |
| 17305 | Application Services |
| 17315 | Instrumentation and Control - Product |
| 17320 | Fiber Optic Data Highways |
| 17325 | Control Panels and Panel Mounted Equipment |
| 17400 | Control Loop Descriptions |
| 17500 | Distributed Control System |
| 17515 | Communications Interface Equipment |
- E. The PCSI shall use the equipment, instrument, and loop numbering scheme that has been developed and shown on the Drawings and Control Loop Descriptions in the development

of the PCSI's submittals. The PCSI shall not deviate from or modify said numbering scheme without the ENGINEER's approval.

- F. Equipment removed in the course of this work shall remain the property of the OWNER where specified under Section 17300.
- G. The PCSI shall coordinate and schedule all required testing and training with the General Contractor, OWNER, and ENGINEER.
- H. This contract shall include, but not be limited to, the following general sequence of tasks:
 - 1. Perform field investigations of each location associated with the project to obtain site-specific information required to prepare detailed submittals.
 - 2. Prepare and submit for review comprehensive design submittals.
 - 3. Procure, assemble, test, install and make operational the various specified components of the system including, but not limited to Ovation RIO panels and associated instrumentation.
 - 4. Procure, assemble, and program all components necessary, but not be limited to, all Human Machine Interface (HMI) monitoring and control programming functionality, databased configuration, graphic screens, communication links, historical archiving, documentation to interconnect the following equipment:
 - a. The New RIO Nodes (RIO-MAIN, RIO-BLWR, RIO-US5)
 - b. The New Power Monitor's and Motor Protection Relays
 - c. Modifications to and new Fiber Optic cabling
 - d. Modifications to existing Ovation Controllers
 - 5. Program and/or modify the existing Controllers 2/52, 8/58 and 9/59 for the new RIOs being supplied under this contract. Coordinate all interface requirements with the electrical subcontractor and furnish any signal isolation devices that might be required.
 - 6. Perform all system configuration tasks required in order for the Dos Rios WRC control system to perform as specified.
 - 7. Conduct factory testing.
 - 8. Perform field testing including startup and cutover.
 - 9. Provide training and system documentation.
 - 10. Perform clean up and closeout activities.
 - 11. Provide maintenance and warranty services.

12. Provide spare parts and materials.

I. The PCSI shall provide all required transducers, current isolators, signal conditioners, interposing relays, signal converters, etc. whether shown on the contract drawings or not. It is the PCSI's responsibility to field investigate any and all interface requirements, locations, wiring, terminations, etc. to provide a complete, and fully configured, integrated, and operational process control system.

J. The work shall include the following:

1. Existing RIO-US12:

- a. Demolish the existing wiring and RIO-US12 Subpanel located inside Substation No. 12 Electrical Building as shown in contract documents. Turn over RIO-US12 equipment to Owner.
- b. Demolish the existing Fiber Optic Cable (US12) between RIO-US12 and the existing FOPP in Primary Control Building No.3.
- c. Within the FOPP, located at Primary Control Building No. 3, identify and record the fiber optics strands and jumpers for Fiber Cables (C11 & C12) and RIO-US12. Fiber strand of cable C11 & C12 are currently utilized to connect RIO-US12 to Ovation Controller 2/52.
- d. The design intend is to:
 - 1) Re-utilized the RIO-US12 fibers, between the Primary Control Building No.3 FOPP and Ovation Controller 2/52, for routing the new RIO-US5 fiber link to Ovation Controller 9/59 located at the Odor Control Unit Building.
 - 2) Reutilized Controller 2/52 RIO Branch Link, freed up by removal of RIO-US12, for connecting the new RIO-MAIN.

2. Existing RIO-US5:

- a. Demolish the existing Fiber Optics cabling between the existing RIO-US5 and Ovation Controller 9/59, located at Odor Control Building No. 2.
- b. Demolish the existing RIO-US5 Subpanel installed at Substation No.6 and turn over to Owner.

3. New Fiber Optics Panel (FOPP-OCU-MAIN):

At OCU Building No.2, provide and install a new NEMA 12 wall mounted fiber optics patch panel (FOPP-OCU-MAIN), complete with PSU, Media Converters including all required connectors, patch cables, hardware and accessories.

4. New RIO-MAIN Panel:

- a. Provide and install a new RIO-MAIN Panel located in the Main Electrical Switchgear Building, complete with PSU, UPS (UPS-MAIN), redundant Ovation RIO node, Input/Output Module with Attachment Unit, Fiber communication interface, Fiber optics patch panel (FOPP-RIO-MAIN), CISCO Integrated Service Routers and Media Converters including all required accessories.
 - b. The design intend is to connect the new RIO-MAIN to the existing Ovation Controller 2/52 which is located within the Odor Control Building No.2. Provide, install, test and make operational a new Fiber Optic cable (FOC-MAIN) between the new FOPP-MAIN, located within the new RIO-MAIN panel, and the new FOPP-OCU-MAIN being provided and installed within the OCU Building No.2.
 - c. At OCU Building No. 2:
 - 1) Provide and install Fiber Optic jumpers between the new FOPP-OCU-MAIN and existing Controller 2/52. Connect the jumpers to Ovation Controller 2/52 Branch LINK which was utilized for the demolished RIO-US12.
 - 2) Provide and install Cat-6 jumpers as required.
 - d. At the Main Electrical Switchgear Building provide, install and make operational CAT-6 Ethernet cables between the Feeder Protection Relays and the CISCO Integrated Service Router installed within RIO-MAIN panel.
5. New RIO-US5 Panel:
- a. Provide, install and make operational RIO-US5 which will be located within the Generator paralleling gear enclosure, complete with PSU, UPS (UPS-US5), redundant Ovation RIO node, Input/Output Modules with Attachment Unit, Fiber communication interface, fiber optics patch panel (FOPP-RIO-US5) including all required hardware devices and accessories as specified in the contract documents.
 - b. The design intend is to connect the new RIO-US5 to the existing Ovation Controller 9/59, which is located inside the Odor Control Building No.2. This will be achieved by routing the Fiber Optic cable via the existing FOPP located within the Primary Control Building No.3. Provide, install and make operational a new FOPP-US5 to be located within the Primary Control Building No. 3 control room. The new FOPP-US5 will be located adjacent to the existing FOPP.
 - c. Provide, install and make operational a new Fiber Optic Cable (FOC-US5) between the FOPP-RIO-US5 and the new FOPP-US5 being installed at Primary Control Building No.3.
 - d. Provide Fiber Optic jumpers between the new FOPP-US5 and the existing FOPP located within the Primary Control Building No.3. Complete the fiber optic link between the existing Ovation Controller 9/59 and new RIO-US5.
6. New Fiber Optics Patch Panel (FOPP-3)

- a. Demolish the existing non-operational Allied Media Converter Rack which is located inside the existing Concentrator 3/4 enclosure.
 - b. Provide, install and make operational a standard 19", 1U Fiber Optics Patch Panel (FOPP-3) which will be located inside the existing Concentrator 3/4 enclosure.
7. New RIO-BLWR Panel:
- a. Provide, install and make operational a new RIO-BLWR Panel to be located within the Stage-1 Aeration Electrical Building, complete with PSU, UPS (UPS- BLWR), redundant Ovation RIO node, Input/Output Modules with Attachment Unit, Fiber communication interface, CISCO Integrated Service Router, Fiber Optic Patch Panel (FOPP-RIO-BLWR), media converter, including all required hardware devices and accessories.
 - b. The design intend is to connect the new RIO-BLWR to the existing Ovation Controller 8/58. Provide, install and make operational a new Fiber Optic Cable (FOC-BLWR) between the FOPP-RIO-BLWR located inside the RIO-BLWR panel and the new FOPP-3 located within the existing Concentrator 3/4 enclosure.
 - c. At Polymer/DAF Building No. 4 Control Room;
 - 1) Provide, install and make operational fiber optic jumpers as required.
 - 2) Provide, install and make operational Cat-6 jumpers as required.

1.02 RELATED WORK

- A. Process and Instrumentation Diagrams are included in the Drawings.
- B. Control System Architecture Block Diagram is included in the Drawing's.
- C. Specific control system and instrumentation materials and requirements are included in related Sections of Division 17.
- D. Instrumentation and Controls conduit systems are specified in Section 16110.
- E. Instrumentation signal cable and alarm and status wiring are specified in Section 16120.
- F. Control System network, communication, and fiber optic cabling are specified in Sections 17300, 17515 and 17320 respectively.
- G. Control Loop Descriptions are included in section 17305.
- H. The Power Monitoring and Motor Protection Relays are specified in Section 16.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300 shop drawings, submittals, and information for the materials and equipment furnished under this and related control system Sections.

B. Submittal requirements include:

1. Shop drawings shall fully demonstrate that the equipment and services to be furnished comply with the provisions of these Specifications and shall provide a true and complete record of the equipment as manufactured and delivered.
2. Submittals shall be bound in separate three-ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11-inch by 17-inch for inclusion within the binder.
3. The submittal drawings' title block shall include, as a minimum, the PCSI's registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.
4. Separate submittals shall be made as follows:

Submittal Number	Submittal Title	Submittal Number	Description and Requirements Location/Governing Specifications
1	Project Plan, Schedule, and Deviation List <i>This submittal shall be submitted and approved before any additional submittals will be accepted.</i>	17300-001	17300
2	Input/Output (I/O) List	17300-002	17300
3	Hardware and Software Packages	17300-003	17315, 17320, 17325, 17500, 17515
4	Panel Layout Drawings, Wiring Diagrams and Loop Wiring Diagrams	17300-004	17300, 17325
5	Testing Plan	17302-001	17300, 17302, 17305
6	Training Plan	17303-001	17303
7	Spares, Expendables, and Test Equipment. All spares in the listed Sections shall be included in a single submittal.	17300-005	17315, 17320, 17325, 17500, 17515
9	Fiber Optic Cabling and Equipment	17320-001	17320
8	Final System Documentation	Per O&M Submittal Numbering	

C. Project Plan, Deviation List, and Schedule

1. The PCSI Project Plan shall be submitted and approved before any further submittals will be accepted. The Project Plan shall, as a minimum, contain the following:
 - a) Overview of the proposed control system in clear text format describing the PCSI understanding of the project work, system architecture drawing, interfaces to other systems, schedule, startup, and coordination.
 - b) Approach to work in clear text format describing how the PCSI intends to execute the work. A discussion of switchover, startup, replacement of existing equipment with new, etc. shall be included as applicable.
 - c) Preliminary software and hardware submittal information solely to determine compliance with the requirements of the Contract Documents prior to the PCSI development of process control programs and system layouts. Favorable review of software and hardware systems as part of this Project Plan stage shall not relieve the PCSI of meeting all the functional and performance requirements of the system as specified herein.
 - d) Project personnel and organization including the PCSI project manager, project engineer, and lead project technicians. Include resumes of each key individual and specify in writing their commitment to this project.
 - e) Preliminary coordination meeting agendas as specified herein.
 - f) Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, loop or I/O wiring diagrams, and graphical display presentations.
2. Exceptions to the Specifications or Drawings shall be clearly defined by the PCSI in a separate Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that a proper evaluation may be made by the ENGINEER. The acceptability of any device or methodology submitted as an "or equal" or "exception" to the specifications shall be at the sole discretion of the ENGINEER.
3. Project schedule shall be prepared and submitted using Microsoft Project scheduling software. Schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. The project schedule shall illustrate all major project milestones including the following:
 - a. Schedule for all subsequent project submittals. Include in the time allotment the time required for CONTRACTOR submittal preparation, ENGINEER's review time, and a minimum of two complete review cycles.

- b. Proposed dates for all project coordination meetings.
- c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
- d. Software purchasing and configuration (following approval of related submittals).
- e. Shipment of all instrument and control system equipment.
- f. Installation of all instrument and control system equipment.
- g. Testing: Schedule for all testing including at a minimum the Unwitnessed Factory Test, Witnessed Factory Test, Operational Readiness Test, Functional Acceptance Test, and 30 Day Acceptance Test. Testing schedule shall include submittal of test procedures a minimum of 30 days prior to commencement of testing. Schedule shall also include submittal of completed test procedure forms for review and approval by the ENGINEER prior to shipment, startup, or subsequent project work.
- h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each controller and HMI server/workstation provided and/or modified under this Contract.
- i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
- j. Submittal of Certification of Installation.
- k. Warranty period
- l. Coordination Meetings Agenda: Agendas shall be submitted for the Coordination Meetings as specified herein. Submit proposed Control System Coordination Meeting Agenda a minimum of two weeks prior to the scheduled meeting date for review and comment by the ENGINEER.

D. Input/Output (I/O) List Submittal

1. The PCSI shall develop and submit the system I/O list that includes all I/O identified in the project drawing P&IDs. Submittal shall be a complete system I/O list for all equipment connected to the control system under this Contract.
2. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format on a CD-ROM and an 8-1/2 inch by 11-inch hard copy.
3. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O.
4. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet tables shall include the following information:

- a. TAG NUMBER(S): The identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by loop.
- b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
- c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
- d. Physical POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
- e. LOGICAL POINT ADDRESS: Since the ASP is performing the programming on the project, then leave this field blank for use by the ASP.
- f. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO – Pulse Output.
- g. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points is "1."
- h. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
- i. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
- j. P&ID – the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
- k. The I/O list shall be sorted in order by:
 - 1) Physical location
 - 2) I/O Type
 - 3) Loop Number
 - 4) Device Tag
- 1) Once the I/O List is approved, the RIO nodes I/O addresses may not be modified without approval by the Engineer and ASPs.

E. Hardware and software packages Submittal

1. Shop drawings shall be submitted as detailed herein. They shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation

requirements, and specific dimensions. Submittals consisting of only general sales literature will not be acceptable.

2. Digital Equipment Hardware Submittal

- a. Catalog cuts for, Network switches, process controller equipment, Ovation remote Input/Output units (RIO), including processing units, memory, input modules, output modules, network interface modules, mounting racks, and power supplies. Submit system bill of materials and descriptive literature for each hardware component that fully describes the units being provided. Any deviation of the hardware systems from the preliminary hardware submittal included in the Process Plan shall be described in detail.
- b. Submit system bill of materials and descriptive literature for each hardware component, which fully describes the units being provided.
- c. Complete system Input/Output (I/O) list for equipment connected to the control system under this Contract. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format on Compact Disk and an 8-1/2 inch by 11-inch hard copy. The I/O list shall include I/O name (or spare), type, physical location, point address, functional description (text that includes signal source, control function, etc.), range (engineering units) and equivalent analog to digital "count" conversion, alarm limits (low-low, low, high, high-high, etc.), relay normal status contact configuration. The I/O list shall be sorted in order by
 - 1) Physical location: Panel, Rack, Controller and Remote I/O Drop name, I/O module position,
 - 2) I/O Type: AI, AO, DI, DO, PI, PO, Communication Interface if on network etc.
 - 3) Loop Number
 - 4) Device Tag
- d. Complete block diagram showing the inter-connections between major hardware components, media type between components, raceway requirements (conduit, wireway, etc.), raceway identification, network protocol used at each network level, and all hardware components showing the interconnection of all modules, interface devices, modems, and plug-in circuit boards.
- e. UPS and battery sizing calculations to verify compliance with the specified power usage and backup power duration requirements.
- f. A list of all hardware electrical and environmental characteristics and requirements. All planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the CONTRACTOR to proceed with the detailed site preparation for all equipment.

