



**Meghan Pump Station (RFCSP)  
Solicitation Number: CO-00645  
Job No.: 19-1006**

**ADDENDUM 2  
October 17, 2023**

To Respondent of Record:

This addendum, applicable to the work referenced above, is an amendment to the price 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 Respondent Questionnaire.

<b>RESPONSES TO QUESTIONS</b>
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1. There are three(3) Specification Sections (i.e. 16460 – Distribution Dry-Type Transformers, 16461 – Motor Control Center, and 16485 – Enclosed Circuit Breakers) which indicates General Electric or General Electric Co. as an acceptable manufacturer.

REQUEST: I formally request that General Electric (ABB) or GE by ABB be considered an acceptable manufacturer for the Specification Sections: 16460 – Distribution Dry-Type Transformers, 16461 – Motor Control Center, and 16485 – Enclosed Circuit Breakers in lieu of the General Electric or General Electric Co. only. This is due to ABB’s purchase of General Electric – Industrial Solutions division back in July 2018 and to be aligned with the rebranding of these products.

*Response: GE and ABB products may be considered by SAWS during submittal review by the awarded contractor.*

2. The Specification Section 16165 – Disconnect Switches does not have General Electric (ABB) or GE by ABB listed in the manufacturers list.

REQUEST: I formally request that General Electric (ABB) or GE by ABB be considered an acceptable manufacturer for Disconnect Switches.

*Response: GE and ABB products may be considered by SAWS during submittal review by the awarded contractor.*

3. The Specification Section 16441 – Panelboards does not have General Electric (ABB) or GE by ABB listed in the manufacturers list.

REQUEST: I formally request that General Electric (ABB) or GE by ABB be considered an acceptable manufacturer for Panelboards.

*Response: GE and ABB products may be considered by SAWS during submittal review by the awarded contractor.*

4. The Specification Section 16466 – Solid State Reduced Voltage Starter does not have General Electric (ABB) or GE by ABB listed in the manufacturers list.  
REQUEST: I formally request that General Electric (ABB) or GE by ABB be considered an acceptable manufacturer for Solid State Reduced Voltage Starter.

*Response: GE and ABB products may be considered by SAWS during submittal review by the awarded contractor.*

5. The Specification Section 16490 – Enclosed Safety Switches does not have General Electric (ABB) or GE by ABB listed in the manufacturers list.  
REQUEST: I formally request that General Electric (ABB) or GE by ABB be considered an acceptable manufacturer for Enclosed Safety Switches.

*Response: GE and ABB products may be considered by SAWS during submittal review by the awarded contractor.*

6. The Specification Section 16491 – Low Voltage Surge Protection Devices does not have General Electric (ABB) or GE by ABB listed in the manufacturers list.  
REQUEST: I formally request that General Electric (ABB) or GE by ABB be considered an acceptable manufacturer for Low Voltage Surge Protection Devices.

*Response: GE and ABB products may be considered by SAWS during submittal review by the awarded contractor.*

7. **Section 15230 – Vertical Turbine Pumps 1.05.E:** NSF Compliant equipment is not equipped with NSF nameplate. If NSF nameplate is required, this language must be revised to say ‘NSF Certified’.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

8. Table 2.2.A: Reduce efficiency requirement for BP-03-101/201 from 79% to 75%. The smaller units do not have a high efficiency rating.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

9. 9. Table 2.2.A: Revise design flow #2 for BP-03-201 from 47gpm to 417gpm. This is believed to be a typo.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**10. 2.4.A.1.b:**Revise coating description so interior of bowl assembly only is coated with fusion bonded epoxy. Exterior should be coated with NSF epoxy to match rest of pump

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**11. 2.4.A.1.d:**Revise bowl bearings to be lead free C844 bronze.

*Response: C844 bronze contains lead and will not be permitted.*

**12. 2.4.A.6:** Delete this paragraph. These items are not applicable to submerged bowl bearings.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**13. 2.4.B.1:** Remove non-metallic bumpers from requirements. These are not necessary or recommended.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**14. 2.4.B.4:** Remove this sentence. Column pipe should be flanged, not threaded.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**15. 2.4.B.6:** Section states that pump operation is 70-100% of full speed. Pump table says all pumps are constant speed. Plan sheets do not show VFD

*Response: See #1, Changes to the Specifications, in this addendum. The spec has been revised to clarify this discrepancy.*

**16. 2.4.C:** Delete this section. This is duplicate of language from 2.4.B.6-11

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**17. 2.4.D.4:** Delete any reference to VHS motors as this is not applicable to this project.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**18. 2.4.D.5:** Delete this sentence. No sub-base plate is provided, as all of these pumps are installed in pump cans

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**19. 2.4.D.6:** Delete this paragraph. Pumps should be provide with API plan 13 flush system.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**20. 2.4.D.7:** Delete references to sole plate. Pumps are installed in suction barrel.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**21. 2.4.D.8:** Remove this sentence. This is not realistic pressure range for the equipment described in this specification.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**22. 2.4.E.2:** Revise from galvanized pipe to stainless steel tube.

*Response: Stainless steel may be considered during submittal review from the awarded contractor. No revision to the spec was made based on this question.*

**23. 2.4.E.3:** Delete this sentence to avoid confusion. Motors are VSS as specified in motor section.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**24. 2.5.A.6:** Delete. Constant speed motors cannot be started 6 times per hour. Typical is 2 cold or 1 hot start per hour, up to 6 starts total per day.

*Response: With the method of start-up, the motors may be started 6 times per hour in accordance with NEMA standards. No revision to the spec was made based on this question.*

**25. 2.5.B:** Remove this section. Motors in this scope are all under 200HP.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**26. 2.6.C:** Remove hot dip galvanization. Barrels should be coated with NSF certified epoxy, inside and out. Due to how top flange is tack welded at factory, galvanization is not recommended.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

27. 2.6.D: Revise this section. Barrels should have top flange tack welded to barrel at delivery in order to set level in field prior to full seam welding by Contractor.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

28. 2.8: Revise this section to be more clearly defined. Bowl interior to receive fusion bonded epoxy, exterior bowls, interior/exterior columns, interior/exterior discharge head to receive NSF certified epoxy primer.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

29. 3.2.B: Remove reference to sole plate. These are not provided for the equipment specified.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

30. 3.2.E: Remove reference to sole plate. These are not provided for the equipment specified.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

31. 3.2.F: Revise tolerance for plumbness to be 0.015"/ft over entire length of barrel.

*Response: No revision was made. The tolerance for plumbness shall be per the HI standard.*

32. 3.4.M: Delete this sentence. Manufacturer will not accept back charges for potential unsuccessful field testing demonstration.

*Response: See #1, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

33. **Section 16013 – Electric Motors** 2.4.C: Paragraph references PFCCs and a RVSS. Pump spec has references to VFD. Plan sheets show RVSS. Need to clarify how these motors are operated and delete any references to equipment that is not required.

*Response: See #1, Changes to the Specifications, in this addendum. The VFD references have been removed from 15230. PFCCs and RVSSs will be required as indicated in the plans and specifications.*

34. 2.7.B: Delete this sentence. Motors are required to have non-reverse ratchet per 2.9.D.

*Response: See #2, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

35. 2.14: Remove factory pump/motor vibration analysis. Pumps are tested with factory calibrated motor. Motors will not run with the pumps until installed at jobsite. Vibration levels will be per HI requirements only; remove language for tolerance more strict than HI.

*Response: See #2, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

36. **Plan Sheets:** M3: Remove requirement for one-piece galvanized steel pump cans. Pump barrels can be provided with NSF certified epoxy coating. Top flanges need to be welded in field to ensure top flange level tolerance is obtained.