- F. Panel Drawings: Drawings shall be furnished for all panels, consoles, and equipment enclosures specified in related Section of Division 17. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. As a minimum, the panel drawings shall include the following:
1. Interior and exterior panel elevation drawings to scale.
 2. Nameplate schedule.
 3. Conduit access locations.
 4. Panel construction details.
 5. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify any component of the assembly by manufacturer and model number.
 6. Fabrication and painting specifications including color (or color samples).
 7. Panel control schematics and interconnection diagrams detailing the electrical connections of all equipment in and on the panel. Diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering.
 8. Submit construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
 9. Heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.
 10. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the CONTRACTOR and included in the Project Bid Price.
 11. Point-to-Point I/O Wiring Diagrams: Point to point wiring diagrams depicting wiring within the panel as well as connections to external devices. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSI and approved by the ENGINEER. Field device wiring shall include the device ISA-tag and a unique numeric identifier. PLC I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified and power sources noted. Submit final wire numbering scheme for approval by the ENGINEER.

G. Testing Plan

1. Test Procedure Submittals: Submit the procedures proposed to be followed for each test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. Include sign-off forms for each testing phase or loop (per the specifications) with sign-off areas for the PCSI, ENGINEER, and OWNER. Refer to Part 3 of this section for complete testing requirements. Submit separate procedures for each specified test phase including:
 - a. Unwitnessed Factory Test
 - b. Witnessed Factory Test
 - c. Operational Readiness Test (ORT)
 - d. Functional Acceptance Test (FAT)
 - e. 30-Day Acceptance Test.
2. Test Documentation: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures. Testing shall not be considered complete until the signed-off test procedures have been submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes are not acceptable substitutes for the formal test documentation.

H. Training Plan

1. Training Plan Submittal: Upon receipt of the ENGINEER's comments on the preliminary training plan included in the Project Plan, submit a final training plan. Training method and coverage shall be in conformance with the system training as specified herein. The training plan shall include:
 - a. Definitions of each course.
 - b. Specific course attendance.
 - c. Schedule of training courses including dates, duration and locations of each class.
 - d. Resumes of the instructors who will actually implement the plan.

I. Spares, Expendables, and Test Equipment Submittal

1. Submit for each Subsystem:
 - a. A list of, and descriptive literature for spares, expendables and test equipment to be provided under this Contract as required by the related technical sections of Division 17.
 - b. A separate list of, and descriptive literature for, additional spares, expendables and test equipment recommended by the PCSI.

- c. Storage instructions for all spare parts.
- J. Certification of Installation
 - 1. Prior to the start of the 30-Day Acceptance Test, submit written Certification of Installation on PCSI's letterhead that the system installation has been completed, tested, and ready for operation to the PCSI's satisfaction as specified.

1.04 REFERENCE STANDARDS

- A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.
- B. American Society for Testing and Materials (ASTM).
 - 1. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- C. Instrument Society of America (ISA)
 - 1. ISA S5.2 - Binary Logic Diagrams for Process Operations
 - 2. ISA S5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
 - 3. ISA S5.4 - Instrument Loop Diagrams
 - 4. ISA S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 - 5. ISA RP60.3 - Human Engineering for Control Centers
 - 6. ISA RP60.6 - Nameplates, Labels, and Tags for Control Centers
- D. American National Standards Institute (ANSI)
 - 1. ANSI X3.5 - Flowchart Symbols and Their Usage in Information Processing
- E. National Fire Protection Agency (NFPA)
 - 1. NFPA 70 - National Electrical Code.
- F. Underwriters Laboratories, Inc. (UL)
 - 1. UL 508 – Industrial Control Equipment

1.05 QUALITY ASSURANCE

- A. The Process Control System Integrator (PCSI) shall be a "systems house" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems house" shall be interpreted to mean an organization that complies with all of the following criteria:
1. Employs a professional Control Systems Engineer or Electrical Engineer registered in the State, Commonwealth, or District in which the project is located to supervise or perform the work required by this Specification Section.
 2. Employs personnel on this project who have successfully completed ISA and manufacturers training courses on general process instrumentation and configuration and implementation of the specific Emerson Ovation distributed controller (with IEC programming methods), Emerson Ovation software and hardware products, software proposed for this project.
 3. Has performed work of similar or greater complexity on at least five previous projects.
 4. Has been actively engaged in the type of work specified in this Specification Section for a minimum of five years.
 3. Has been actively engaged in industrial process control programming and system integration for a minimum of ten years.
 4. Has been actively engaged in HMI configuration and system integration for a minimum of five years.
- B. The PCSI shall maintain a permanent, fully staffed and equipped service facility with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSI shall be capable of responding to on-site problems within 12 hours of notice.
- C. The General Contractor must name the proposed PCSI on the bidding documents. The PCSI shall be:
1. Prime Controls
1725 Lakepointe Drive
Lewisville, Texas 75057
Attn: Brian Poarch
Phone: 972-221-4849
- D. The listing of specific PCSI organizations above does not imply acceptance of their products and capabilities that do not meet the specified ratings, features and functions. PCSI's listed above are not relieved from meeting these specifications in their entirety
- E. Actual installation of the instrumentation system need not be performed by the PCSI's employees; however, the PCSI as a minimum shall be responsible for the technical

supervision of the installation by providing on site supervision to the installers of the various components.

- F. Required Evidence of Qualifications: PCSI shall provide a proposal detailing how the PCSI proposes to fulfill the requirements set forth in this Specification. PCSI shall include a concise resume of each individual's education, work experience and accomplishments. The proposal shall contain the following specific information:
2. Maintenance services available for hardware and software: Evaluation will be based on the PCSI's capability to provide the required routine and emergence services. The PCSI's proposal is to describe the capabilities and location of his/her nearest (to jobsite) service organization. It is the intent of the Specifications to obtain all system maintenance services from the PCSI. If the PCSI intends to subcontract all or portions of the service requirements, it must be stated as such along with the name and address of the organization.
 3. Technical validation examples of recently completed and similar scope projects: The PCSI is to provide information regarding type, size, complexity, and performance of five (5) systems recently completed, along with names, addresses, and telephone numbers of persons qualified to verify PCSI's statements approximate cost of the instrumentation system supplied, project completion date and description. Evaluation shall be based on the similarity of system requirements and PCSI's performance.
 4. A description of how the PCSI plans to execute the various function sand locations where the various portions of the work will be performed, coordinated and managed (e.g., design, engineering, manufacturing, programming, testing and scheduling). The PCSI is required to state in his/her proposal those functions which he/she intends to subcontract to other organizations and include the name, address and capabilities of these organizations.
 5. Documentation that demonstrates a minimum of five (5) years recent, past experience in the design, manufacture and commissioning of instrumentation and control systems of comparable size, type and complexity to the proposed project. The PCSI shall be required to have his/her own in-house capability to handle complete system engineering, fabrication, and testing.
 6. The PCSI shall indicate that he/she has in his/her employ capable personnel for detailing engineering, coordination, drafting, procurement and expediting, scheduling, construction, testing, inspection, installation, training start-up service for calibration and commissioning and warranty compliance for the period specified.

1.06 SYSTEM DESCRIPTION

- A. The DOS RIOS WRC is existing facility and all work shall be coordinated with operating personnel to minimize impact on its daily operations.
- B. The existing DOS RIOS WRC control system is an Emerson Ovation proprietary control system consisting of Distributed Control Units (DCU's) located throughout the Dos Rios WRC Facility. Three DCUs are involved in this project, out of which two are located at

Odor Control building and one at Polymer (DAF) facility control room. The main Operator Control Room is located at the CMS Building, however, there are several Operator Interfaces throughout the facility.

- C. The three distributed Controllers 2/52, 9/59 and 8/58 along with all RIO connected to these controllers are operational.

1.07 DELIVERY, STORAGE AND HANDLING

A. Shipping Precautions

1. After completion of shop assembly, factory test and approval of all equipment and cabinets, panels 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. Dehumidifiers shall be placed inside the polyethylene coverings. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.
2. Special instructions for proper field handling, storage and installation required by the manufacturer for proper protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resalable plastic bags or other acceptable means of protection.

B. Identification During Shipping and Storage

1. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

C. Storage

1. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters including in-line equipment and shall be adequately protected against mechanical damage. Equipment stored in untreated spaces shall have condensation space heaters installed to prevent moisture condensing on or within the equipment. Provide suitable power source for space heaters as required.
2. If any apparatus has been damaged, such damage shall be repaired by the PCSI at his/her own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such tests as directed by the ENGINEER. This shall be at the cost and expense of the PCSI, or the apparatus shall be replaced by the PCSI at no additional cost.

1.08 PROJECT/SITE REQUIREMENTS

- A. Environmental Requirements. Air conditioned areas require NEMA Type 1A, 12 ventilated enclosures. All other areas above or below grade require NEMA Type 4X stainless steel

enclosures unless installation within classified (hazardous) areas is required. Refer to Section 16000 for specific environmental and hazardous area classifications.

- B. Elevation: Equipment shall be designed to operate at a ground elevation of approximately 600 feet above mean sea level.
- C. Temperature:
 - 1. Outdoor areas' equipment shall be suitable for -30 to 50 C degrees ambient.
 - 2. Equipment located in indoor locations shall be suitable for 10 to 35 C degrees' ambient minimum.
 - 3. Storage temperatures shall range from 0 to 50 C degrees' ambient minimum.
 - 4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.
- D. Relative Humidity. Air conditioned area equipment shall be suitable for 20 to 95 percent relative, non-condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.
- E. Power Supply: 120 volts AC sources of electrical power supply shall be from unregulated industrial panel boards (either utility or standby generator) unless a UPS power source is indicated on the Drawings.

1.09 MAINTENANCE

A. Tools

- 1. None.

B. Test Equipment

- 1. Test equipment as defined in the related technical specification Sections of Division 17.

1.10 WARRANTY

- A. Provide equipment warranty per Section 01740, Warranties and Bonds, and as specified in Part 3 herein.

1.11 COORDINATION MEETINGS

- A. The PCSI shall schedule and hold three mandatory control system coordination meetings. The PCSI shall make arrangements for meetings and the meetings shall be held at the general contractor's field office at the DOS RIO WRC plant site. The meetings shall include, as a minimum, the Owner, Engineer, the general contractor's project engineer, the electrical subcontractor, the PCSI's project engineer, any other subcontractors performing any portion of the instrumentation system installation.

1. The first general coordination meeting shall be held no less than 30 calendar days in advance of the first shop drawing. The PCSI shall also present their approach for integrating the new Ovation RIO's in existing controller and programming with the Dos Rios WRC Emerson Ovation control system. The PCSI shall prepare and distribute an agenda for this meeting a minimum of two weeks before the scheduled meeting date for review and comment by the Engineer. The meeting will last up to one (1) business day. The purpose of the meeting shall be for the PCSI to
 - a. Present a draft Project Plan submittal (as specified herein)
 - b. Summarize the PCSI's understanding of the project
 - c. Discuss any proposed substitutions or alternatives
 - d. Present the PCSI's project schedule
 - e. Discuss all in-house and field testing scheduling/coordination requirements
 - f. Discuss delivery milestone dates
 - g. Request any additional information required from the Engineer.
2. The second general coordination meeting shall be held after the Hardware and Software, Panel Drawings, Loops Drawings, Testing Plan and Training Plan shop drawing submittals have been reviewed by the Engineer and returned to the PCSI. The PCSI shall prepare and distribute an agenda for this meeting a minimum of two weeks before the scheduled meeting date. The meeting will last up to one (1) business day. The purpose of the second meeting is to:
 - a. Discuss comments made on the submittal packages
 - b. Refine scheduled milestone dates
 - c. Coordinate equipment installation and testing activities
 - d. Provide a forum for any additional required coordination between the PCSI, general contractor and AES.
3. The third control system coordination meeting shall be held one month prior to Witnessed Factory Testing. The PCSI shall prepare and distribute an agenda for this meeting a minimum of two weeks before the scheduled meeting date. The meeting will last up to one (1) business day. The purpose of the last control system coordination meeting is to discuss:
 - a. Review of work progress
 - b. Discuss field observations, problems and decisions
 - c. Identification of problems which impede planned progress

- d. Review of submittal schedule and submittal status
- e. Review of off-site fabrications and delivery schedules
- f. Maintenance of progress schedule
- g. Corrective measures to regain project schedules
- h. Planned activities for subsequent work period
- i. Coordination of projected progress
- j. Maintenance of quality and work standards
- k. Effect of proposed changes on progress schedule and coordination
- l. Other business relating to PCSI work

1.12 FINAL SYSTEM DOCUMENTATION

- A. Submit operation and maintenance manuals covering instruction and maintenance on each type of equipment in accordance with the Section 01730.
- B. The instructions shall be bound in three-ring binders with drawings reduced or folded for inclusion and shall provide at least the following as a minimum.
 - 1. A comprehensive index.
 - 2. A complete "As Built" set of the PCSI approved hardware, software, and panel fabrication shop drawings.
 - 3. A complete list and data sheets of the equipment supplied, including serial numbers, ranges and pertinent data.
 - 4. Full specifications on each item.
 - 5. System schematic drawings "As Built", illustrating all components.
 - 6. Detailed service, maintenance and operation instructions for each item supplied.
 - 7. Special maintenance requirements particular to these systems shall be clearly defined, along with special calibration and test procedures.
 - 8. The operation instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
 - 9. Complete parts list with stock numbers and name, address and telephone number of the local Supplier.

- C. The PCSI's final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.
- D. The manuals shall contain all illustrations, detailed drawings, wiring diagrams and instructions necessary for installing, operating and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.
- E. Submit original software diskettes, CD-ROMs, or data packs of all software provided under this Contract. Submit original paper based or electronic documentation of all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers, etc. All software provided under this Contract shall be licensed to the OWNER.
- F. The requirements for the PCSI's final documentation are as follows:
 - 1. As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Any errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.
 - 2. The Hardware Maintenance Documentation shall describe the detailed preventive and corrective procedures required to keep the system in good operating condition. Within the complete Hardware Maintenance Documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance Documentation shall include, as a minimum, the following information:
 - a. Operation Information - include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 - b. Preventative-Maintenance Instructions - These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines and the adjustments necessary for periodic preventive maintenance of the System.
 - c. Corrective-Maintenance Instructions - include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause and instructions for remedying the malfunction.

- d. Parts Information - include the identification of each replaceable or field-repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross-references between system PCSI's part number and manufacturer's part numbers shall be provided.
3. . The following items shall be included with the software maintenance documentation:
- a. System PCSI's User Manuals - All applicable software manuals developed by the PCSI for the application software.
 - b. Application/Custom Software Manuals - All software maintenance information not included in the system supplier's standard manuals. Each custom program developed specifically for the system shall include the following information as a minimum:
 - 1) Table of Contents
 - 2) Overview of the program
 - 3) Narrative describing specifically how the program works. All calculations, references to process I/O points and operator inputs should be mentioned and cross referenced to the logic diagrams or code.
 - 4) Flowcharts or system logic diagrams in Boolean format shall be provided to clarify the narrative description.
 - 5) A List of Variables used by the program including the function of each. A cross reference to the Software Functional Design Documentation shall be provided where appropriate.
 - c. Software Listings and Databases- Submit copies of well-annotated as-built program listings of all software provided shall be furnished for all software items. Listings shall reflect the as-built condition of the logic development submitted as part of the shop drawing review process. Listings shall include, but not be limited to, the following:
 - 1) All listings associated with the system generation and software configuration (e.g., system parameterization tables, build maps, disk maps, etc.). Submittals shall be included for process controllers, HMI application software and all other equipment where specific programs or scripts were developed for this project.
 - 2) Listings of all data bases configured for and associated with the system.
 - 3) Listing of all custom or modified software developed specifically for the system. Listings shall reflect any changes made after the factory acceptance test.
 - d. Machine Readable Documentation - The supplier shall provide two sets of as-built documentation on CD-ROMs or Thumb Drive in machine readable format for all programs developed under this Contract. The machine readable documentation shall be 100 percent compatible with the Software Listings previous defined and include all documentation files including logic and annotation files. Any changes made during or after factory acceptance test shall be incorporated.

- e. Retrofit Documentation - The PCSI shall investigate, diagnose, repair, update and distribute all pertaining documentation of deficiencies that become evident during the warranty period. All such documentation shall be submitted to the ENGINEER within 30 days of solving the problem.
4. The CONTRACTOR shall provide Operator's Manuals for the system operators. These manuals shall be separately bound and shall contain all information necessary for the operator to operate the system. The manuals shall be written in non-technical terms and shall be organized for quick access to each detailed description of the operator's procedure. Manuals shall contain, but not be limited to, the following information:
- a. A simple overview of the entire system indicating the function and purpose of each piece of equipment.
 - b. A detailed description of the operation of the HMI and Local Operator Panels including all appropriate displays.
 - c. A detailed operational description of all hardwired panels.
 - d. Step-by-step procedures for starting up or shutting down an individual component.
 - e. A comprehensive description of the operation and control of each plant process. All operator actions to these processes and the associated reaction described.
 - f. A listing of all data base point names with their respective English language point descriptions and HMI graphic screen cross reference where the points can be found.
 - g. A complete glossary of terms.
 - h. Complete, step-by-step procedures for performing complete system or selected file backup and restoration.

1.13 CODES, INSPECTION AND FEES

- A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.
- B. Obtain all necessary permits and pay all fees required for permits and inspections.

PART 2: PRODUCTS

2.01 GENERAL REQUIREMENTS

A. General

- 1. Substitutions on functions or type of equipment specified will not be acceptable unless specifically noted. In order to insure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems and the establishment of minimums with regard to ranges and accuracy, strict compliance with

the above requirements shall be maintained. In order to insure compatibility between all equipment, it shall be the responsibility of the PCSI to coordinate all interface requirements with mechanical and electrical systems and furnish any signal isolation devices that might be required.

2. To facilitate the OWNER's future operation and maintenance, products shall be of the same major instrumentation manufacturer, with panel mounted devices of the same type and model as far as possible.

B. Physical

1. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals that are established standards for the water industry.
2. All electronic instrumentation shall be of the solid-state type and shall utilize linear transmission signals of isolated 4 to 20 mA dc (milliamperes direct current), however, signals between instruments within the same panel or cabinet may be 1-5V dc (volts direct current).
3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.
4. Equipment installed in a hazardous area shall meet Class, Group, and Division to comply with the NFPA 70 and CCR, Title 8, Electrical and General Safety Orders.
5. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.
6. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, and shall consist of equipment models that are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
7. All electronic/digital equipment shall be provided with radio frequency interference protection. Provide heating, cooling, dehumidifying, and filtering devices in control panel, enclosures, and cabinets as required to maintain internal ambient conditions within the most restrictive requirements of the equipment housed. Submit calculations as part of the panel fabrication submittal process verifying these requirements.

C. Electrical

1. Equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 117 volts, plus or minus 10 percent, except where specifically noted. Where possible, all field instruments shall be 24 VDC loop powered. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
2. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.
3. Equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored unless otherwise noted.
4. All transmitter output signals shall include signal and power source isolation.

D. Nameplates

1. General: Provide nameplates as specified below unless specified otherwise in the detailed technical specifications of related Sections of Davison 17.
2. All panels and field instruments shall be supplied with suitable nameplates that identify the panel and individual devices as required.
3. Nameplates shall be a 3/32-inch thick, black and white, laminated Bakelite or Lamecoid with engraved inscriptions. The letters shall be white against a black background. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.
4. Orient nameplates to facilitate reading the device identifier from a cursory inspection. Do not mount nameplates behind or under equipment.
5. Nameplate fasteners and mounting shall be:
 - a. Stainless steel wire, 0.048-inch diameter with stainless steel crimped clamps for hanging nameplates.
 - b. Stainless steel screws for cabinet mounted nameplates
6. Nameplates shall be as recommended by ISA Recommended Practice RP60.6.

2.02 LIGHTNING/SURGE PROTECTION

- A. Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground, and where practical, each ground wire run individually and insulated

from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4 junction box coupled to the enclosure.

- B. Either a one or multi-stage protection circuit, depending on the application, shall furnish AC power protection. Either a two or three-stage protection circuit, depending on the application, shall furnish I/O protection.
- C. All wiring, hardware, and connection means shall comply with the National Electric Code and/or applicable local codes.
- D. All suppressors shall have integral mounting brackets to attach 35mm DIN rail conforming to DIN EN50022, with the exception of conduit mounted devices.
- E. The suppressor shall be mounted as close to the equipment it is protecting as possible.
- F. Mounting guidelines will be followed as indicated in installation instruction provided by the manufacturer.
- G. Wires shall be attached to the suppressor by means of a cable-clamping terminal block activated by a screw. Connections shall be gas-tight, and the terminal block shall be fabricated of non-ferrous, non-corrosive materials.
- H. All wiring points and plug connections shall be "touch safe" with no live voltages that can make contact with a misplaced finger in accordance with IEC 529.
- I. Connections between AC power systems and electrical and electronic equipment shall meet the following.
 - 1. Surge suppression modules for AC power circuits shall be UL listed or recognized.
 - 2. Surge protection modules shall consist of two parts; a base terminal block and a plug protection module. Base shall directly connect to DIN rail. Replacing a plug shall not require the removal of any wires nor shall it interrupt the signal. Base and plug shall have the ability to be coded to accept only the correct voltage plug.
 - 3. Both plugs and bases shall have a rating of IP20 according to IEC 529. Bases shall have an integral label holder to mark each terminal block.
 - 4. Operating temperature range shall be at least -40°C to +80°C.
 - 5. Surge protection modules for continuous load current equal to 20 Amps or less shall meet the following.
 - a. Surge protection modules shall be designed to withstand a maximum 10 kA test current of an 8/20 microsecond waveform according to IEC 1024 Application Guide A and ANSI/IEEE C62.41 Category C Area.
 - b. Surge protection modules shall consist of a multistage hybrid circuit with staging inductors or resistors to properly coordinate the components.

- c. Surge protection modules shall have a visual indication of circuit integrity. Devices shall include a SPDT contact rated for at least 250 VAC, 1 Amp, for remote failure indication.
 - d. Bases shall include metal mounting foot, which provides ground connection to DIN-rail.
 - e. Manufacturers shall be Phoenix Contact model series Plugtrab PT 2-PE/S or Equal. One plug and base required for single phase AC power.
6. Protection modules for continuous load current over 20 Amps shall meet the following.
- a. Surge protection modules shall be designed to withstand up to a 40 kA test current of a 8/20 microsecond waveform according to IEC 1024 Application Guide A and ANSI/IEEE C62.41 Category C Area.
 - b. Surge protection modules shall have a visual indication of circuit integrity. Devices shall include a SPDT contact rated for at least 250 VAC, 1 Amp, for remote failure indication.
 - c. Manufacturers shall be Phoenix Contact model series Bricktrab or Equal.
7. Analog and discrete DIN rail mounted, non-pluggable, high density devices shall meet the following
- a. Surge protection shall consist of a multistage hybrid circuit with staging inductors or resistors to properly coordinate the components. Series resistance shall not exceed 4.7 ohms (+/- 10%).
 - b. DIN rail mounted surge protection housing width shall not exceed 6.2mm.
 - c. Surge protection for analog and digital I/O shall be designed to withstand a 5 kA test current of a (8/20) μ s waveform according to IEC 1024 Application Guide A and ANSI/IEEE C62.41 (Line to Ground). Surge handling capability of Line 1 + Line 2 shall be 10 kA of (8/20) μ s waveform.
 - d. Operating temperature range shall be at least -40°C to +85°C.
 - e. Maximum load current through the surge protection module shall not exceed 250 milliamps for analog and digital signal protection.
 - f. Cutoff frequency for analog modules shall be 3 MHz for a 50-ohm system and 1 MHz for a 150-ohm system. Cutoff frequency for digital modules shall be 2 MHz for a 50-ohm system and 600 KHz for a 150-ohm system.
 - g. Wire size range shall between 24 and 14 AWG.
 - h. Ex-I modules shall contain only diode and gas tube (no MOV) and shall be isolated from ground by 500VDC as required by EN 50 020.

i. Manufacturers

- 1) Phoenix Contact model series TT-2-PE-24DC, TT-2/2-24DC, or TT-EX(I)-24DC. Phoenix Contact model series PT 2 x Ex(I)-24DC. One plug and base required for two analog loops or four discrete signals.
- 2) Equal.

2.03 UL LABEL

- A. Each control panel and terminal cabinet shall bear the UL label. The UL Label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and any other equipment necessary to achieve compliance with UL 508 requirement. The Drawings do not detail all UL 508 requirements.
- B. The UL label requirements shall apply to all panels except where enclosures contain instruments mounted through the enclosure walls or doors. In this case, panel construction shall meet all requirements of UL labeling as described above, but no UL label is required. This exception applies only if UL Recognized instruments or devices for the intended purpose are not made.

PART 3: EXECUTION

3.01 GENERAL INSTALLATION

- A. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices are diagrammatic only. Exact locations shall be as determined by the PCSI during development and fabrication of systems.
- B. The drawings indicate the intent and not the precise nature of the interconnection between the individual instruments. Exact nature of the final equipment interconnections shall be as determined by the PCSI during development and fabrication of systems.
- C. The process control system software and hardware shall be configured as required to achieve the functional requirements as specified herein and shown on the Drawings.
- D. Where indicated on the drawings or instrument list as not requiring installation, provide the instruments suitably packaged for storage in compliance with Section 01600.
- E. Where specific installation details are not specified or shown on the Drawings, installation recommendations from the equipment manufacturers or American Petroleum Institute (API) shall be followed as applicable.
- F. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the ENGINEER but in no case shall more than one ground point be employed for each shield.

- G. Once installed, remove lifting rings from cabinets/assemblies. Permanent plugs shall be provided for the holes of the same material and color as the cabinet.
- H. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the CONTRACTOR shall bear full responsibility for such violations and assume all costs arising therefrom.
- I. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as required on the Electrical Drawings for the locations.
- J. The PCSI shall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the PCSI shall be required to ship his/her material in sections sized to permit passing through restricted areas in the building. The PCSI shall also investigate, and make any field modifications to the allocated space for each cabinet, enclosure and panel to assure proper space and access (front, rear, side).
- K. The PCSI shall provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the ENGINEER's approval. The PCSI shall certify that all field wiring for power and signal circuits are correctly done in accordance with best industry practice and provide for all necessary system grounding to insure a satisfactory functioning installation. The PCSI shall schedule and coordinate work under this section with that of the electrical work specified under applicable Sections of Division 16.

3.02 TESTING

A. General

1. As part of the requirement of this specification section it is the responsibility of the PCSI to provide a complete operational control system. Confirmation of an operational control system is dependent upon results derived from test procedures as specified in this Section. As part of this Contract the PCSI shall provide factory testing prior to shipment of the equipment and also testing of the equipment once installed in the field. Once the system is in operation an additional 30-Day Acceptance Test is required.
2. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.
3. All tests shall be conducted in accordance with prior ENGINEER- approved procedures, forms and checklist all as submitted by the PCSI under Part 1 of this Specification. Each test to be performed shall be described and a space provided after it for signoff by the appropriate parties after its satisfactory completion. Include "punchlist" forms with the test procedure to document issues that arise during the testing. Punchlist forms shall include a resolution section that allows a description of the fix and signoff areas for PCSI, OWNER, and ENGINEER.

4. Copies of the sign off test procedures, forms and checklists will constitute the required test documentation. The test result forms shall be submitted to the ENGINEER for approval at the completion of each test.
 5. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide suitable means of simulation. Define these simulation techniques in the test procedures.
 6. The PCSI shall coordinate all required testing with the CONTRACTOR, all affected Subcontractors, the ENGINEER, and the OWNER.
 7. The PCSI shall furnish the services of field service engineers, all special calibration and test equipment and labor to perform the field tests.
 8. The ENGINEER reserves the right to test or retest all specified functions, whether or not explicitly stated on the Test Procedures, as required to determine compliance with the functional requirements of the overall system. Such testing required to determine compliance with the Specified requirements shall be performed at no additional cost to the OWNER. The ENGINEER's decision shall be final regarding the acceptability and completeness of all testing.
 9. No equipment shall be shipped until the ENGINEER has received all test results and approved the system is ready for shipment.
- B. Factory Testing: Prior to shipment of the equipment the following tests are required:
1. Unwitnessed Factory Test (UFT).
 - a. The entire system except for primary elements, final control elements, and field mounted transmitters shall be interconnected and tested to ensure the system will operate as specified. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions and control devices/functions.
 - b. All panels, and assemblies shall be inspected and tested to verify that they are in conformance with related submittals, Specifications and Drawings. During the tests all digital system hardware and software shall be operated for at least five days continuously without a failure to verify the system is capable of continuous operation.
 - c. Tests to be performed shall include but not be limited to the following. Each of these tests shall be specifically addressed in the Test Procedure submittal.
 - 1) 100% wiring and database address verification of panel components and process controller I/O as applicable.
 - 2) Demonstrate functionality of the process controls in conformance with the process control loop descriptions. Simulate operating conditions to verify the performance of the monitoring and control functions.

- 3) Demonstrate graphical user interfaces (hardware and software) for process controllers, and HMI.
 - 4) Demonstrate the data communication network for in-plant
 - 5) Test system recovery from failure scenarios including cold boot, warm boot, communication loss, power failure, process failure, historical archiving, etc.
- d. All control panels provided or modified under the requirements of the related technical specification sections of Division 17 shall be included in these tests.
 - e. Submit UFT results for review by the ENGINEER
2. Witnessed Factory Test (WFT).
- a. Implicit in the scheduling of the Witnessed Factory Test is the assumption that the PCSI has completed the WFT test procedures as defined in the UFT, successfully completed the UFT, submitted the UFT results to the ENGINEER, and received approval of the UFT results by the ENGINEER.
 - b. All system tests performed and specified for the unwitnessed factory test shall be repeated in the presence of the ENGINEER and OWNER.
 - c. The PCSI shall notify the ENGINEER and OWNER in writing that the system is ready for the Witnessed Factory Test and allow the ENGINEER and/or OWNER to schedule a test date within 30 days of receipt of the "Ready to Test" letter. At the time of notification, the PCSI shall submit WFT Test Procedure incorporating any revisions to the detailed test procedure previously approved by the ENGINEER in the project system plan.
 - d. The purpose of the test shall be to verify the functionality, performance and stability of the hardware and software. The system must operate continually for 100 hours without failure before the test shall be judged successful. Successful completion of this test, as determined by the ENGINEER, shall be the basis for approval of the system to be shipped to the site.
 - e. Tests performed during the ENGINEER and/or OWNER Witnessed Factory Test shall be designed to demonstrate that hardware and software fulfill all the requirements of the Specifications. The test conditions shall resemble, as closely as possible, the actual installed conditions.
 - f. The ENGINEER and/or OWNER's representative shall have unrestricted access to the system for a period of time equal to at least 20 percent of the test duration.
 - g. All deficiencies identified during these tests shall be corrected and retested prior to completing of the Witnessed Factory Test as determined by the ENGINEER.
 - h. Punchlist items and resolutions noted during the test shall be documented on the Punchlist/Resolution form.