*Response: See #1 & 2, Changes to the Plans, in this addendum. The indicated revision to has been made to Sheets M3 & M4.*

37. M4: Detail Drawing B is inaccurate. Motor is labeled Accessory Item #10 which indicates 125HP unit. The discharge line is 8", which is in conflict with how this unit is shown on M3 and described in pump specification. It is believed this Detail B should be showing Accessory Item #9, and correspond with unit tag BP-03-101.

*Response: See #2, Changes to the Plans, in this addendum. The indicated revision to Sheet M4 has been made.*

38. M4: Detail drawings show a large object that looks like a bowl stage overlaid on pump can profiles. Please remove to avoid confusion.

*Response: See #2, Changes to the Plans, in this addendum. The indicated revision to Sheet M4 has been made.*

39. M4: Suction pipe into cans is shown as plain end. Revise profile to show these as flanged suction inlets.

*Response: The suction line shall be welded steel; therefore, a flanged suction inlet will not be required. No revision to the spec was made based on this question.*

40. M4: Notes refer to SAWS Detail drawings which are not included in bid documents. Please add detail drawings to plan sheets.

*Response: SAWS details are available on the SAWS website at the address below and therefore will not be included in the plan set.*

*[https://apps.saws.org/business\\_center/specs/constspecs/](https://apps.saws.org/business_center/specs/constspecs/)*

41. S3: Show flanged connection to suction barrel on Section S3 drawing. Drawing implies plain end suction pipe with the barrels provided.

*Response: The suction line shall be welded steel; therefore, a flanged suction inlet will not be required. No revision to the spec was made based on this question.*

42. Electrical: Several drawings reference 120-ohm platinum RTDs (one reference to future RTDs). Per spec, motors are not provided with RTDs.

*Response: See #3 & 4, Changes to the Plans, in this addendum. 120 OHM RTD'S are not required for 125 hp motor. See Drawings E14 and E15 for revisions.*

43. Electrical: Several specification sections reference 70-100% operating speed, and also 6 starts per hour. Plan sheets do not show VFD operation, but RVSS. This needs to be clarified and all conflicting language removed.

*Response: See #1, Changes to the Specifications, in this addendum. Reference to 70-100% operating speed have been removed. RVSS is correct.*

44. Reference Spec Section 13300-61.6.E Quality Assurance: The selected PCSS shall be one of the following:

1. PCSS SHALL BE SELECTED BASED ON SAWS RECOMMENDATION.
2. or equal. If not listed, the contractor is required to submit the qualifications submittal for consideration.

Typically, in a SAWS Standard Instrumentation and Controls – General Provision Spec, they have a list of pre-approved PCSSs or PCSIs. Will this project have a list of pre-approved PCSSs?

*Response: See #7, Changes to the Specifications, in this addendum. Specification 13300, Section 1.6. has been revised to include the following approved PCSIs: Prime Controls, Control Panels USA, Richardson Logic Control, Walker Industrial, and Tesco Controls. Approved ASPs shall be Prime Controls, Control Panels USA, Signature Automation, Walker Industrial, and Tesco Controls.*

45. On plan sheet M3 the engineer listed two fire PVC lines as 2 ½” C900 DR 18. There is no such pipe. The smallest C900 is 4” diameter. Please reconsider this connection design and what type of connection to use, such as a welded flange (4”) then reduce off the flange to the proper size for the pipe connection.

*Response: See #1, Changes to the Plans, in this addendum. The indicated revision to Sheet M3 has been made.*

46. In the spec book it lists Special Inspections Support as a bid item, 1130-3. Is that required as it is not on the bid form?

*Response: See #3, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made. Other notable revisions include adding Preparation of Right-of-Way and reordering the bid items to match the bid form.*

47. On page M3 the 16" discharge line has several tees that are called PE (Item 1669). These should have a flange on the tees to connect the valves. Can this be double checked as these will be fabricated in the shop with flange connections? Otherwise it may require welding in the field if not addressed.

*Response: The flange on the tee is on the portion of the tee on the individual pump discharge lines that will connect to the valves. The plain end portion of the tee are on the two sides on the discharge header. The plans identify the tees as plain end by flanged joint.*

48. On page M3 the 16" discharge has a reducer that goes from 16" to 8". Can this be a simple 16"x8" tee with the 8" being a flange and have the reducer removed all together?

*Response: No, the 12"x8" reducer will be required.*

49. On sheet M5-HPT 1 End View it shows 3/4" HPDE tubing being used for air. This should be specifically called out as PE100 for compressed air. The drawings call for this to have a max pressure rating of 250 psi. Can it please be verified that this is what is desired and can a specification be added for the HDPE 100 air pipe?

*Response: 3/4" HDPE flexible air supply tubing for underground/outdoor use rated for a maximum of 250 psi shall be used for the air line per the HPT 1 End View on Sheet M5. PE100 can be reviewed during submittal review with the awarded contractor to determine whether it meets these requirements.*

50. Specification section 15240-2.4.H.2 states "All interior or exterior fill lines are to be supported from wall as shown on the drawings.". Please confirm that the Inlet riser may be encased in concrete. In order to satisfy the air gap requirement the Inlet may be moved to far inside the tank to safely use standard bracing to the wall.

*Response: Confirmed, the inlet riser may be encased in concrete. See #4, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

51. Please remove the handrail call out for Inlets and Outlets per specification section 15240-2.4.J.1. The Inlet is a riser that should not require any handrails and the outlet does not have a SAWS Standard Detail that can be found.

*Response: See #4, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*



**52.** Please confirm the material type for the exterior handrails for the dome hatches.

*Response: The material type for the exterior handrails shall be aluminum.*

**53.** Specification section 15240-3.3.E.3 states “All concrete testing shall be in accordance with ASTM C-31 and C-39, at the expense of the Contractor or Owner and shall be conducted by an independent testing agency approved by the Engineer.” Please confirm if it is the Owner or Contractor.

*Response: All testing shall be at the expense of the Contractor. See #4, Changes to the Specifications, in this addendum. The indicated revision to the spec has been made.*

**54.** Are there any domestic steel requirements for this project?

*Response: No, there are not.*

**55.** Please confirm if Type IL-ASTM C 595 would be an acceptable alternative to Type I/II cement [Section 15240-2.3.A.1]. Some suppliers in the area have notified us that they do not carry Type I/II cement and only carry Type IL-ASTM C 595 cement?

*Response: Type IL-ASTM C 595 cement will be acceptable.*

**56.** Per note 11 of plan sheet C3 states “...shall be located above the ground water table...” however, specification section 15240-2.2.D states “The slab shall be designed to resist uplift with the condition of standing water at finished grade elevation with the tank empty. The tank floor shall also be designed to resist uplift during construction activities.” Please confirm the tank sits above the flood elevation and even so, the tank is to be designed to resist a flood elevation of 1.5’ above FFE.

*Response: Confirmed, the tank sits above the flood elevation. Per Sheet C3, the finished grade elevation around the tank shall be 1437.50’, and the finished floor elevation shall be 1436.00’. Therefore, the spec requirement to be designed for uplift with the condition of standing water at finished grade is equivalent to the proposed condition of elevation of 1.5’ above FFE. No revision to the spec was made based on this question.*

**57.** Please confirm if a perimeter drain around the tank is required.

*Response: Confirmed, the perimeter drain is required as shown on SAWS Detail DD-904-01.*

**58.** On sheet E12, Note 15, the last sentence states the secondary service from CPS Transformer to the Main Disconnect conductors are to be provided by SAWS. Does that apply to ALL 3-#400MCM, 1-#3/0 NEU, 1-#3/0 G circuits? Conduit #'s 5 - 16 are same type of cabling as # 1 – 4. Please review and clarify the intention.

*Response: Conductors shall be provided by the contractor and installed per CPS Energy and SAWS requirements. See #5, Changes to the Plans, in this addendum. The indicated revision to the has been made. Note 15 on Sheet E12 has been modified.*

- 59.** On sheet E9 is conduit #42A combining conduits #38 through #42? It does not add up.

*Response: Conduit #42A (3") shall include 62-#14 + 21-#12 GND + 11 Pr. #18 STP routed between Autosensory Panel and PB-2. Conduit #97 (2") shall be a spare conduit routed from Autosensory Panel to PB-2. See #6 & 7, Changes to the Plans, in this addendum. The indicated revision to the plans have been made. Conduit Schedule (E9 & E10) have been updated.*

- 60.** The discharge header pressure transmitter PIT 03001 shown on M5 and I4 is not listed on the conduit schedule nor does E8 show the discharge header pressure transmitter & associated cabling back to the Autosensory panel. Please review and revise.

*Response: See #7 & 8, Changes to the Plans, in this addendum. The indicated revision to the plans has been made. Circuit for discharge header pressure transmitter has been added to plans (E8) and conduit schedule (E10).*

- 61.** The booster pump inlet PSL03-101 through 501 circuits are not shown on the conduit schedule, nor are they shown on E8. Can this be clarified?

*Response: See #6 & 7, Changes to the Plans, in this addendum. The indicated revision to the plans has been made. Circuits for Inlet Low Pressure Switch have been added to plans (E8) and conduit schedule (E10).*

- 62.** The description for conduit #97 shows both control and instrument circuits from booster pump station to be in the same conduit, but it only lists 15-#18STP,#12G. Is it the intention for the control circuits to be routed in individual conduit from PB-2 to the Autosensory panel? If so, it is missing from the conduit schedule, along with circuits from the Booster Pump Inlet low pressure cutoff switches listed above. Also, it seems Conduit #97 should be incorporated into DB E conduit #42A, which would be 11-#18STP, not 15 for analog circuits from the Booster Pump Station. Please review and revise.

*Response: See #6, 7, and 8, Changes to the Plans, in this addendum. The indicated revision to the plans has been made. Conduit #97 (2") shall be a spare conduit routed from Autosensory Panel to PB-2. Conduit #42A (3") shall include 62-#14 + 21-#12 GND + 11 Pr. #18 STP routed between Autosensory Panel and PB-2. The intent is to route one conduit with all necessary wires and cables to PB-2 then distribute. Plans (E8) and Conduit Schedule (E9 & E10) have been updated.*

- 63.** The conduit/circuit from the auto sensory panel to the MCC/SCP selector switch control shown on E15 does not show up on the plan drawings or on the conduit schedule. Please review and advise.

*Response: See #7 & 9, Changes to the Plans, in this addendum. The indicated revision to the plans has been made. Circuit for MCC/SCP Selector Switch has been added to Plans (E3) and Conduit Schedule (E10).*

**64.** Is it the intention to include generator E-stop conduits to the conduit schedule?

*Response: See #6, Changes to the Plans, in this addendum. The indicated revision to the plans has been made. Circuit for Generator E-stop has been added to Conduit Schedule (E9).*

**65.** Specification Section 16000 1.06 B.3 contradicts section 16000 1.06 C 2 in regard to the responsible party for the Primary side of the incoming service conductors. CPS – Electric Service Standards (2021 edition) section 1305.3 states "Customer shall furnish and install primary voltage ductline (line-side) and transformer slab in accordance with CPS Energy specifications. Where transformer supplies CPS Energy primary metering cabinet, Customer shall be responsible for furnishing and installing load-side conduits, and primary metering cabinet slabs. CPS Energy will furnish, install, and terminate primary voltage cables between step-down transformer and primary metering cabinet." Please review and confirm CPS Standards are to apply to this project.

*Response: See #6, Changes to the Specifications, in this addendum. CPS standards apply for this project and shall be adhered to. Specification 16000, Section 1.06.C.2 has been revised to read the following: Furnishing and installing the primary conduit and coordination with power company to ensure installation of primary cables.*

**66.** Is the Elastomeric Polyurethane coating for interior metal surfaces also applicable for the interior of the welded steel pipe?

*Response: The interior of welded steel pipe shall be coated with cement mortar liner in accordance with SAWS Specification 816.*

**67.** What is the intent on welded steel pipe connections in relation to the interior pipe coatings? With the length of pipe runs and small diameters, there is no way to repair the interior coatings after a field weld has been made.

*Response: Welded steel pipe shall be installed per SAWS Specification 816.5 Subsections 23.e. and 23.f. The interior surfaces of all steel piping, fittings, and specials shall be cleaned by sandblasting and then primed and coated with a cement mortar lining. Cement mortar lined and coated steel pipe shall be used for 4-inch and larger pipe.*

**68.** Can structural drawings for the transformer foundation and SCADA antenna foundation be provided?

*Response: See #10, Changes to the Plans, in this addendum. The transformer foundation call out has been revised to clarify that it shall be constructed per SAWS standard details. See Sheet E25 for information on the SCADA antenna foundation.*

69. Motor Specification Section 16013 2.04 C calls to provide the booster pump Power Factor Correction Capacitors as required to conform to motor manufactures requirements to correct motors power factor to .95 without overexciting the motor. It is to be installed withing 10 circuit feet from the solid state reduced voltage motor starter; In Vertical Turbine Pump Spec Section 15230 it does not mention power factor capacitors in the motor specifications in this section.

*Response: See #1, Changes to the Specifications, in this addendum. PFCC are required and shall be installed as indicated in plans. Specification 15230, Section 2.5.A was modified to include the following: Provide power factor capacitor as required to conform to motor manufacturer requirement to correct the motor's power factor to 0.95 without overexciting the motor. Power factor to be installed a minimum of 10 circuit feet from the solid state reduced voltage motor starter.*

70. Note 13 on Sheet E12 states “Provide and Install Power Factor Correction Capacitor as provided by motor Manufacture as stated for the basis of bid. Mount Capacitors to top of Motor Control Center. Provide 30 circuit feet of wire from MCC Base.” Power Factor Correction Capacitors are typically mounted in the MCC and provided by the gear supplier, but it appears the intent is to have these provided by the motor manufacture and mounted in a separate enclosure above the MCC. Is it acceptable to have the gear supplier include this and have it located inside the MCC?

*Response: PFCC inside the MCC is not acceptable. PFCC may be provided by either motor manufacturer or gear supplier as long as they conform to the motor manufacturer requirements and they shall be mounted in separate enclosure above the MCC as stated in Sheet E12, Note 13.*

71. The retaining wall detail on C5 appears to be a cast in place wall with fence post cast into the wall, this would not be possible with a solid concrete block wall as assumed with TXDOT standard. Please advise. If it is to be made of block, what kind of concrete block is the retaining wall to be made out of? The drawings and TxDOT references do not clarify.

*Response: Retaining wall shall be a concrete block retaining wall conforming to TxDOT detail RW(CB) “CONCRETE BLOCK RETAINING WALL”. Acceptable concrete block retaining wall systems are those listed as unrestricted status on TxDOT website (<https://www.txdot.gov/business/resources/highway/bridge/approved-systems/concrete-block-retaining-wall.html>)*

72. General Condition 5.3.1 is requiring that “All test reports and shop drawings shall be signed and sealed by a Texas Registered Professional Engineer” - this is out of the norm from what we see on other SAWS projects and other municipalities. Please confirm this is needed on all geotesting reports submitted.

*Response: This signature and seal will be required as outlined in General Condition 5.3.1.*

73. The drawings and spec section 15201 call for fiberglass vents and louvers on the building, while the specs call for aluminum, please specify what is desired.