- i. The following documentation shall be available for reference at the test site during the WFT:
 - 1) All Drawings and Specifications, addenda and change orders.
 - 2) Master record copy of the test procedure to be used for formal signoff of the test.
 - 3) List of the equipment to be tested including make, model and serial number.
 - 4) Hardware submittal.
 - 5) Software documentation submittal.
 - j. Submit WFT results for review by the ENGINEER
- C. Field Testing - Following installation of the process control system components and prior to plant start up the following tests are required:
1. Operational Readiness Test (ORT)
 - a. General: The entire system shall be certified (inspected, wired, calibrated, tested, etc., and documented) that it is installed and ready for the ORT as defined below.
 - b. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications. PID loop tuning shall be completed as specified herein.
 - c. The Loop/Component Inspections and Tests shall be implemented using ENGINEER-approved forms and checklists. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment and calibration. These reports shall include the following information and checkoff items with spaces for sign off by the system supplier:
 - 1) Project Name, Test Date, PCSI Name, and Lead PCSI Technician Name
 - 2) Loop Number
 - 3) Tag Number for each component.
 - 4) Checkoffs/signoffs for each component.
 - Tag/identification
 - Installation
 - Termination – wiring and tubing

- Scale, Range, and Set point as applicable
 - Calibration/adjustment (4 point for analog, set point for switches) rising and falling
- 5) Checkoffs/signoffs for the loop
- Panel interface terminations
 - I/O interface terminations
 - I/O signal operation
 - Inputs/outputs operational: received/sent, processed, adjusted
 - Total loop operation
 - Process Controller Scaling and Adjustment
- 6) Space for comments
- d. The PCSI shall maintain the Loop Status Reports sheets at the job site and make them available to the ENGINEER/OWNER at any time.
- e. These inspections, calibrations, and tests do not require witnessing. However, the ENGINEER shall review Loop Status Sheets and spot-check the PCSI test process periodically. Any deficiencies found shall be corrected by the PCSI prior to commencement of the Functional Acceptance Test.
- f. Submit ORT results for review by the ENGINEER.
2. Functional Acceptance Test (FAT).
- a. General: Prior to startup, the entire installed instrument and control system shall be certified that it is ready for operation. A witnessed FAT shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. All preliminary testing, inspection, and calibration shall be complete as defined in the Operational Readiness Test.
- b. Each specified function and process control shall be demonstrated on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.
- c. Loop-specific and non-loop-specific tests shall be the same as specified under Factory Tests except that the entire installed system shall be tested and all functions demonstrated using live field based data to the greatest extent possible.
- d. Updated versions of the documentation specified to be provided for during the Factory Tests shall be made available to the ENGINEER at the job site during the tests. In addition, one copy of all O & M Manuals shall be available for reference at the job site during testing.

- e. Following initial startup, the entire process control system shall operate for a continuous 100 hours without failure before this test will be started.
 - f. Punchlist items and resolutions noted during the test shall be documented on the Punchlist/Resolution form. In the event of rejection of any part or function test procedure, the PCSI shall perform repairs, replacement, and/or retest within 10 days.
 - g. Submit FAT results for review by the ENGINEER.
3. 30-Day Acceptance Test
- a. After completion of the Operational Readiness and Functional Acceptance Tests, the PCSI shall be responsible for operation of the entire system for a period of 30 consecutive days, under conditions of full plant process operation, without a single non-field repairable malfunction
 - b. During this test, plant operating and PCSI personnel shall be present as required. The PCSI is expected to provide personnel for this test who have an intimate knowledge of the hardware and software of the system. The plant is operated 24 hours per day. Coordinate staffing requirements during the 30-day test to coincide with normal shift operations as much as possible. Off-shift emergencies shall be fully supported by PCSI staff. Provide PCSI staff with cell phones and pagers to ensure that support staff is available by phone and/or on-site within 4 hours of a request by operations staff.
 - c. While this test is proceeding, the ENGINEER and OWNER's Agent shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Water treatment plant operations shall remain the responsibility of OWNER and the decision of plant operators regarding plant operations shall be final. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes.
 - d. Any malfunction during the tests shall be analyzed and corrections made by the PCSI. The ENGINEER and/or OWNER will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.
 - e. Any malfunction, during this 30 consecutive day test period, which cannot be corrected within 24 hours of occurrence by the PCSI's personnel, or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction.
 - f. Upon completion of repairs, by the PCSI, the test shall be repeated as specified herein.
 - g. In the event of rejection of any part or function, the PCSI shall perform repairs or replacement within 10 days.

- h. All data base, process controller logic, and graphical interface system errors must be functioning as required per the specifications prior to the start of each test period. The 30-day test will not be considered successful until all data base points and logic functions are tested and verified to be correct.
 - i. The total availability of the system shall be greater than 99.5 percent during this test period. Availability shall be defined as:

$$\text{AVAILABILITY} = (\text{TOTAL TIME} - \text{DOWN TIME}) / \text{TOTAL TIME}$$
 - j. Down times due to power outages or other factors outside the normal protection devices or backup power supplies provided, shall not contribute to the availability test times above.
 - k. Upon successful completion of the 30-day operation test and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete.
4. Certification of Installation: Following successful completion of the 30-day test, the PCSI shall issue a Certification of Installation. Certification shall be on PCSI corporate letterhead, and signed by an officer of the firm. Certification shall state that the process control system has been completed in conformance with plans and specifications. Certification shall be submitted to the ENGINEER as specified herein.

3.03 TRAINING

- A. The cost of training programs to be conducted with plant personnel shall be included in the Contract price. The training and instruction shall be directly related to the system being supplied. The PCSI is responsible for training associated with the control panels, hardware, and software.
- B. The following training classes are required:
 - 1. Process controller hardware familiarization, operator interface configuration and process controller programming including I/O familiarization, logic programming, and register mapping.
 - 2. Modifications made to the HMI software configuration including database development, displays, reports logging, alarming, and analog trending.
 - 3. Communication system configuration including system configuration, system architecture, and equipment familiarization.
- C. The supplier shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
- D. The supplier shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to OWNER.

- E. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.
- F. All training schedules shall be coordinated with, and at the convenience of the OWNER. Shift training may be required to correspond to the OWNER's working schedule.
- G. Each training class shall be a minimum of 8 hours in duration. Separate classes shall be conducted for the OWNER's maintenance and operating personnel. Maintenance classes shall stress troubleshooting, repair, calibration, and other technical aspects of the HMI system. Operator classes shall stress operational theory and use of the HMI display screens. Each of the training classes listed above for operators shall be conducted twice during separate weeks to allow for scheduling of OWNER personnel. Training time shall be determined by the size and complexity of the project.
- H. The training classes shall be scheduled a minimum of 2 weeks in advance of when they are to be given. Proposed training material, including a detailed outline of each lesson, shall be submitted to the ENGINEER and OWNER at least 30 days in advance of when the lesson is to be given. The ENGINEER and OWNER shall review the submitted data for suitability and provide comments that shall be incorporated into the course.
- I. On-site Training: On-site (field) training shall be conducted at the plant site and shall provide detailed hands-on instruction to plant personnel covering; system debugging, troubleshooting, maintenance procedures, calibration procedures and system operation. The training shall run at times chosen by the OWNER. The training shall be conducted over a period of three months as follows:
 - 1. Two weeks immediately after Functional Acceptance Test. A total of three eight-hour sessions shall be scheduled covering general operational theory and applications.
- J. Additional Training: After completion of all training specified above, the CONTRACTOR shall provide additional training on subjects selected by the OWNER. This training shall be conducted by the individual most familiar with the configuration of this project. Training time shall be based on two eight-hour sessions.

END OF SECTION

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SECTION 17315

INSTRUMENTATION AND CONTROL - PRODUCT

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This section covers the furnishing, installation, and services for the field-mounted instruments, major systems, panels, and subassemblies as detailed on the drawings and in the P&IDs.
- B. Furnish, install, calibrate, test, adjust, and place into satisfactory operation the primary sensors, and field instruments as shown on the Drawings and specified herein.
- C. The Drawings and Specification illustrate and specify functional and general construction requirements of the sensors, and field instruments and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. The PCSI shall provide all components, piping, wiring, accessories, and labor required for a complete workable and integrated system.

1.02 RELATED WORK

- A. Refer to Section 13300.

1.03 SUBMITTALS

- A. Refer to Section 13300.

1.04 REFERENCE STANDARDS

- A. Refer to Section 13300

1.05 QUALITY ASSURANCE

- A. The Engineer shall determine whether a product is an Approved Equal based upon the information listed herein and the manufacturer's data sheets regarding the models specified. Alternate equipment must meet the criteria listed herein and any additional information in the manufacturer's data sheets in order to be accepted as an Approved Equal Supplier must furnish five working installation references for any alternate equipment along with OWNER, contact, and telephone number.

PART 2: PRODUCTS

2.01 IDENTIFICATION TAGS

- A. All sensors and field instruments shall have an identification tag meeting the following requirements:
 - 1. Tag numbers of sensors and field instruments shall be as shown on the drawings and as specified. For items not shown or specifically tagged, the tag number shall be established by the PCSI.
 - 2. Tags shall be stainless steel tags with embossed letters.
 - 3. Information to be permanently embossed onto the tag shall include the identifying tag number, manufacturer, model number, service, and range.
 - 4. The tags shall be fastened to the device with a circllet of stranded stainless steel wire rope and clamp.
 - 5. All sensors and field instruments mounted on or within control panels and enclosures shall have the identification tag installed so that the identification is easily visible to service personnel. Panel mounted devices shall have the tag attached to the rear of the device.

2.02 DOOR SWITCHES

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - 1. Schlage
 - 2. Honeywell
 - 3. Approved Equal
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- C. Type:
 - 1. Surface Mount Magnetic Switches for single and double doors
- D. Function/Performance:
 - 1. Contact: Normally Close on door close.
 - 2. Switching Voltage: 24 VDC
 - 3. Current: 0.25 Amps at 30 Vdc

4. The door position switch shall detect the open or closed status of an opening and then send this status to remote I/O (RIO) panel.

2.03 TEMPERATURE SWITCH

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Chromalox- WR
 2. OMEGA-KT110
 3. Approved Equal
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- C. Type:
 1. Thermostatic bi-metal
- D. Function/Performance:
 1. Operation: Thermostat closes as per the Low/High temperature switch application.
 2. Repeatability: Greater than 1.0 percent of temperature.
 3. Range: 40°F to 90°F
 4. Setpoint: Field adjustable and set between 20 and 80 percent of the adjustable range.
 5. Hysteresis: ± 4 deg. F
 6. Reset: Unit shall be of the automatic reset type unless noted otherwise on the Instrument Device Schedules.
 7. Switch Rating: 250 VAC at 10 amps; and 30 VDC at 5 amps.
 8. Operating Temperature: -45 to 70°C
- A. Physical:
 1. Positive Snap action switching.
 2. Switching Arrangement: Single pole double throw (SPST).

3. Protection: NEMA 2 (IP 20) or better.
- B. Power Requirements
1. None
- 2.04 FIXED MOUNT TYPE LEVEL SWITCHES
- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
1. Contegra FS-90
 2. Flygt Model EMH-10.
 3. Approved Equal
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- C. General
1. Provide sufficient lengths of Manufacturer's specialty cables for installation of power and signal conductors as provided with each instrument.
- D. Type:
1. Ball float switch.
- E. Function/Performance:
1. Differential: Less than one inch.
 2. Switch Rating: 10 amps at 240VAC or 24VDC.
 3. Contact Arrangement: Form C contact which is field selectable normally open or closed.
- F. Physical:
1. Float: 316 stainless steel, 5-1/2-in diameter.
 2. Switch: Totally encapsulated mercury-free switch.
 3. Cable: Heavy duty, PVC jacketed integral to float.
- G. Options/Accessories
1. Provide stainless steel hardware.
 2. Lead wire shall be a waterproof cable of sufficient length so that no splice or junction box is required.
 3. Provide cast-aluminum weatherproof junction box with terminals for all floats and tapped as required for conduit connections.

2.05 INSTRUMENTATION REQUIREMENT LISTING:

Item	Instrument Tag	Description	Range or Set Point
1	TSH-01A	Main Electrical Building Switchgear Room High Temp	Set at 850 F Rising
2	TSH-01B	Main Electrical Building Control Room High Temp	Set at 85 deg. F Rising
3	TSH-01C	Main Electrical Building Battery Room High Temp	Set at 85 deg. F Rising
4	TSH-02A	1st stage Aeration Building MCC Room High Temp	Set at 85 deg. F Rising
5	TSH-02B	1st stage Aeration Building Control Room High Temp	Set at 85 deg. F Rising
6	TSH--03	Generator Paralleling Enclosure High Temp	Set at 85 deg. F Rising
7	LSHH-02	Main Electrical Building Sump High Level	1-inch above Floor
8	LSH-02	Main Electrical Building Sump Pump-2 Start Float switch	TBD during construction
8	LSL-02	Main Electrical Building Sump-2 Stop Float Switch	TBD during construction
8	LSH-03	Main Electrical Building Sump Pump-3 Start Float Switch	TBD during construction
9	LSL-03	Main Electrical Building Sump Pump-3 Stop Float Switch	TBD during construction
10	LSH-01	Main Building Outside Sump Pump-1 High Level Float Switch	1-inch above Floor
11	XS-01	Main Electrical Building Intrusion	N/A
12	XS-02	1st Stage Aeration Building Intrusion	N/A
13	XS-03	Generator Paralleling Enclosure Intrusion	N/A

PART 3: EXECUTION

3.01 GENERAL

- A. PCSI shall furnish the services of qualified factory-trained servicemen to assist in the installation of the instrumentation and control system equipment.
- B. Install each item in accordance with manufacturers recommendations and in accordance with the Contract Documents. Transmitters and instruments which require access for periodic calibration or maintenance shall be mounted so they are accessible while standing on the floor. Care shall be taken in the installation to ensure sufficient space is provided between instruments and other equipment or piping to allow for easy removal and servicing.

- C. All items shall be mounted and anchored using stainless steel hardware unless otherwise noted.
- D. All field instruments shall be rigidly secured to walls, stands or brackets as required by the manufacturer and as shown on the Contract Drawings.
- E. Conform to all applicable provisions of the NEMA standards, NEC and local, State and Federal codes when installing the equipment and interconnecting wiring.

3.03 CLEANING

- A. All items shall be cleaned prior to installation, testing, disinfection and final acceptance.

END OF SECTION

SECTION 17500

DISTRIBUTED CONTROL SYSTEM

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Refer to Section 17300.
- B. Furnish and install cabling and cable accessories, including tools necessary for connecting and testing the system, Ovation Controller and Remote I/O nodes, remote I/O data highway, and input/output devices.
- C. Modified Ovation Controllers database and program shall be backed up after completion of the 30-Day Test. These backups shall be turned over to the Owner.
- D. PCSI to ensure that the new Ovation RIO node panels are interfaced to existing Ovation Controllers as specified in the contract document. All software packages provided shall be licensed under the Owner's name and address. The PCSI shall coordinate with the Owner for correct name and address.

1.02 RELATED WORK

- A. Refer to section 17300

1.03 SUBMITTALS

- A. Refer to Section 17300.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 17300.

1.05 MAINTENANCE

- A. Spare Parts
 - 1. Spare parts equal to at least 25% of field replaceable System components shall be supplied. As a minimum, the following shall be provided:
 - a. One spare Remote node I/O controller.
 - b. One spare input/output Electronic module of each type furnished or 25% of installed quantity, whichever is greater.
 - c. One spare power supplies of each type utilized in the System.

- d. Ten percent (10%) (minimum of 2) of each type of miscellaneous components, switches, lights, and cable connectors, Fuses as provided with the System.
2. Spare parts equal to at least one set of manufacturer's recommended spares shall be supplied.
3. All spare parts shall be packaged in the original manufacturer's packaging to prevent damage during storage. All packages shall be legibly and properly identified with indelible markings on the exterior as to contents.
4. Complete ordering information including manufacturer, part number, part name, and equipment for which the part is to be used shall be provided.

1.06 WARRANTY

- A. Refer to Section 17300.

1.07 SYSTEM FINAL DOCUMENTATION

- A. Refer to Section 17300.

PART 2: PRODUCTS

2.02 GENERAL

- A. Equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided.
- B. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.
- C. The System shall be designed and constructed to withstand the demands of real time process management and control.
- D. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion through the installation of plug-in circuit cards or additional cabinets.
- E. All equipment furnished shall be designed and constructed so that in the event of power interruption, or temperatures outside the operational range, the systems specified hereunder shall go through an orderly shutdown with no loss of memory, and resume normal operation without manually resetting when power is restored.