*Response: Aluminum vents and louvers are required in the air compressor room as shown. Fiberglass vents and louvers are required on the chemical storage room as shown.*

74. The drawings call for 2 Bard Heating/AC units, but spec section 15201 calls for 1. Please advise.

*Response: See #5, Changes to the Specifications, in this addendum. The spec has been revised to match the plans.*

75. There are two minor structural details/sheets that need to be added. One is the transformer pad with a containment pit. It references “see details on sheets S6 & S7” but those are not provided. Also, there are no structural details for the storage tank drainage structure.

*Response: See #10, Changes to the Plans, in this addendum. The call out referencing S6 & S7 has been removed from sheet E2.*

76. Specification 01130 1.05, Basis of Payment does not have a description of Preparation of ROW. The bid items don’t match the bid item numbers and the allowance for foundation subgrade does not match what is stated in the bid form. Please correct/confirm.

*Response: Please reference SAWS Specification 101 for the preparation of ROW. See #3, Changes to the Specifications, in this addendum. The allowance for foundation subgrade has been revised to match what is shown on the bid form.*

## CHANGES TO THE SPECIFICATIONS

1. Remove 15230 in its entirety and replace with the version attached to this addendum.
2. Remove 16013 in its entirety and replace with the version attached to this addendum.
3. Remove 01130 in its entirety and replace with the version attached to this addendum.
4. Remove 15240 in its entirety and replace with the version attached to this addendum.
5. Remove 15201 in its entirety and replace with the version attached to this addendum.
6. Remove 16000 in its entirety and replace with the version attached to this addendum.
7. Remove 13300 in its entirety and replace with the version attached to this addendum.

## CHANGES TO THE PLANS

1. Remove Sheet 21 (M3) in its entirety and replace with the version attached to this addendum.
2. Remove Sheet 22 (M4) in its entirety and replace with the version attached to this addendum.
3. Remove Sheet 48 (E14) in its entirety and replace with the version attached to this addendum.

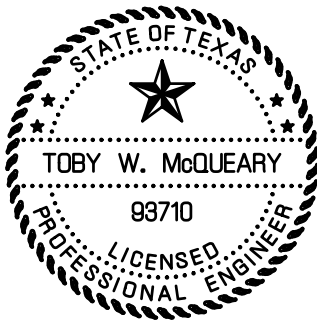
4. Remove Sheet 49 (E15) in its entirety and replace with the version attached to this addendum.
5. Remove Sheet 46 (E12) in its entirety and replace with the version attached to this addendum.
6. Remove Sheet 43 (E9) in its entirety and replace with the version attached to this addendum.
7. Remove Sheet 44 (E10) in its entirety and replace with the version attached to this addendum.
8. Remove Sheet 42 (E8) in its entirety and replace with the version attached to this addendum.
9. Remove Sheet 37 (E3) in its entirety and replace with the version attached to this addendum.
10. Remove Sheet 36 (E2) in its entirety and replace with the version attached to this addendum.

**END OF ADDENDUM 1**

This Addendum is one hundred two (102) pages in its entirety including the attachments.

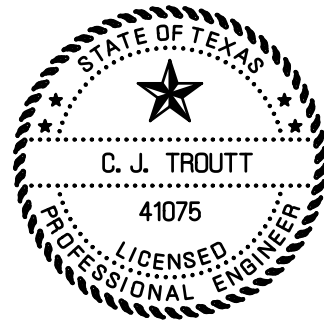
**Attachments**

- Specifications 15230, 16013, 01130, 15240, 15201, 16000, and 13300 (78 pages)
- Sheets M3, M4, E14, E15, E12, E9, E10, E8, E3, and E2 (10 pages)



A handwritten signature in blue ink, appearing to read "Toby W. McQueary".

10-17-2023



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10/17/2023

**SECTION 15230  
VERTICAL TURBINE PUMPS**

**PART 1.0 – GENERAL**

**1.1 SCOPE**

- A. Provide all labor, materials, and equipment as shown and specified to furnish and install vertical turbine pumps, electric motors, pump columns, shafts, bases, bearings, suction barrels, and all appurtenances, complete in place, and operable.

**1.2 RELATED SECTIONS**

- A. All sections of the Contract Documents and technical specifications are related sections. Failure to review Contract Documents and technical specifications does not relieve the Contractor supplier or manufacturer of complying with the requirements herein.

**1.3 REFERENCES**

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
1. American National Standards Institute (ANSI)
  2. American Society for Testing and Materials (ASTM)
  3. Anti-Friction Bearing Manufacturers Association (AFBMA)
  4. Hydraulic Institute (HI)
  5. Institute of Electrical and Electronic Engineers (IEEE)
  6. National Electric Code (NEC)
  7. National Electrical Manufacturers Association (NEMA)
  8. Steel Structures Painting Council (SSPC)
  9. American Water Works Association (AWWA)
  10. National Sanitation Foundation (NSF)

**1.4 SUBMITTALS**

- A. Provide submittal data, manuals and drawings as specified in Section 01340, Shop Drawings.
- B. Pump Data
1. Certified pump curves shall identify shut-off head, duty point, and range at which the pump operates without vibration and cavitation. For pumps that are to be operated by variable speed units, provide a minimum of five curves with at least three different speeds between the maximum and minimum RPM of the pump.
  2. Certified pump curves shall identify the torque versus speed requirements for the pump and motor.
  3. Net positive suction head (NPSH) requirements
  4. Brake horsepower
  5. Pump inertia
  6. Pump thrust
  7. Pump efficiency and pump speed

8. Materials used in fabrication of all pump components including dimensions, weights, coating requirements, and cross sectional views
9. Factory performance test results and certifications
10. Performance test results with permanent pump installed and vibration analysis
11. Names and addresses of the nearest factory authorized service organization
12. Elevation drawings noting sizes, depths, lengths, and dimensions; foundation and anchoring details; total weight of pump unit including pump, column, head, and motor
13. Factory non-witness test requiring Engineer approval prior to shipment
14. Minimum submergence requirements
15. Manufacturer's specification
16. Engineering data
17. Minimum submergence required over suction bell
18. Impeller diameter
19. Diameter of pump can and suction can design
20. Critical Speed
21. L-10 bearing life calculations for radial thrust bearings at pressure heads and flow rates shown
22. Parts diagram
23. Bill of Materials furnished

C. Motor Data

1. Horsepower
2. Electrical characteristics
3. Bearing life ratings
4. Insulation ratings
5. Weight
6. Thrust Bearing
7. Wiring Diagram
8. Space Heaters
9. Dimensions

D. Instruction Books

1. Service and maintenance manual
2. Service parts list
3. Outline drawing

E. Manufacturer's Certifications

1. Submit manufacturer's certification that Contract Documents have been examined by the manufacturer for proposed electrical, mechanical, and structural systems affecting performance of the pumping equipment, and that the equipment will thoroughly and efficiently meet the specified performance requirements.
2. Submit manufacturer's certification that the maximum power requirement, if used, shall not exceed the motor rating under operating conditions on the pump characteristic curve.
3. Submit seal manufacturer's certification that the seal is designed for service and application specified and is installed and aligned properly.