- F. The wired RIO panels input/output shall be transparently accessible from all existing Dos Rios WRC Control System workstations attached to the data highway by direct connection, bridge network or modem.
- G. All software licenses required to achieve the functionality described in the Specifications shall be provided.

2.03 DISTRIBUTED BRANCH CONTROLLER

- A. None. Plant existing DCS system is Emersion Ovation. Existing Ovation Controllers (OCR-161) as specified in the contract drawings shall be use to scan the Remote I/O node being installed in this project.

2.04 DISTRIBUTED REMOTE INPUT/OUTPUT NODE

A. General

1. The Remote I/O (RIO) node shall consist of a Remote Node Controller (RNC), input/output modules and Media Attachment Unit, power supplies, interconnecting cables, communication lines and other optional items necessary to meet the functional requirements. Major hardware components of the Remote I/O node shall include:
 - a. Redundant Remote Node Controller (RNC)
 - b. Media attachment unit
 - c. Complete set of Input/Output Modules (Emod and Pmod)
 - d. I/O termination Bases
 - e. Redundant PSU with AUX AC.
 - f. Fiber Optics Communications
 - g. Transition Panels
2. Electrical supply voltage to the RIO Node shall be 120 VAC plus or minus 15%, 48-63Hz. and the system power supplies shall be fused for overload protection.
3. All components of the RIO system shall be of normally recognized industry standards and regularly sold for industrial installations. The RIO node shall assemble all components into structurally sound housings. All products shall have corrosion protection.
4. Each RIO Node (including all I/O) shall be powered from the UPS power conditioning system specified herein.
5. The RIO Node system shall be a digital solid-state logic system capable of

performing the same functions as conventional relays, timers, counters, and math functions.

6. All components shall be designed, manufactured, and tested in accordance with recognized industrial standards. All products shall be CE marked, making them compliant with the Low Voltage Directive LVD 2006/95/EC. The RIO Node subsystems shall be approved for and adhere to the following agency and environmental specifications:
 - a. Vibration. 3.5 mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150 \Hz. The method of testing is to be based upon IEC 60068-2-6 test FC. The system is to be operational during and after testing.
 - b. Shock. Half-Sine 15G, 11 msec. The method of testing is to be based upon IEC 60068-2-27 test Ea. The system is to be operational during and after testing.
 - c. Temperature. All hardware shall operate at an ambient temperature of 0 to 60 degrees C (32 to 140 degrees F), with an ambient temperature rating for storage of - 40 to + 85 degrees C (- 40 to + 185 degrees F).
 - d. Relative Humidity. The RIO Node Controller hardware shall function continuously in the relative humidity range of 5% to 95% with no condensation.
 - e. Noise Immunity. The RIO Node Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the following the EMC Directive 2004/108/EC
7. The supplier shall provide operating instruction manuals with adequate information pertaining to the following:
 - a. System specifications
 - b. Electrical power requirements
 - c. Application considerations
 - d. Assembly and installation procedures
 - e. Power up procedures
 - f. Troubleshooting procedures
 - g. Programming procedures
 - h. Explanation of internal fault diagnostics
 - i. Shut down procedures

j. Recommended spare parts list

8. The supplier shall have a network of field sales and support personnel located in major cities throughout the United States. The Manufacturer shall also have a field service department with experienced representatives stationed in major cities with the capability to provide telephone consultation, prompt on-site service, and field replacement parts.
9. The supplier shall provide product application assistance by trained and experienced engineers to assist with program and system development through telephone consultation and on-site check-out, debug, and start-up assistance.
10. The supplier shall have the capability to conduct on-site training programs at a location provided by the customer.
11. The RIO Node controller and all of the corresponding components within the family of controller products shall be by a company who regularly manufactures and services type of equipment.
12. The manufacturer shall have a fully operational quality assurance and quality control program in place and shall comply with ISO9001 standards for "Quality Systems- Model for Quality Assurance in design/Development, Production, Installation, and Servicing".
13. The manufacturer or its authorized representative shall provide complete technical support for all of the products. This shall include headquarters or local training, regional application centers, local or headquarters technical assistance and a "1-800" phone line.
14. The RIO Node system manufacturer shall assemble all components into structurally sound housings. All connecting cables, switches, and other operator-controlled devices shall be constructed to withstand normal use and handling without damage.
15. The RIO Node system shall be a modular design with a plug-in processing unit, input/output modules, or assemblies. All components shall be marketed and supported by the one manufacturer. All necessary cables shall be included.
16. Modules are defined herein as devices that plug into a Bases and are keyed to allow installation in only one direction and position. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot.
17. All system modules, main and expansion system shall be designed to provide for free air flow convection cooling. No internal fans or other means of cooling, except heat sinks, shall be permitted.
18. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings, each of which indicates the

manufacturer's catalog number and a product manufacturing date code.

19. The existing DCS controller is Ovation OCR 161 as manufactured by Emerson Process Management. It will communicate via specific fiber optics cable with the Ovation Remote I/O node being supplied for the project. No alternate will be acceptable.

B. RIO Architecture

1. The system architecture shall include:
 - a. Node controller and data highway level redundancy.
 - b. Modular, plug-in components support type and installed and configured quickly and easily with single point DIN rail fastening
 - c. Built-in connectors for power and communications wiring
 - d. Electronic ID identifies module type, group, serial number, and revision
 - e. No interconnecting cables for I/O bases
 - f. Built-in spare fuse holders and strip gauge in base
 - g. Redundant power supplies for system reliability
 - h. "Hot swapping" capability to streamline system maintenance
 - i. Standardized status indicators with color coded diagnostic message
 - j. Allow distribution of I/O modules to strategic locations throughout the plant.
 - k. Field terminal blocks accepting two 14 AWG or a single 12 AWG wire
 - l. The RIO Node controller shall be equipped with a battery backed time of day clock and calendar.
 - m. Diagnostics
 - (1) The RIO node shall perform in-line diagnostics to monitor its internal operations. If a failure is detected, the node controller shall initiate a system shutdown and fail-over. The following at a minimum shall be monitored:
 - i. Memory Failure
 - ii. Memory battery low
 - iii. Node over temperature and general fault
 - iv. Communications port failure
 - v. Scan time over run
 - vi. I/O module failure

- vii. Analog I/O loop failure.
- (2) Diagnostic information shall be accessible at the programming terminal that attached to the Branch Controller. A diagnostic page shall provide information that identifies the nature of the fault, the absolute memory or I/O address of the fault, and the date and time of occurrence of the fault.
- (3) Diagnostic information shall be accessible to the host communications interfaces.
- (4) All diagnostic information shall be accessible to the ladder program running in controller or other executing software.
- (5) The node controller shall have LED indicators to display system status and provide internal RIO diagnostic alarm. The RIO node controller shall perform internal diagnostic and provide visual indication to the user by illuminating a "green" indicator when no fault is detected and a "red" indicator when a fault is detected.

C. Communication Ports and Remote I/O Communications

- a. The communication link between the Controller and RIO Node shall be through base unit mounted fiber optics interface and cable as recommend by the manufacturer
- b. Diagnostic and equipment status information shall be available from each RNC.
- c. The RIO Node shall support redundant configuration for input/output module and controller communication link.
- d. The remote I/O system shall have a remote input/output arrangement capable of operation at locations physically separated from the Controller by up to 5,000 feet and as detailed on the drawings.
- e. Provide communications cable as recommended by the DCS system manufacturer.

D. Input/Output Modules (I/O)

1. General

- a. The I/O count and type shall be provided as required to implement the functions specified plus an allowance for active spares as noted below.
- b. Each I/O drop or I/O location shall include 25 percent (minimum of 4) active input points (both DI and AI) and 25 percent (minimum of 4) active outputs points (both DO and AO) for future use. The spares shall be of the same type than I/O modules supplied. Spare output points that

require the use of an external relay shall be supplied with the external relay. Regardless of the spare requirement, all installed unused points on all I/O modules shall be wired to terminal blocks, respecting the order that they occur on the I/O modules. Termination of spares at the end of the cabinet's terminal strips shall not be acceptable.

- c. Each I/O drop or I/O location shall include two spare I/O base module for future use.
- d. Each I/O module shall have field replaceable fuse protection, a spare fuse and blown fuse indicators.
- e. Field wiring terminal blocks shall be pull-apart type, if mounted on the I/O modules, or mounted on the I/O mounting base to allow I/O module replacement without disconnection of the field wiring. All field wiring terminal blocks shall be 300V minimum NEMA rated, and accommodate no less than two (2) #14 gauge wires.
- f. I/O module usage shall comply with the following table unless noted otherwise:

<u>I/O Type</u>	<u>Module Type</u>
Analog input	4-20mA (remote power supply) with HART protocol support.
Analog output	4-20mA (remote power supply)
Discrete input	125 VAC/VDC differential type.
Discrete output	Relay

- g. Minimum isolation between input/output and logic voltage shall be 1500V RMS per NEMA standards via opto-isolation for AC I/O modules and 500 VDC for DC and Analog I/O modules.
- h. Analog inputs and outputs shall be isolated physically and electronically from each other
- i. I/O modules shall be plug-in mounted to the I/O mounting bases. I/O modules shall be designed to allow insertion into any mounting base.
- j. The 24 VDC power for analog instrument loops shall be provided by the PCSI as a part of the system. The 24 VDC power supply shall be derived from the 120 VAC input power circuit to the RIO panel. The field side of the 24 VDC power sources(s) shall have individual or grouped (of logically associated circuits) fusing and provided with a readable, visible, labeled blown fuse indicator.
- k. Each discrete output shall have an associated interposing relay located in the same control panel.

- I. Where multiple mechanical components are provided for process redundancy, their field connections to I/O modules shall be arranged such that the failure of a single I/O module will not disable any mechanical components of the redundant system.
- m. I/O modules shall contain a maximum of 16 points per card.
- n. Surge protection for outputs driving coils, solenoids, etc., shall be provided by the PCSI as required.

E. Remote I/O node Programming Software

- 1. None.

2.05 SINGLE PHASE UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM

A. Manufacturers

- 1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - a. Eaton Powerware Model Ferrups
 - b. American Power Conversion Smart – UPS
 - c. Approved Equal
- 2. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. Technical Specifications

- 1. Rating: 120VAC, 60 hertz, 850 VA minimum shall provide uninterrupted conditioned power fully loaded conditions for 30-minutes.
- 2. Description: On line dual track power conditioner and true (zero mille-second transfer time) uninterruptible power supply providing isolation, line regulation and conditioning, using sealed 48-volt maintenance free batteries and switch mode power supply for uninterrupted power with 0.5 to 0.7 power factor and 2.7 to 3.5 crest factor.
- 3. Regulation: 1-3 percent load regulation with less than 2pF effective coupling capacitance for line to load.
- 4. Output Waveform: Computer grade sine-wave with 3% maximum single harmonic and 5% maximum total harmonic distortion.
- 5. Output Frequency: 60 hertz +/- 0.5 hertz.
- 6. Operating Temperature: 0 degrees to +40 degrees Centigrade.
- 7. Relative Humidity: 5% – 90% without condensation.

8. Input Protection: Independent battery charger fuse and DC fuses.
9. Output Protection: Current limited.
10. Battery Charger: Two step charger, 8 amps and 2 amps.
11. AC Input: 120V, 60Hz, single phase, +15%, -20%.
12. Provide an external maintenance bypass switch with an auxiliary contact for each UPS supplied. The switch shall transfer power without interrupting the load utilizing make before break contacts.
13. The UPS system shall be sized to sustain 1.5 times the connected full load for a minimum period of 30 minutes in an operating environment of 32 deg F to 104 deg F. Exact sizing is the responsibility of the supplier.
14. The UPS system shall have built-in self-diagnostic monitoring capable of monitoring as a minimum AC volt in/out, AC current in/out, battery voltage, VA load, watts, power factor percent of full load, time of day, system hours, inverter hours and projected run time available. Unit shall have two normally open relay contacts for remote alarm condition reporting. The supplier shall connect all available status contacts to the control system.
15. The UPS sizes are for reference only. The supplier shall provide sizing data on the UPS listing all loads and calculations required for sizing the UPS system for Consulting Engineer review and approval. The system supplier shall provide test data on the UPS to show conformance with these specifications including, but not limited to, full load back-up time, half load back-up time, efficiency at full load, output voltage/frequency regulation during adverse input power conditions, etc.
16. Each UPS shall be provided with a external bypass switch, in a Nema 1A enclosure, wall mounted, which will permit seamless transfer of the UPS to a separate source and back, without loss of load, for maintenance of the UPS. The manufacturer of the transfer switch shall be the manufacturer of the UPS.

2.07 LIGHTNING/SURGE PROTECTION

- A. Refer to Section 17300

PART 3: EXECUTION

3.01 GENERAL INSTALLATION

- A. All equipment specified herein shall be factory installed, programmed, field adjusted, tested and cleaned as an integral part of equipment specified elsewhere in these Specifications.
- B. Furnish labor, materials, equipment, and incidentals required to install the system in accordance with Specification Section 17300 and as specified herein.

END OF SECTION

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SECTION 17515

COMMUNICATIONS INTERFACE EQUIPMENT

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This Section of the Specifications describes the requirements for Communications Interface Equipment and Systems to be furnished under other Sections of the Specifications as listed in the Related Work paragraph of this Section.
- B. All equipment described herein shall be submitted and furnished as an integral part of equipment specified elsewhere in the Related Work Specifications.

1.02 RELATED WORK

- A. Section 17325 Control Panels and Panel Mounted Equipment
- B. Section 17500 Distributed Control System
- C. Section 17320 Fiber Optic Data Highways

1.03 SUBMITTALS

- A. Submittals for equipment specified herein shall be made as a part of equipment furnished under other Sections. Individual submittals for equipment specified herein will not be accepted and will be returned un-reviewed.
- B. Submit catalog data for all items supplied from this specification Section as applicable. Submittal shall include catalog data, functions, ratings, inputs, outputs, displays, etc., sufficient to confirm that the equipment provides every specified requirement. Any options or exceptions shall be clearly indicated.

1.04 REFERENCE CODES AND STANDARDS

- A. Instrumentation equipment, materials and installation shall comply with the National Electrical Code (NEC and with the latest edition of the following codes and standards:
 - 1. National Electrical Safety Code (NESC)
 - 2. The International Society of Automation (ISA)
 - 3. UL 508A, the Standard of Safety for Industrial Control Panels
 - 4. ANSI C37.90.2 Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
 - 5. UL 1449 Third Edition Surge Protective Devices
 - 6. All equipment and installations shall conform to applicable Federal, State, and local codes.
- B. All equipment shall comply with the requirements of the National Electric Code and Underwriters Laboratories (UL) where applicable.

- C. Each specified device shall also conform to the standards and codes listed in the individual device paragraphs.

1.05 QUALITY ASSURANCE

- A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of five (5) years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. Equipment submitted shall fit within the space or location shown on the Drawings. Equipment which does not fit within the space or location is not acceptable.
- C. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

1.06 WARRANTY

- A. The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for 2 years from date of acceptance of the equipment containing the items specified in this Section. Within such period of warranty, the Manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work requiring shipping or transporting of the equipment shall be performed by the Contractor at no expense to the Owner.

PART 2: PRODUCTS

2.01 INTEGRATED SERVICE ROUTER

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - 1. CISCO 2901 with Cisco IOS Universal Image.
 - 2. NO Equal
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- C. Power Requirement
 - 1. AC input Voltage : 100 to 240 Vac auto ranging
 - 2. AC frequency : 47 Hz to 63 Hz.
 - 3. AC input current : 1.5A (110 V), 0.6A (230 V)
 - 4. Typical Power (No Module) : 40 W
 - 5.
- D. Environmental
 - 1. Operating temperature : 32 Deg F to 104 Deg F

2. Storage Temperature : -40 Deg F to 158 Deg F
3. Operating humidity : 20% to 95% Non-condensing
4. Storage humidity : 5% to 95% Non-condensing
5. Maximum operating altitude : 10,000 ft.