**1.5 QUALITY ASSURANCE**

- A. Pumping units shall be specifically designed for heavy duty, continuous use, and municipal/industrial grade. Irrigation or agricultural grade units are not allowable. Use new materials of high grade, and with properties best suited to the work required.
- B. Pumping units and motors shall be the product of manufacturers with at least 10 years of successful experience in the design, manufacturing and application of pumping units of the type, size and performance capabilities as specified. The pump manufacturer shall have at least three similar size pumps of the model, type, and size of pump in service and operational for at least five years. Manufacturers shall provide a list of references for those pumps.
- C. All components of the pump shall be supplied, assembled, and warranted by one of the approved pump manufacturers. Pump components shall not be acquired from separate entities and assembled as a final product by a manufacturer's representative. All pumps shall be supplied by the same manufacturer.
- D. Pumps, as an assembled unit, shall be compliant to NSF/ANSI Standard 61 and meet the requirements of the US Safe Drinking Water Act.
- E. Pumps shall include a nameplate displaying NSF-G certified.
- F. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of Work.
- G. Store material to permit easy access for inspection and identification. Keep all materials off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. Store and maintain equipment in accordance with manufacturer's direction.
- H. Factory Tests
  - 1. Pump Test
    - a. The pump manufacturer shall perform a non-witness factory performance test of the entire pump assembly to demonstrate compliance with the specifications and to verify guaranteed performance of the pump. A calibrated factory driver may be used in lieu of the job driver.
    - b. The factory test shall include the actual flow, total dynamic head, pump horsepower, and pump efficiency for all the duty points listed.
    - c. Tests shall be sufficient to determine the curves of head, input horsepower, and efficiency relative to capacity from shutoff to 150% of design flow.
    - d. Test pump and recirculate water for at least one hour under simulated service conditions.
    - e. The test shall also check for excessive vibration and leaks in all piping and seals.
    - f. A minimum of six points, including shutoff, shall be taken for each test. At least one point of the six shall be taken as near as possible to each specified condition.
  - 2. The Contractor shall submit the factory test results and certification to the Owner and Engineer for approval before the pump is released for shipment.

- I. In-Place Test
  - 1. Perform a complete pump test including flow rates, motor amperage, and all other information normally checked on a maintenance- type pump test on an existing booster pump. Run the pump test at:
    - a. 100 psi discharge
    - b. 122 psi discharge
    - c. 128 psi discharge

**1.6 OPERATION AND MAINTENANCE DATA**

- A. The manuals shall be prepared specifically for this installation and shall include all required cut sheets, drawings, equipment lists, descriptions, etc. In addition to the requirements of Section 01340, Shop Drawings, the manuals shall include the following at a minimum:
  - 1. Complete column assembly, pumping equipment, suction can, discharge head, oiler, parts list, test reports, maintenance data and schedules, spare parts information, and cross-referenced to exploded view of assembly drawings
  - 2. Dimensional drawings for all provided components with their respective weights

**PART 2.0 – PRODUCTS**

**2.1 GENERAL**

- A. Provide vertical, multistage, turbine pumps complete with pump bowl, electric motor, column assembly, discharge head, bearings, and all accessories and appurtenances necessary to provide a complete operating pumping system. Select pump and motor combination on overall efficiency. Pump and all components shall conform to AWWA, ANSI B58. 1-1961 "American Standard for Vertical Turbine Pumps" and the Hydraulic Institute Standards for Centrifugal Pumps.

**2.2 PERFORMANCE**

- A. When operating at the maximum output speed of the motor, under load and including slip (at 60Hz), the pumping units shall meet all minimum conditions listed in the table below. Pump capacity, head and efficiency defined in the data corresponding to Design Point One shall be the “guaranty point”.

VERTICAL TURBINE PUMPS

Design Conditions	Units	BP-03-301, 401, 501	BP-03-101	BP-03-201
Location	N/A	Booster Pump Station	Booster Pump Station	Booster Pump Station
Number of Pumps Required	Ea	3	1	1
Liquid Being Pumped	N/A	Treated Potable Water	Treated Potable Water	Treated Potable Water
pH	N/A	6.8 to 8.0	6.8 to 8.0	6.8 to 8.0
Maximum Free Chlorine	mg/L	4	4	4
Maximum Chlorides	mg/L	250	250	250
Temperature	°F	32 to 105	32 to 105	32 to 105
Specific Gravity	N/A	1	1	1
Variable or Constant Speed	N/A	Constant	Constant	Constant
Maximum Motor Size	HP	125	50	50
Maximum Pump Operating Speed	RPM	1800	1800	1800
Pump Bowl Max. Diameter	Inch	12	10	10
Discharge Flange Diameter	inch	12	6	6
Shaft Bearing Lubrication	N/A	Pumped Liquid	Pumped Liquid	Pumped Liquid
Type of Impeller	N/A	Enclosed	Enclosed	Enclosed
Type of Shaft	N/A	Open	Open	Open
Minimum Shaft Diameter	inch	1 1/2	1 1/4	1 1/4
Number of Suction Barrels	Ea	3	1	1
Minimum Suction Barrel Diameter	inch	18	18	12
Shut Off Head	ft	482	329	329
Max NPSHr	ft	15	20	20
<b>Duty Point No. 1</b>				
Design Flow (1 <sup>st</sup> Design Point)	gpm	1,050	300	300
Total Dynamic Head (1 <sup>st</sup> Design Point)	ft	300	300	300
Minimum Bowl Efficiency (1 <sup>st</sup> Design Point)	%	80	75	75
<b>Duty Point No. 2</b>				
Design Flow (2 <sup>nd</sup> Design Point)	gpm	1,277	417	417
Total Dynamic Head (2 <sup>nd</sup> Design Point)	ft	231	231	231
Minimum Bowl Efficiency (2 <sup>nd</sup> Design Point)	%	76	74	74

- B. The pump shall have a Capacity vs Head curve with an increasingly rising slope steeper or equal to the slope of the line between the two duty points.
- C. Select equipment which is designed and built for continuous service at all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.
- D. Select a pump and impeller that meets the performance requirements using an impeller that is at least one size smaller than the largest impeller size that can be furnished with that pump size.

### 2.3 ACCEPTABLE MANUFACTURERS

- A. The following is a list of acceptable manufacturers for BP-03-101 & 201.
1. Fairbanks Morse/Pentair
  2. Flowserve
  3. ITT Goulds
  4. Peerless
- B. The following is a list of acceptable manufacturers for BP-03-301, 401, & 501.
1. Fairbanks Morse/Pentair
  2. Flowserve
  3. ITT Goulds
  4. Peerless
- C. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

### 2.4 PUMP COMPONENTS

- A. Pump Bowl Assembly
1. Provide pump bowls fabricated of fine grained, high tensile strength iron, ASTM A 48, Class 30 or better, with smooth surfaces devoid of blow holes and other irregularities. Use clean, sound casting without defect. Do not plug, weld or otherwise repair defects.
    - a. The pump bowl assembly shall be designed for use with a water lubricated enclosed bearing column.
    - b. Pump interior to be lined/coated with an NSF approved fusion bonded epoxy.
    - c. Pump bowl wear rings shall be constructed of 400 series stainless steel.
    - d. Pump bowl bearings shall be constructed of nickel-aluminum-bronze, ASTM B505.
    - e. The bowls shall be hydrostatically tested at 1.5 times the pressure produced at shut-off head.
    - f. The bowls shall be smooth and free of sharp projections and be connected by flanged and bolted construction. Bowl shall be porcelain enameled on the bowl interior or epoxy-lined.
  2. Install impellers of the enclosed type.
    - a. Impeller shall be enclosed type constructed of nickel-aluminum-bronze.
    - b. The impellers shall be machined and finished smooth to insure proper performance. They are to be balanced prior to assembly.
    - c. They shall be securely fastened to the shaft with SS Type 416 tapered lock collets, threaded lock collets or double keys.
    - d. The impellers shall be adjustable vertically by external means at the driver location.
    - e. Wear rings shall be 400 series SS. Impeller wear rings shall be a minimum of 50 BHN different than the bowl 400 series SS wear rings.
    - f. Pump shaft shall be constructed of SS Type 416 HT material. It shall be supported by nickel-aluminum-bronze bearings above and below each impeller.
  3. Employ a bronze suction case bearing, packed with insoluble grease, and protected against entry of sand or other abrasives.