E. Physical

1. Power Supply : 120VAC
2. Microprocessor based managed type.
3. 19", 1U Rack unit, (1.8"H x 17.3"W x 17.3"D) Rack Mountable.

F. Functional Performance

1. Per Port status LED indication.
2. Wire Speed switching and routing.
3. Integrated WAN ports : 2 x 10/100/1000BaseT network/Gigabit technology ports with RJ-45 connectors for Category 5e cabling.
4. DRAM: Default 512 MB (Maximum: 2 GB)
5. Expansion slots
 - a. External Compact Flash: Default Slot 0; 256 MB (Max 4 GB)
Slot 1; None (Max 4 GB)
 - b. USB 2.0 (Type A) : 2
 - c. EHEIC Slot : 4 or (Double Width EHEIC card – 2 nos.)
6. Serial Console: 1 and Aux. Port: 1
7. Supports BGP, DVMRP, EIGRP, IS-IS, OSPF, PIM-SM, PIM-SSM, Policy-based routing, static IPv4 routing and static IPv6 routing protocols
8. Meets AS/NZS 3548, BSMI CNS 13438, CAN/CSA-E60065-00, CISPR 22 Class A, CISPR 24 and CS-03 certification/standards

G. Options and Accessories Required:

1. Provide minimum 3-year warranty.
2. The additional modules shall be included:
 - a. IP base IOS license and Security license.
 - b. 10/100/1000 Port, Ethernet Switch Interface Card to support port requirement as specified in contract document.
 - c. USB memory stick, 128 M or higher.

2.02 INDUSTRIAL ETHERNET MEDIA CONVERTER

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. B & B Electronics EIR series

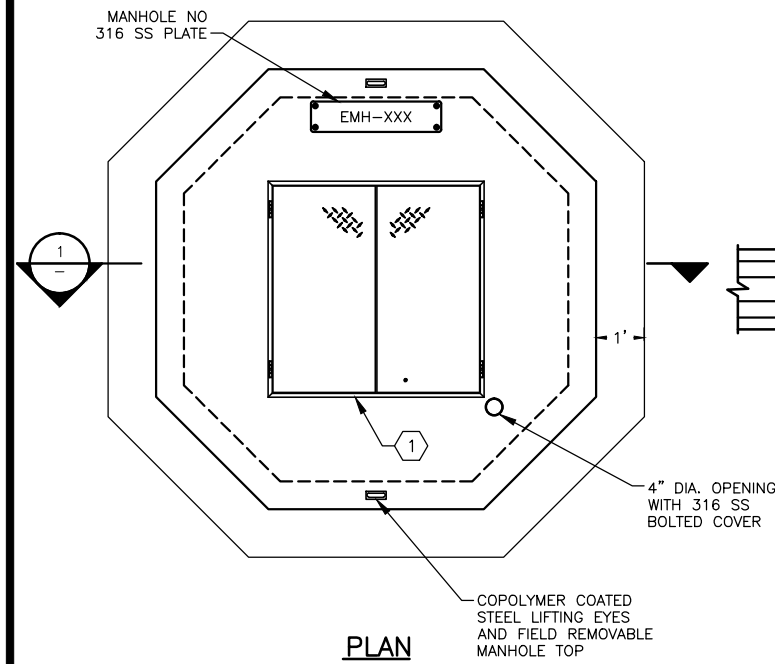
2. Moxa IMC-21 Series
 3. N-TRON
 4. SIXNET
 5. Approved Equal
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- C. Environmental
1. Operating temperature: 14 Deg F to 104 Deg F
 2. Operating humidity: 20 – 95% Non-condensing
 3. Storage Temperature: -40 to 158 Deg F
- D. Physical
1. Power Supply: 12 VDC to 30 VDC
 2. DIN Rail mountable.
 3. Vibration Resistance, Shock, Free Fall
- E. Functional Performance
1. Per Port status LED indication.
 2. Wire Speed switching.
 3. 10/100BaseT ports with RJ-45 connectors for Category 5e cabling.
 4. ST or SC type Fiber Optic Connectors for 100BaseFX, 1000BaseSX for Multimode Fiber and 1000BaseLX for Single Mode Fiber as shown on the drawings.
- F. Options and Accessories Required:
1. Provide minimum 3-year warranty.

PART 3: EXECUTION

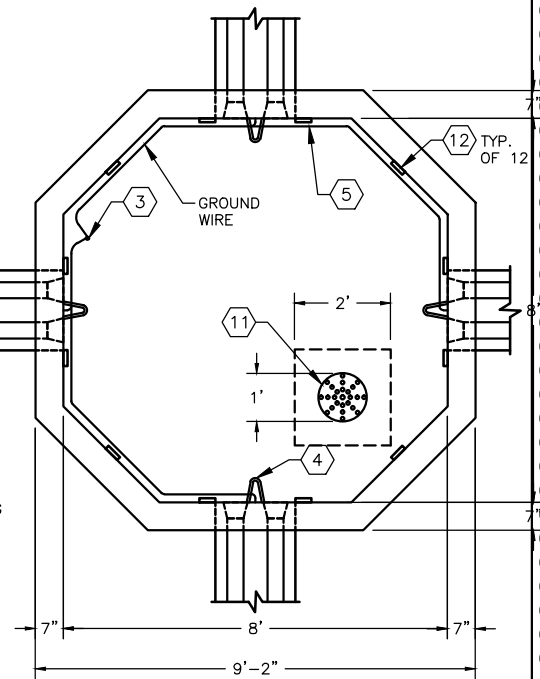
3.01 INSTALLATION

- A. All equipment specified herein shall be factory installed in an overall assembly, field adjusted, tested and cleaned as an integral part of equipment specified elsewhere in these Specifications.

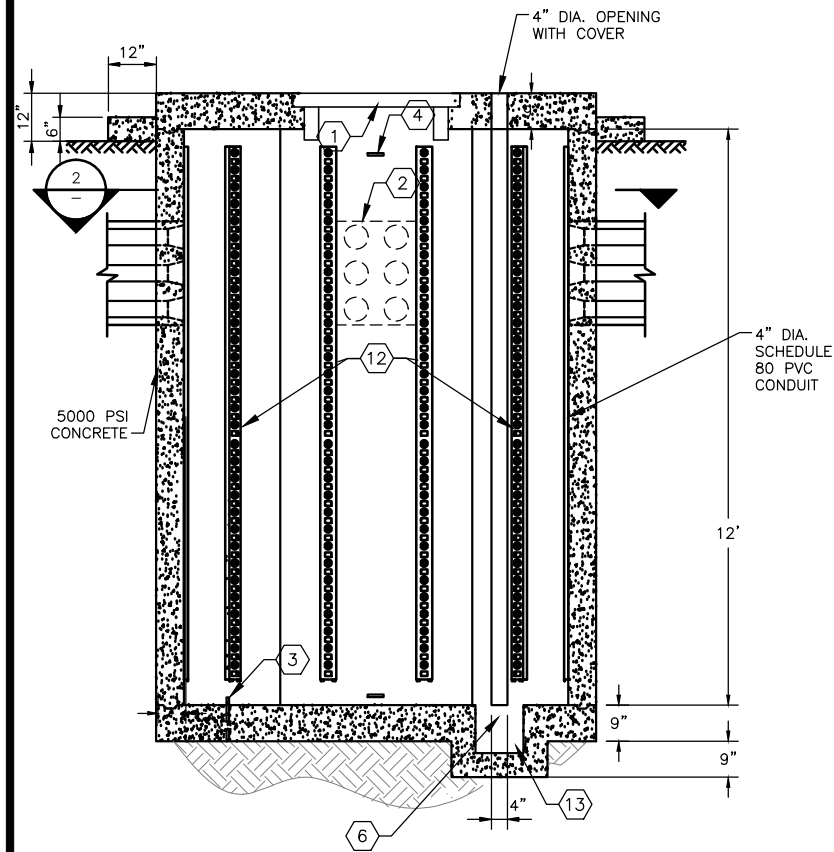
END OF SECTION



PLAN



SECTION
NTS

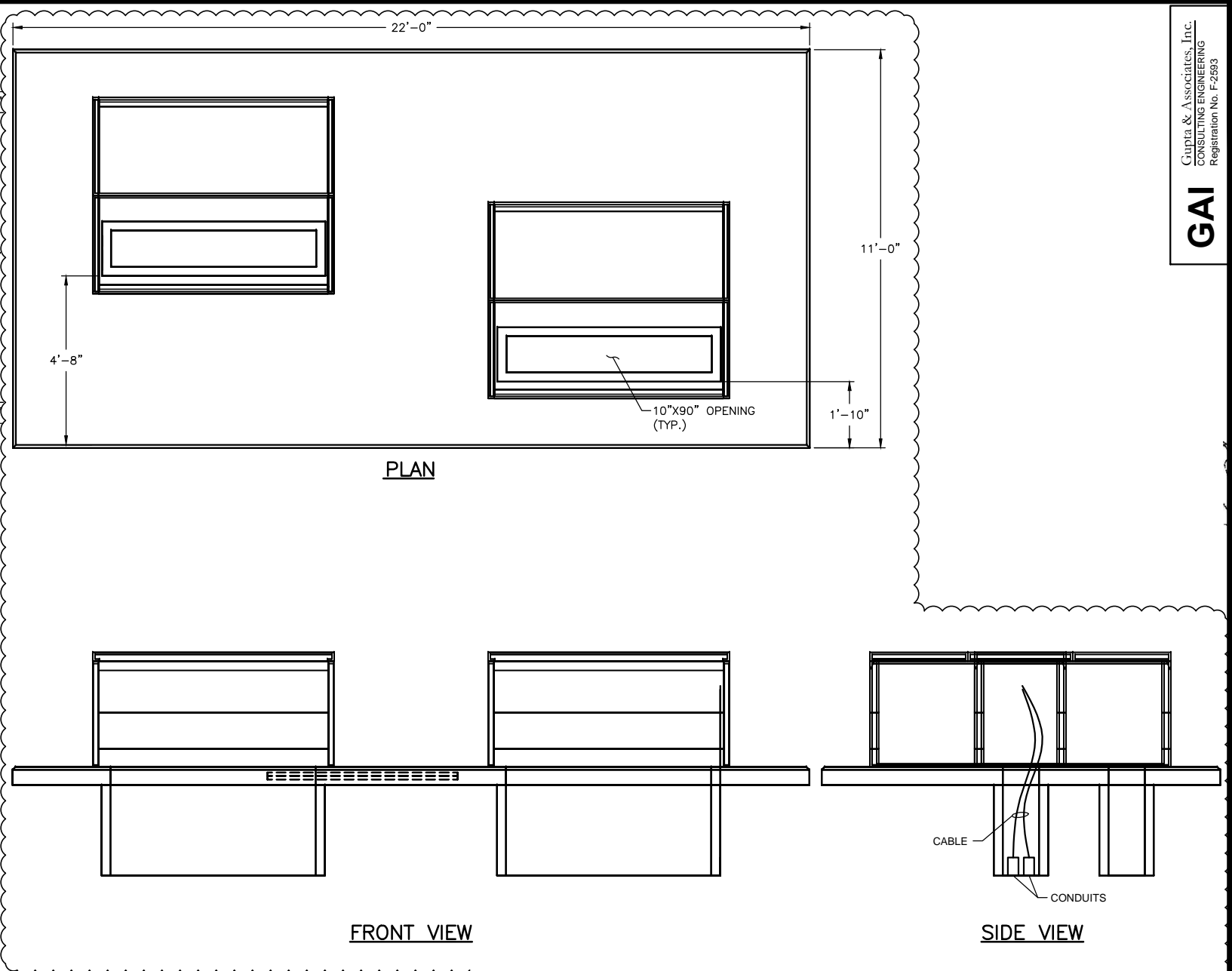


SECTION
NTS

ELECTRICAL MANHOLE (EMH)



- NOTES BY SYMBOL (X)
- MANHOLE COVER SHALL BE AS SPECIFIED, AND SHALL BE STAMPED ELECTRICAL OR COMMUNICATION AS REQUIRED BY CONTRACTOR.
 - ALL CONDUITS SHALL BE TERMINATED IN MANHOLE WITH BELL ENDS AND CENTER ON THE ENTERING WALL.
 - 3/4"Ø X 10'-0" STAINLESS STEEL.
 - PROVIDE PULLING IRONS AS SPECIFIED.
 - #4/0 BARE STRANDED TINNED COPPER CONDUCTOR TO MAIN GROUND GRID.
 - MANHOLES SHALL BE EQUIPPED WITH SUMP.
 - MANHOLE EXTENSIONS SHALL BE USED WHENEVER BOX IS BELOW EXISTING GRADE.
 - ANCHORS SHALL BE 316 SS.
 - MANHOLES SHALL BE FLUSH WITH THE PAVEMENT WHEN INSTALLED IN ROADWAYS.
 - MANHOLE SHALL BE 12" ABOVE GRADE WHEN LOCATED IN GRASSY AREAS, CONTRACTOR SHALL PROVIDE A 12" MOW STRIP 6" TALL AROUND MANHOLE.
 - SHALL BE REMOVABLE PLASTIC GRATE.
 - MOUNTING RACKS SHALL BE AS SPECIFIED.
 - REFER TO SPECIFICATION 16600 "UNDERGROUND SYSTEM" FOR ADDITIONAL INFORMATION.



PLAN

FRONT VIEW

SIDE VIEW



- NOTES BY SYMBOL (X)
- REFER TO DRAWING S-2 FOR STRUCTURAL DETAIL.

GAI
Gupta & Associates, Inc.
CONSULTING ENGINEERING
Registration No. F-2593

SAWS JOB NO.
14-6504
CP&Y
12500 SAN PEDRO AVE.
SAN ANTONIO, TX 78216
TELE REGISTRATION #F-1741

SAWS
SAN ANTONIO
WATER SYSTEM



NO.	REVISION	DATE	BY
1	ADDENDUM NO. 5	10/03/2016	WDS

VERIFY SCALE
SCALE: 1" = 1'

BAR IS ONE INCH ON ORIGINAL. THIS SHEET, ADJUST SCALE.