4. Provide sufficient lateral in the pump bowls to allow operation at shutoff head.
5. Provide bearing support for shaft above and below each impeller.

B. Column

1. Column pipe shall be coated and lined with fusion-bonded epoxy, white in color, certified to NSF/ANSI 61.
2. Column pipe in sizes 4-inch through 12-inch diameter shall be interchangeable sections not over 10 feet in length, and shall be connected with threaded, sleeve-type couplings or flanged. Column pipe 14-inch diameter and larger shall be flanged and furnished in interchangeable sections not over 10 feet in length.
3. All shaft joints shall be designed so that they will not loosen during forward or reverse rotation of the shaft.
4. Shaft diameter shall be sized to meet that required for the nameplate horsepower rating and to prevent distortion and vibration over the continuous operating range. The size of the shaft shall be no less than determined by the applicable ANSI/AWWA standards and shall be such that elongation due to hydraulic thrust will not exceed the actual clearance of the impellers in the pump bowls.
5. Column pipe shaft bearings shall be compatible with the operating conditions and fluid properties provided.
6. The line shafts shall be of SS Type 416, turned and ground.
7. SS line shaft couplings with a safety factor of 1.5 times the shaft safety factor shall join the line shafts. These threaded couplings shall have left-hand threads to tighten during pump operation.
8. The shaft joints shall be torqued with supplier provided torque wrenches tightened to accomplish a completed butt joint.
9. Shaft thread compound shall be tested, verified, and provided by the installer with documented and Owner approved application procedures.

C. Discharge Head

1. The discharge head shall be of fabricated steel of the proper configuration and construction for the application including to support the pumping unit and motor.
2. Fabricated steel discharge heads should have 300-lb ANSI discharge nozzle flanges.
3. The top of the discharge head shall have a registered fit for mounting driving motor.
4. The head shaft shall be 416SS and shall be turned and ground. The head shaft or top shaft shall not exceed 10 feet in length. The pump manufacturer shall include a method of adjusting the pump impellers at the top of the head shaft. This shall be through an adjustable flanged coupling between the motor shaft and the pump top shaft. This method shall provide a positive locking device.
5. The discharge head shall be configured with openings for maintenance.
6. Pump discharge head shall be equipped with lifting lugs.

D. Seal Arrangement

1. Provide a balanced single cartridge mechanical seal with a vent and flush port on gland, floating seal rings and a static O-ring. The adjusting studs and nuts shall be stainless steel for the mechanical seal housing. The materials shall be 316 stainless steel for all metal components,

- graphite-loaded sintered silicon carbide for the rotating seal ring, sintered silicon carbide for the stationary seal ring, hastelloy C-276 for the spring, and Viton or Fluoroelastomer for the O-ring.
2. Provide ¾-inch diameter galvanized pipe from pump head to a point along the ground to carry any water that leaks past the seal to the ground away from the pumps.

## 2.5 ELECTRIC MOTOR

### A. Pump Motor Characteristics

1. NEMA Design B squirrel-cage, induction, shell type design, housed in a TEFC enclosure, inverter duty, suitable for 460V, 3 phase, 60 HZ.
2. The motor shall be designed for an ambient temperature of 40°C. Stator winding and stator leads insulated with moisture resistant inverter duty insulation which will resist a temperature of at least 356°F. The magnet wire shall be specially made for inverter duty and the end turns and phase-to-phase insulation shall be increased. Motors not used in conjunction with VFDs may use class F non-hygroscopic insulation.
3. The motor shall be a premium efficiency model with a full load. The rotor and stator shall be built of low loss steel, and the thrust bearings shall be shielded against non-sinewave power if VFDs are used.
4. The rotor and stator shall be built of low loss steel.
5. The motor shall have a refined balance and stress relieved rotor assembly.
6. Designed for continuous duty, capable of sustaining a minimum of 6 starts per hour, evenly spaced. The motor shall meet or exceed the requirements of NEMA MG1 Table 12.
7. Capable of operating at liquid temperature of 104°F in conformance with Factory Mutual requirements without overheating or operating in the service factor.
8. Non-overloading over the entire range of the pump operating curve within the nameplate horsepower.
9. The motor shall include properly sized space heaters. Provide a conduit box for the power leads.
10. Size the motor to be non-overloading at the any point on the characteristic curve of the pump, including run-out. Provide a motor with a power draw that does not exceed the nameplate rating while the pump is operating between the normal minimum and maximum system curves, using a service factor of 1.15. Do not exceed the total capacity of the motor, including service factor, while the pump is operating between the normal minimum and emergency, run-out system curves.
11. Provide in addition to the manufacturer's standard data a certified dimensional print, performance curves, reed critical frequency data, speed vs. torque vs. amps curves.
12. Provide power factor capacitor as required to conform to motor manufacturer requirement to correct the motor's power factor to 0.95 without overexciting the motor. Power factor to be installed a minimum of 10 circuit feet from the solid state reduced voltage motor starter.
13. Refer to Section 16013 - ELECTRIC MOTORS under Division 16, Electrical for motor information not specified in this section.

## 2.6 SUCTION BARREL

- A. Provide suction barrels for pump with adequate number of bowls and suitable length to accommodate suction barrel. Reference plans, section 2.2(A) of this specification, and HI standards for dimension requirements of suction barrel.

- B. Provide suction barrels of fabricated steel. Fabricate the barrels of the diameter and wall thickness required, and of suitable lengths to accommodate the number of bowls specified.
- C. Barrels shall be coated with NSF certified epoxy, inside and out.
- D. Barrels shall have the top flange tack welded to the barrel at deliver in order to set level in the field. Contractor shall full seam weld the top flange to the barrel once the barrel has been leveled.
- E. The suction barrel shall be designed and provided by the manufacturer of the pumps and meet the latest HI standards.
- F. Suction barrels with anticipated maximum flows in excess of 3,000 gpm shall have internal straightening vanes and an inlet pipe splitter plate the entire length of the inlet, as required by HI latest standards.
- G. All suction barrels shall have the top flange installed in the factory and the level should be verified in the field prior to pouring concrete. Each top flange shall have a drilled and tapped bolt pattern that is equal to a standard 150 lb flange. Bolt holes shall straddle the centerline of the suction barrel inlet. The bolting to attach the discharge head to the suction barrel shall be Type 304 stainless steel and furnished by the barrel manufacturer. The top surface shall have a O-ring groove with O-ring for sealing purposes. A gasket will not be acceptable.
- H. The barrel inlet shall be as shown on the plan sheets and shall be flanged with an AWWA C207-94 Class D steel flange.
- I. The barrel length shall be as shown on the plan sheets and per HI standards. Provide a bottom cap plate in equal thickness to the top flange. Four evenly spaced, 3" x 3" x 3/8" angles, with a 1-inch hole in each, shall be welded to the outside diameter on the barrel to assist the installing Contractor in mounting and aligning the suction barrel.
- J. The barrel shall be fitted with two 3/4-inch couplings to serve as a vent for the barrel.