SAN ANTONIO WATER SYSTEM
DOS RIOS WRC ELECTRICAL SYSTEM
IMPROVEMENTS - PHASE 1
ELECTRICAL
STANDARD DETAILS - VII

Date:	JULY 2016
Designed:	WDS
Drawn:	ER
Reviewed:	GBL
CP&Y Proj. No.	SAWS14201

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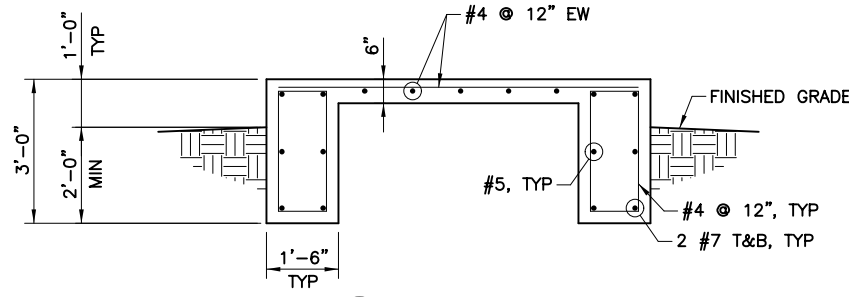
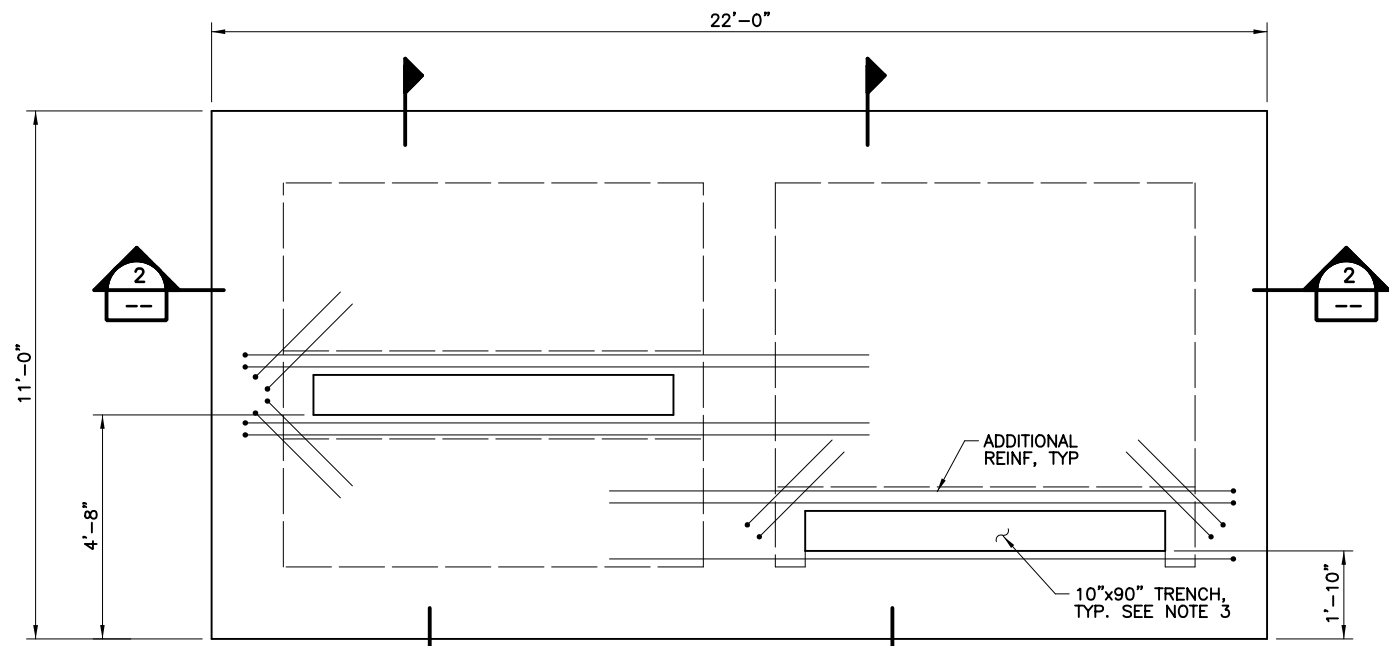
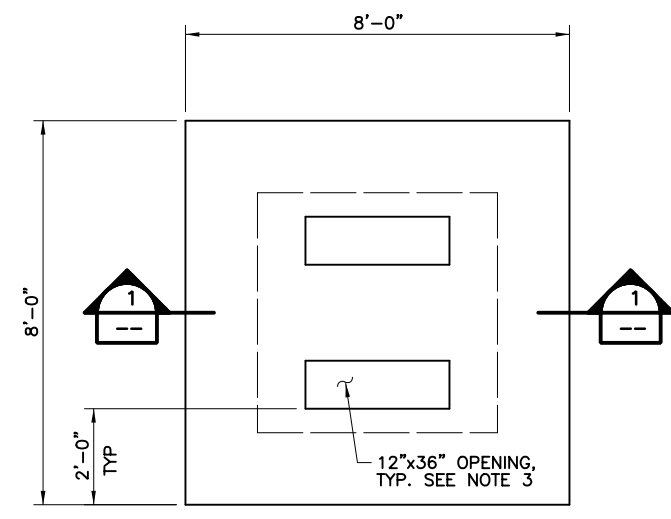
NO.	REVISION	BY	DATE
1	ADDENDUM NO. 5	JW	10/3/16

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VERIFY SCALE

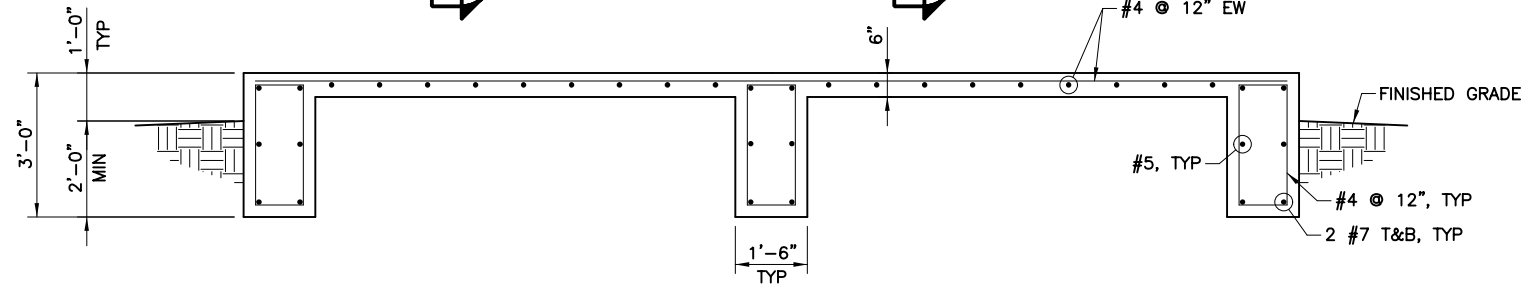
SAN ANTONIO WATER SYSTEM
DOS RIOS WRC ELECTRICAL SYSTEM
IMPROVEMENTS - PHASE 1
MISCELLANEOUS PADS PLAN AND SECTION

Date:	MARCH 2016
Designed:	CJP
Drawn:	GWM
Reviewed:	JPW
CP&Y Proj. No.	SAWS14201



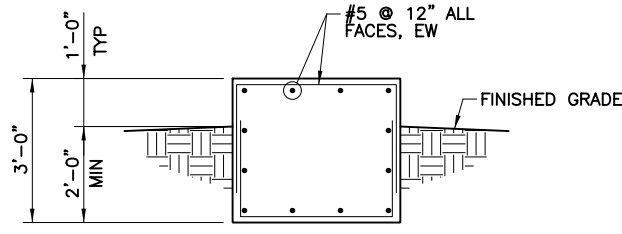
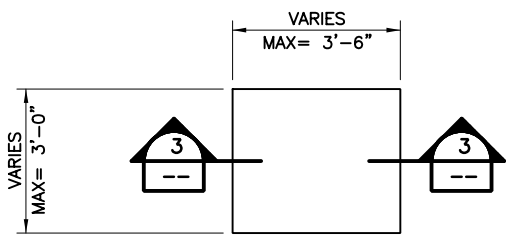
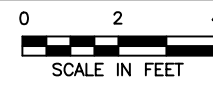
SECTION 1

SECTIONALIZING CABINET PAD



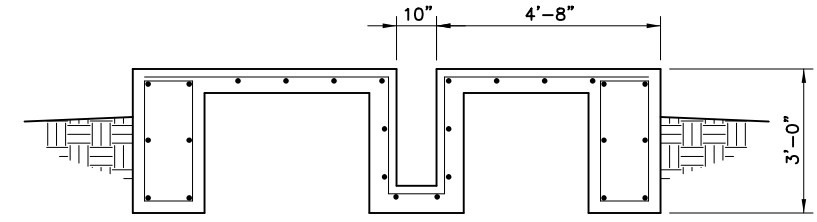
SECTION 2

15KV PAD MOUNTED SWITCH PAD

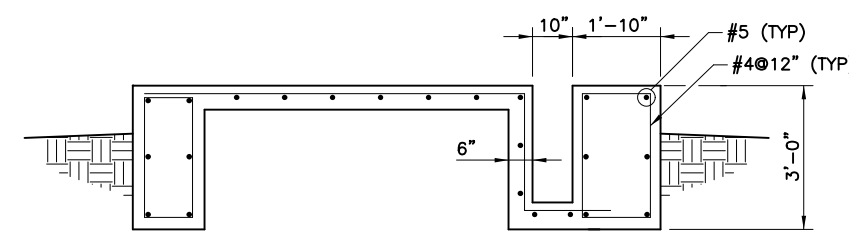


SECTION 3

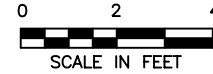
MISC. HVAC PADS



SECTION 4



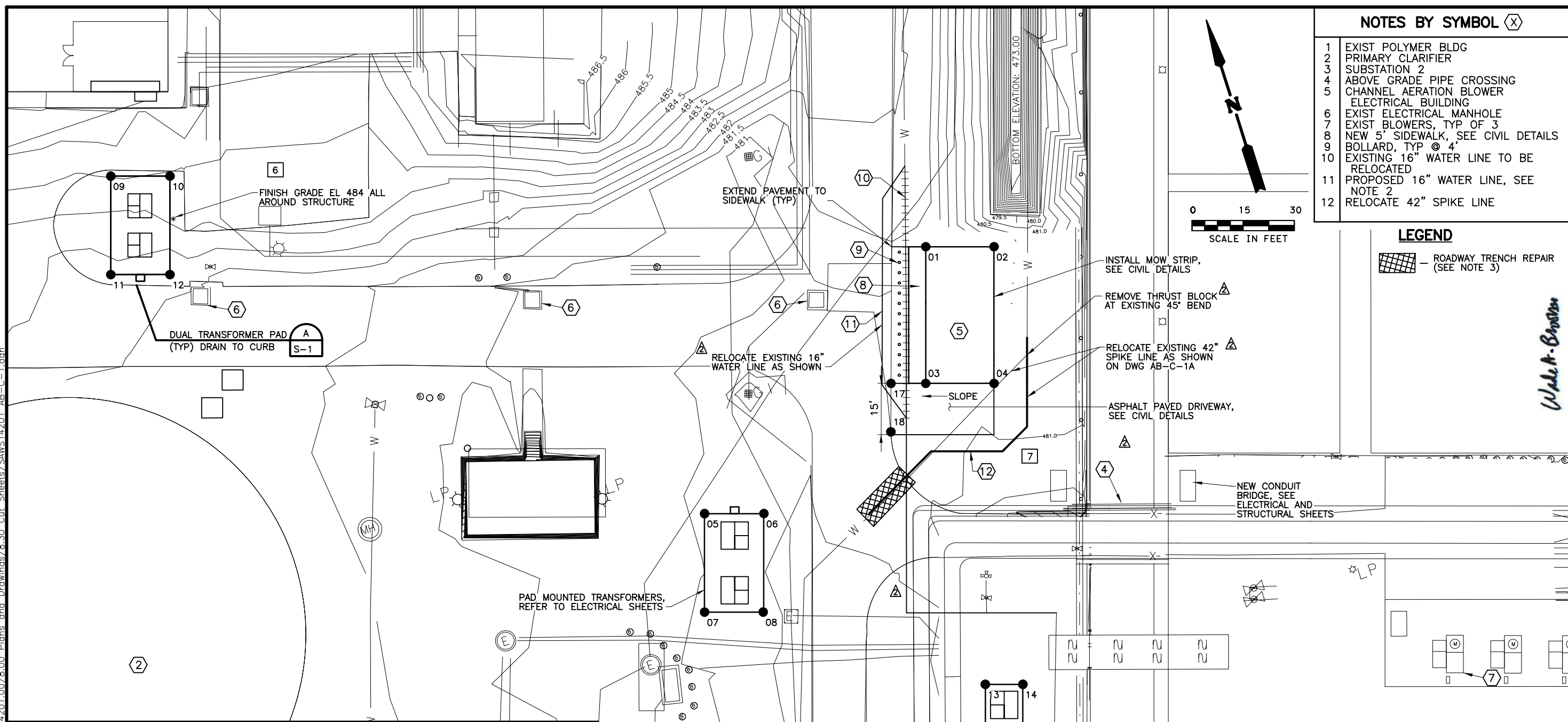
SECTION 5



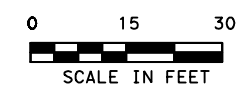
GENERAL NOTES

- COORDINATE WITH CIVIL, HVAC, AND ELECTRICAL SHEETS.
- EXCAVATE MINIMUM 2'-6" BELOW FINISHED GRADE AND REPLACE NATIVE MATERIAL WITH COMPACTED SELECT FILL PER SPECIFICATIONS.
- CONTRACTOR TO VERIFY SIZE & LOCATION OF ALL SLAB PENETRATIONS WITH EQUIPMENT VENDOR BEFORE POURING CONCRETE. PROVIDE ADDITIONAL REINFORCING AS SHOWN OR AS DIRECTED ON SHEET G-11.

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- NOTES BY SYMBOL** (X)
- 1 EXIST POLYMER BLDG
 - 2 PRIMARY CLARIFIER
 - 3 SUBSTATION 2
 - 4 ABOVE GRADE PIPE CROSSING
 - 5 CHANNEL AERATION BLOWER ELECTRICAL BUILDING
 - 6 EXIST ELECTRICAL MANHOLE
 - 7 EXIST BLOWERS, TYP OF 3
 - 8 NEW 5' SIDEWALK, SEE CIVIL DETAILS
 - 9 BOLLARD, TYP @ 4'
 - 10 EXISTING 16" WATER LINE TO BE RELOCATED
 - 11 PROPOSED 16" WATER LINE, SEE NOTE 2
 - 12 RELOCATE 42" SPIKE LINE



- LEGEND**
- ROADWAY TRENCH REPAIR (SEE NOTE 3)

SAWS JOB NO.
14-6504

CP&Y
12500 SAN PEDRO AVE.
SAN ANTONIO, TX 78216
TELE REGISTRATION #E-1741
TBAE REGISTRATION #EBR 2019

WATER SYSTEM
SAN ANTONIO

STATE OF TEXAS
WADE A. BROOKS
LICENSED PROFESSIONAL ENGINEER
NO. 66206

NO.	REVISION	DATE
2	ADDENDUM NO. 5	WB 10/5/16
1	ADDENDUM NO. 4	WB 9/27/16

DATE IS ONE NOT ON ORIGINAL ON THIS SHEET, ADJUST SCALE

VERIFY SCALE

1" = 0'

SAN ANTONIO WATER SYSTEM
DOS RIOS WRC ELECTRICAL SYSTEM
IMPROVEMENTS - PHASE 1
EXISTING & PROPOSED TRANSFORMER AREA
SITE PLAN AND DIMENSIONAL CONTROL

Date:	OCTOBER 2016
Designed:	RLJ
Drawn:	GWM
Reviewed:	TJS
CP&Y Proj. No.	SAWS14201

SHEET
AB-C-1
SHEET 122 OF 166

POINTS

POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	13637184.78	2152759.36	481.50	OUTSIDE CORNER, TOP OF SLAB
2	13637178.73	2152778.42	481.50	OUTSIDE CORNER, TOP OF SLAB
3	13637146.66	2152747.25	481.50	OUTSIDE CORNER, TOP OF SLAB
4	13637140.60	2152766.31	481.50	OUTSIDE CORNER, TOP OF SLAB
5	13637129.95	2152673.97	482.25	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
6	13637124.71	2152690.49	482.25	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
7	13637102.48	2152665.24	482.25	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
8	13637097.23	2152681.75	482.25	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
9	13637276.77	2152538.18	484.75	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
10	13637271.52	2152554.69	484.75	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
11	13637249.29	2152529.44	484.75	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
12	13637244.05	2152545.96	484.75	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
13	13637057.42	2152737.19	481.25	OUTSIDE CORNER, TOP OF SWITCH PAD
14	13637054.09	2152747.68	481.25	OUTSIDE CORNER, TOP OF SWITCH PAD
15	13637036.46	2152730.53	481.25	OUTSIDE CORNER, TOP OF SWITCH PAD
16	13637033.13	2152741.01	481.25	OUTSIDE CORNER, TOP OF SWITCH PAD
17	13637149.74	2152737.56	481.1	EXISTING GRADE
18	13637135.41	2152733.01	481.2	EXISTING GRADE

BENCHMARKS AND BORE DATA (X)

POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
BM6	13637263.58	2152584.83	483.78	BENCHMARK 6
BM7	13637117.08	2152769.75	481.25	BENCHMARK 7

- SHEET NOTES:** (A)
1. PRIOR TO CONSTRUCTION, CONTRACTOR SHALL CONFIRM CLEARANCE OF CONSTRUCTION EQUIPMENT, MATERIALS, AND BUILDING COMPONENTS.
 2. SEE DRAWING AB-C-1A FOR RELOCATION OF 42" SPIKE LINE.
 3. SEE DRAWING AB-C-1A FOR TRENCH REPLACEMENT IN ROAD.
 4. SEE DRAWING AB-C-1A FOR SPIKE LINE DEWATERING DETAILS.

Wade A. Brooks

5 Oct. 2016

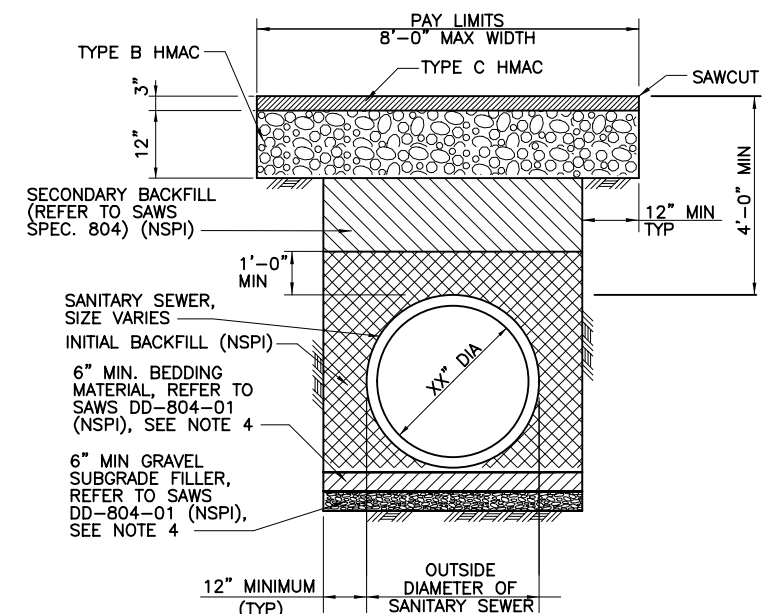
NO.	REVISION	DATE	BY
2	ADDENDUM NO. 5	10/5/16	WB
1	ADDENDUM NO. 4	9/27/16	WB
0	VERIFICATION		

SAN ANTONIO WATER SYSTEM
DOS RIOS WRC ELECTRICAL SYSTEM
IMPROVEMENTS - PHASE 1
EXISTING & PROPOSED TRANSFORMER AREA
SITE PLAN 42" WATERLINE RELOCATION

Date:	OCTOBER 2016
Designed:	WB
Drawn:	DJM
Reviewed:	TJS
CP&Y Proj. No.	SAWS14201

SPIKE LINE NOTES:

1. THE LOCATION, DEPTH AND PIPE JOINT LOCATIONS OF THE EXISTING SPIKE LINE SHOWN ON THE DRAWING ARE APPROXIMATE, BASED ON AVAILABLE INFORMATION, AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE ENGINEER, THE OWNER OR THE OWNER'S REPRESENTATIVE.
2. THE CONTRACTOR SHALL FIELD VERIFY THE LOCATION OF THE EXISTING LINE TO INCLUDE LOCATION OF PIPE JOINTS AT THE TIE-IN POINTS SHOWN ON THE DRAWING PRIOR TO ORDERING ANY MATERIAL. THE CONTRACTOR SHALL NOTIFY THE ENGINEER AND SAWS INSPECTOR OF EXACT PIPE JOINT LOCATIONS AND CLEARLY SHOW EXACT TIE-IN LOCATIONS AND PIPE LENGTHS ON THE PIPE SUBMITTALS/SHOP DRAWINGS.
3. EXISTING PIPE MATERIAL IS PCCP BURIED AT A DEPTH OF APPROXIMATELY 10'-0".
4. THE SPIKE LINE IS ACTIVE. THE CONTRACTOR SHALL CONSTRUCT AS MUCH OF THE LINE AS POSSIBLE AND COORDINATE WITH SAWS ON SHUTDOWN OF THIS LINE DURING TIE-IN.
5. THE CONTRACTOR SHALL MAKE PROVISIONS FOR CAPTURING STATIC WATER IN THE LINE AND DISPOSING OF THIS WATER BACK TO SETTLING BASIN 10.
6. RELOCATED PIPE AND BENDS SHALL BE NEW 42" DIAMETER PCCP PIPE.
7. ALL BENDS AND PIPE JOINTS SHALL BE INSTALLED WITH A JOINT HARNESS ASSEMBLY.
8. NEW PIPE AND PIPE INSTALLATION SHALL BE IN ACCORDANCE WITH SAWS STANDARD SPECIFICATIONS 820 AND 840.
9. CONTRACTOR SHALL REMOVE AND DISPOSE OF OFFSITE THE EXISTING SECTION OF PIPE AS REQUIRED TO MAKE CONNECTIONS AND CONCRETE FILL THE REMAINING PIPE COMPLETELY.
10. CONTRACTOR SHALL BACKFILL THE TRENCH OF THE REMOVED SECTION OF PIPE IN ACCORDANCE WITH SAWS STANDARD SPECIFICATION 804.
11. CONTRACTOR SHALL REMOVE EXISTING THRUST BLOCK AT EXISTING 45 DEG. BEND.

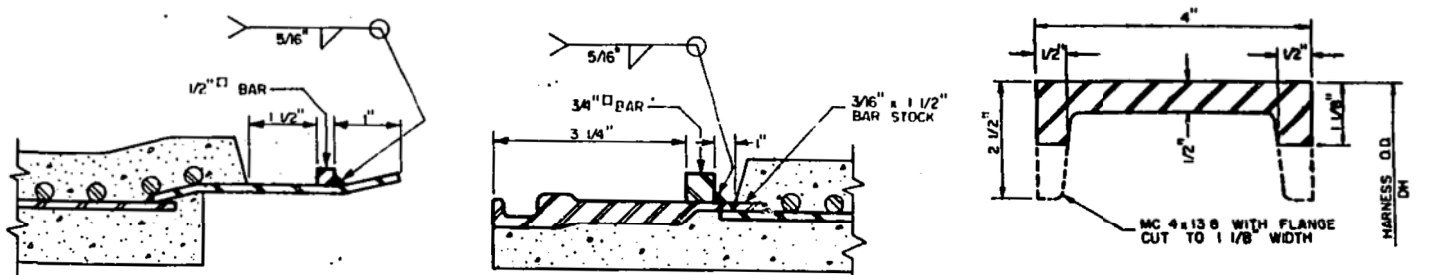
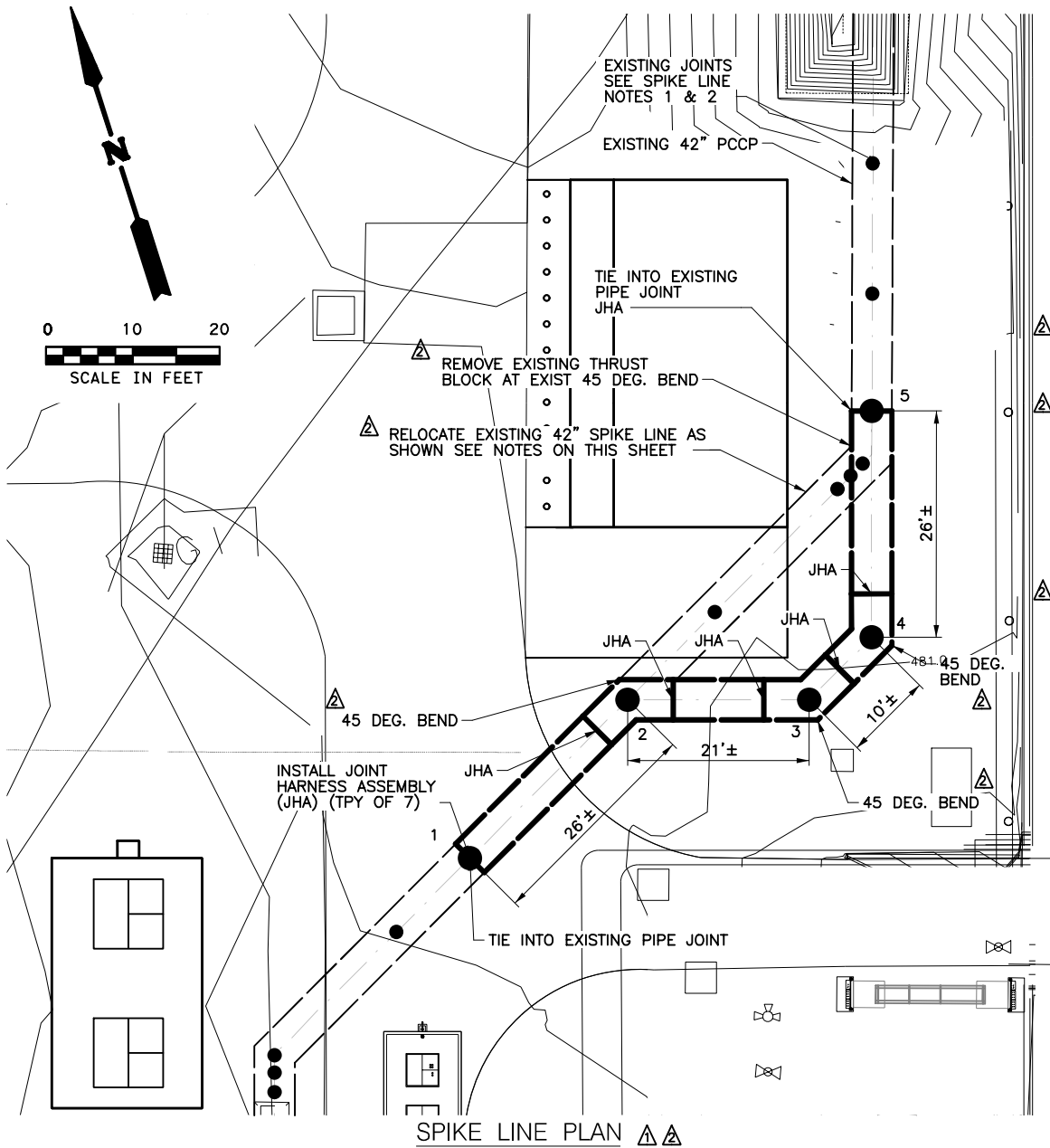


TYPICAL TRENCH REPLACEMENT IN ROAD
NOT TO SCALE

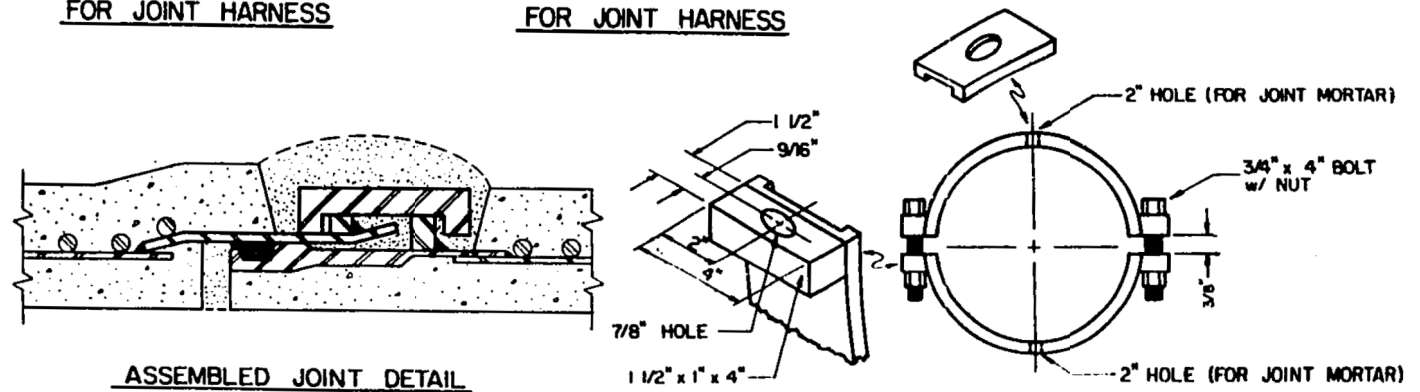
TRENCH REPLACEMENT NOTES:

1. THE EXISTING PAVING SURFACE SHALL BE SAW CUT IN A STRAIGHT LINE A MINIMUM OF 12" WIDER AN UNDISTURBED SIDES OF THE TRENCH SYMMETRICAL ABOUT THE CENTER LINE OF THE EXCAVATION.
2. ANY CONCRETE PAVING SHALL BE SAW CUT 6" WIDER THAN UNDISTURBED SIDES OF EXCAVATION.
3. IF EXCAVATION AREA IS OPEN FOR TEMPORARY PUBLIC USE THE SURFACE SHALL BE MAINTAINED LEVEL WITH ADJACENT RIDING SURFACE WITH COLD MIX AC OR TEMPORARY AC.
4. DEPTH OF GRAVEL SUBGRADE FILLER TO BE DETERMINED IN FIELD BY SAWS FIELD REPRESENTATIVE IN CONDITIONS WHERE BOTTOM IS UNSTABLE.
5. DAMAGED PAVEMENT OUTSIDE THE TRENCH CUT SHALL BE REMOVED AND REPLACED WITH A BASE THICKNESS OF 12" OR A THICKNESS MATCHING EXISTING, WHICHEVER IS GREATER.

POINTS				
POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	13637115.36	2152719.89	UNKNOWN	EXISTING PIPE JOINT
2	13637127.24	2152742.73	UNKNOWN	APPROXIMATE LOCOTN OF 45 DEG. BEND
3	13637120.91	2152762.67	UNKNOWN	APPROXIMATE LOCOTN OF 45 DEG. BEND
4	13637125.58	2152771.71	UNKNOWN	APPROXIMATE LOCOTN OF 45 DEG. BEND
5	13637150.43	2152779.63	UNKNOWN	EXISTING PIPE JOINT



TYPICAL BELL DETAIL FOR JOINT HARNESS
TYPICAL SPIGOT DETAIL FOR JOINT HARNESS



ASSEMBLED JOINT DETAIL w/ JOINT HARNESS

NOTES:
HARNESS JOINT ASSEMBLY HAS BEEN DESIGNED TO PROVIDE 3/4" JOINT FLEXIBILITY.
12" WIDE JOINT WRAPPER REQUIRED FOR EACH HARNESSSED JOINT.

JOINT HARNESS ASSEMBLY
NOT TO SCALE

DEWATERING NOTE:

1. CONTRACTOR SHALL DEWATER SPIKE LINE PRIOR TO DEMOLITION AND RELOCATION.
2. CONTRACTOR SHALL COORDINATE DEWATERING WITH SAWS PERSONNEL.
3. SAWS WILL INSTALL STOP LOG AS SHOWN ON THE DEWATERING DISCHARGE LOCATION PHOTO AND ISOLATE THE SPIKE LINE.
4. CONTRACTOR SHALL FURNISH SUMP PUMP PIPING AND ALL APPURTENANCES REQUIRED TO PUMP DRAINED STATIC WATER FROM THE STOP LOG AREA INTO THE ADJACENT SETTLING BASIN 10.



DEWATERING DISCHARGE LOCATION

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Wade A. Brooks

5 Oct 2016