## 2.7 ACCESSORIES

- A. Nameplates
  1. Provide each pump and motor with a stainless steel nameplate securely affixed in a conspicuous place.
  2. Do not paint over nameplate.
  3. Nameplates shall be imprinted.
  4. Pump Nameplate
    - a. Each pump nameplate will show the duty point, at rated speed in revolutions per minute, serial number, impeller number, and number of stages.
  5. Motor Nameplate
    - a. See Electric Motor section in Division 16.
- B. Vortex Suppressor/Basket Strainer
  1. When shown, pumps shall have a vortex suppressor/basket strainer installed on the pump's suction except for pumps installed in suction barrel constructed with internal vanes and anti-

cross in suction barrel bottom. The vortex suppressor/basket strainer shall be constructed to meet the following requirements:

- a. Performance requirements
  - i. Approach velocity
    - A) 3.0 feet per second, maximum, at design flow
  - ii. Net open area
    - A) 65%
- b. Design requirements
  - i. Basket-type with solid bottom plate and internal straightening vanes.
  - ii. Screen
    - A) 0.120-inch woven wire cloth on 5/8-inch centers
  - iii. Materials
    - A) Wire cloth to be 316 stainless steel material.
    - B) All other materials to be 304 stainless steel with a minimum thickness of 3/16-inch.
  - iv. Mounting
    - A) Bolted to the pump suction bell using 5/16-inch minimum diameter 18-8 SST bolts. "Clips" are not acceptable

## 2.8 COATING SYSTEM

- A. Provide a factory applied NSF certified epoxy primer, coatings shall be as specified, to the pump bowls exterior, motor, discharge head exterior, and column exterior.
- B. Provide a high solids epoxy lining on the pump discharge head exterior
- C. Provide a fusion-bonded epoxy lining inside the pump bowls.

## 2.9 LIFTING, ALIGNMENT, AND ACCESS

- A. Provide lifting lugs capable of supporting the weight of the entire pump and motor.
- B. Provide the motor support pedestal with an accurate, machine-registered fit for alignment of the driver.
- C. Provide suitable openings for each access to the seal.

## PART 3.0 – EXECUTION

### 3.1 INSPECTION

- A. Install all equipment and connecting piping in accordance with Manufacturer's instructions. Prior to testing and start-up, FPR and manufacturer's representative to inspect to verify the system is complete.
- B. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which adversely affect installation.
- C. Promptly report defects which may affect Work to Engineer.



**3.2 INSTALLATION**

- A. Clean all new piping prior to testing.
- B. The top flange of suction barrels shall be leveled to within 0.002 of an inch per foot of diameter of the flange.
- C. Install products in accordance with manufacturer's written instructions.
- D. Provide sufficient clearances for thermal expansion and contraction.
- E. Install Type 316 stainless steel hex head bolts, nuts, and washers for anchoring to a suction barrel.
- F. Tolerances for plumbness shall be in accordance with Hydraulic Institute standards.

**3.3 FIELD PAINTING**

- A. Field painting shall conform to the requirements of Section 09920.
- B. Motor and discharge head exterior shall be field coated by removing factory primer and applying a final protective coating.
- C. Number the pumps with 6-inch or larger stencils using black alkyd paint. Pump numbers are to correspond to wiring in MCC.

**3.4 FIELD PERFORMANCE TEST**

- A. After pumps have been completely installed and started-up under the direction of the Manufacturer, conduct field tests to demonstrate that pump operation conforms to these Specifications.
- B. If the pump performance does not comply with Specifications, take corrective measures or remove and replace pumps with pumps which satisfy the conditions specified, at no additional cost.
- C. The Contractor shall provide all necessary test equipment, including temporary flow meters, pressure gauges, piping plugs or caps, or temporary bulkheads, and current meters.
- D. Contractor shall ensure there is sufficient volume of water available to conduct test and that all downstream components are capable of receiving pumped liquid. If there is no available water, the Contractor shall provide water for testing purposes. If downstream components are not in place, Contractor shall make provisions for recycling pumped water and disposal.
- E. Contractor shall verify that all structures, pipes, and equipment are installed correctly and make any adjustments required before start-up of pump. Any component parts which are damaged as a result of this testing or which fail to meet the requirements of these specifications shall be replaced, reinstalled, and re-tested at the Contractor's expense.
- F. No form of energy shall be turned on to any part of the system prior to approval of Manufacturer's service representative.

- G. Field tests shall consist of operating the pumps under normal and abnormal conditions.
- H. Flow, pressure, vibration, and current shall be measured and documented for at least three operating points on each pump.
- I. Pumps shall be checked for proper alignment to avoid imbalance and excessive vibration. Any misalignment of greater than ¼-inch shall be remedied prior to demonstration period.
- J. Provide a testing acceptance letter from the Manufacturer on his letterhead that states the pump was installed in accordance with the manufacturer's instructions, has met all performance requirements, and has been accepted by the Manufacturer.
- K. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments, and then re-test the equipment. Such tests and adjustments shall be repeated until, in the opinion of the ENGINEER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

**3.5 DEMONSTRATION PERIOD**

- A. Satisfactory operation of pumps, under the Owner's control, for the specified Demonstration Period shall commence a minimum of 48 hours after successful field testing. If malfunctions of other operational problems halt the Demonstration Period, the Contractor shall make appropriate corrections and restart the Demonstration Period.
- B. Substantial Completion will not occur until after the Demonstration Period has been accepted by the Engineer and Owner.

**3.6 SERVICES BY MANUFACTURER**

- A. A factory trained representative of the Manufacturer shall provide services for installation supervision, start-up and test services and operation and maintenance personnel training services.
- B. The Manufacturer's Representative shall make a minimum of 2 visits, minimum 4 hours on-site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up, testing, and training on the system.
- C. Manufacturer's Representative shall provide a written report certifying that the installation has been checked, is adequate for the intended purpose, all power connections have been checked, all controls are functional, and that the equipment is ready to be placed into service.
- D. Manufacturer's Representative shall start-up and operate the system in the presence of the Engineer, and conduct the field performance test to verify that the equipment meets or exceeds the specified requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory. The Manufacturer's Representative shall provide a written report documenting the results of the field testing.
- E. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the Owner.

**3.7 FINAL ACCEPTANCE**

- A. Final acceptance use will not occur until after the following activities have been performed and accepted by the Engineer.
1. Training the Owner's operating and maintenance personnel by the Manufacturer's Representative.
  2. Satisfactory completion of the Demonstrative Period under the Owner's control.

**END OF SECTION**

**SECTION 16013  
ELECTRIC MOTORS**

**PART 1 – GENERAL**

**1.1 SCOPE**

This section gives requirements for electric motors specified in various sections of these specifications and shown on the drawings. Provide all electric motors specified, shown or otherwise required.

**1.2 RELATED WORK**

- A. Section 16195- Electrical Identification.
- B. Section 01300- Submittal Procedures.
- C. Section 01340- Shop Drawings, Product Data and Samples.

**1.3 REFERENCE STANDARDS**

- A. American National Standards Institute/Anti-Friction Bearing Manufacturers Association (ANSI/AFBMA): Load Ratings and Fatigue Life for Ball Bearings.
- B. American National Standards Institute/national Electrical Manufacturers Association (ANSI/NEMA): MG 1 - Motors and Generators.
- C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA): NFPA 70 - National Electrical Code (NEC).
- D. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - 1. IEEE112 – Standard Test Procedure for Polyphase Induction Motors and Generators
  - 2. IEEE114 – Standard Test Procedure for Single-Phase Induction Motors
- E. American National Standards Institute/Underwriters Laboratories, Inc. (ANSI/UL)
  - 1. UL547 – Thermal Protectors for Motors
  - 2. UL674 – Electric Motors and Generators for Use in Hazardous Locations, Class I Groups C and D, Class II Groups E, F and G

**1.4 SUBMITTALS**

- A. Submit the following under the provisions of Section 01300 – Submittals:
  - 1. Outline drawings
  - 2. Completed motor data sheets
  - 3. Assembly drawings
  - 4. Anchor bolt location drawings
  - 5. Electrical schematics and wiring diagrams
  - 6. Equipment performance curves and data
  - 7. Bill of installation/assembly materials
  - 8. Equipment weights
  - 9. Catalog data
  - 10. Operating instructions
  - 11. Maintenance and lubrication recommendations

12. Recommended spare parts for startup including prices
  13. Special maintenance tool requirements
  14. Recommended spare parts list for one year operation
  15. Quality control procedures
  16. Nondestructive test procedures
  17. Acceptance test procedure
  18. Surface preparation and painting procedure
  19. Shipping, handling, and storage procedures
  20. Installation/erection procedure
  21. Code compliance certificate
  22. Electrical equipment heat run test records
  23. Nameplate data
    - a. Number of Phases
    - b. Frequency in Hertz
    - c. Amperes at full load
    - d. Nominal speed at full load
    - e. Winding insulation system as defined by IEEE
    - f. NEMA design letter and code letter
    - g. Temperature rise (reference NEMA MG-1, Part 12)
    - h. Bearing Type
    - i. Motor dimensions and frame number
    - j. NEMA machine type classification
    - k. Data necessary for the programming of the Multilin protective relay if applicable.
    - l. Space heater voltage and wattage.
  24. Performance/acceptance test report
  25. Size of the largest three phase power factor correction capacitor unit which can be connected to three phase motors.
- B. Instruction Books. At project completion, provide three (3) sets of bound "Motor Instruction Books." Include service and maintenance manual, renewal parts catalog, and outline drawing for each different type and size of 3-phase motor.

### 1.5 QUALITY ASSURANCE

- A. Inspect and Test motors in accordance with specified NEMA standards. Test polyphaser motors to the requirements of ANSI/IEEE 112. Test single phase motors to the requirements of ANSI/IEEE 114.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare each unit for the type and mode of shipment specified. The preparation shall be suitable for at least six months of outdoor storage from time of shipment requiring no disassemble prior to operation (except for bearing and seal inspections).
- B. Provide instruction as necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite.
- C. Coat exterior machined surfaces with a suitable rust preventative.
- D. After drained and cleaned, coat internal areas of bearings and auxiliary equipment in oil lubrication systems fabricated from carbon steel with a suitable oil-soluble rust preventative.

- E. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic plugs or caps.
- F. When sleeve bearings are furnished, block the rotor to prevent axial and radial movement.
- G. When space heaters are furnished, make heaters are furnished, make heater leads accessible without disturbing the sipping package. Tag the leads for identification.

## **PART 2 – PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Provide electric motors by any of the following manufacturers:
  1. U.S. Motors
  2. TECO-Westinghouse Motor Company
  3. Toshiba

### **2.2 SIZES**

Horsepower sizes shown are maximum acceptable continuous ratings. Determine service factors according to NEMA MG-1 12.47. Service factor is to be a minimum of 1.15.

### **2.3 VOLTAGE, FREQUENCY AND SPEED**

- A. Voltage Ratings.
  1. Single Phase: 230 volts where the source voltage is 240 volts.
  2. Three Phase: 460 volts where the source voltage is 480 volts.
- B. Frequency. 60 Hertz
- C. Speed. As specified or required for driven equipment. Suitable for acceleration the connected load with supply voltage at starter supplies terminal dipping to 90% of motor rated voltage.

### **2.4 DESIGN TYPE**

This specification defines the minimum requirements for low-voltage, random-wound, squirrel-cage, induction motors in the NEMA frame sizes for non-classified electrical area service. Use this specification for the selection and purchase of induction motors purchased separately or furnished with driven equipment as a package.

Motors shall perform satisfactorily for the application and installation conditions. Motors shall be suitable for operation in an outdoor corrosive and wet environment. Single speed and polyphase motors shall have efficiencies which equal or exceed those in ANSI/NEMA MG-1 (latest edition) for “NEMA Premium Efficiency” motors. Motor nameplate shall indicate that motor is a “NEMA Premium Efficiency” motor.

- A. For ½ Horsepower and Smaller. Use single phase motors of the resistance split-phase type and equipped with thermal protectors for motors smaller than 1/6 horsepower. For motors of 1/6 horsepower to ½ horsepower, provide single phase motors of NEMA Design N capacitor start type.
- B. For ¾ to 40 Horsepower. Provide three-phase, NEMA B, squirrel cage, induction type motors. Provide motors designed to operate at a maximum of 80 degrees C rise above an ambient temperature of 40°C and at an elevation of up to 1000 m/3300 ft above sea level.

- C. For Over 40 Horsepower. Provide three-phase, NEMA Design B, squirrel cage, induction type motors. Motor efficiency greater than 93.6 percent (93.6%) required as measured in accordance with IEEE Standard 112 Test Method E. Provide motors designed to operate at a maximum of 80 degrees C rise above an ambient temperatures of 40°C and at an elevation of up to 1000 m/3300 ft above sea level. Lock rotor rating safe stall time to be 15 seconds or greater. Provide power factor capacitor as required to conform to motor manufacture requirement to correct the motor's power factor to .95 without overexciting the motor. Power factor to be installed a minimum of 10 circuit feet from the solid state reduced voltage motor starter.

## 2.5 MOTOR INSULATION

- A. Use motor insulation that will sustain temperature rises according to NEMA MG-1, 12.41 for fractional horsepower and universal motors and according to NEMA MG-1, 12.42 for integral horsepower motors.
- B. Unless otherwise required, use a NEMA MG-1, 1.65, Class "F" insulation system made of non-hygroscopic material.
- C. In addition, provide two (2) epoxy dip and bake applications to windings as suitable for Gulf Coast Environment.

## 2.6 LEADS

For motor leads, use Class I stranded copper conductors with insulation the same or better as specified in the preceding paragraph. Provide permanent identification numbers on leads according to NEMA MG-2. Use crimp-on, solder - less copper terminals on leads and place shrunk insulation sleeves or covers between leads and terminals.

## 2.7 ENCLOSURES AND FRAME

- A. Unless otherwise required, provide motors of weather protected 1 (WP1) construction, with the exception of booster pumps, which shall be totally enclosed fan cooled (TEFC).
- B. Make motor enclosure fans non-sparking type, low inertia, and suitable for bidirectional rotation and mount on hub with stainless steel bolts.
- C. Furnish each enclosure with a stainless steel automatic breather/drain located at the low point of the enclosure.
- D. Motor frame and enclosure shall have provisions for grounding to the main grounding system. Drill and tap rear foot on horizontal motors and the flange base on vertical motors on the junction box side for a service post ground connector.
- E. Provide motors weighing more than 300 lbs. with lifting eyebolts, rings or lugs capable of supporting the weight of the motor.

## 2.8 BEARINGS

- A. Provide oil-lubricated anti-friction (sleeve) bearings with a ring oil lubrication system for motors 200HP and larger. Provide oil lubricated bearings for motors less than 150 HP with oil reservoir and level sight glass. Include slight glass with static and operational oil levels. Provisions for necessary oil circulation and cooling..
- B. Motors shall have proper bearing insulation to prevent circulation of shaft currents and resulting damage. Provide also insulating means for any oil-supply connections and monitoring equipment to prevent electrical bypassing of the bearing insulation.

- C. Oil and Grease lubricated bearing shall have a life of at least 100,000 hours.
- D. Provide oil-lubricated bearing housings and a reservoir of sufficient depth, to serve as a settling chamber for foreign materials, with a drain plug, and vents as required, accessible from the exterior of the motor. Drains shall be extended clear of the motor housing a minimum of 2½-inches with a gate valve and pipe plug on each oil drain. Furnish oil-lubricated motors with a constant oil-level sight gauge mounted on the motor housing and marked with running- and stopped-oil levels.
- E. Provide motors with suitable seals to prevent moisture from entering through the shaft openings. Provide an Inpro/Seal isolator (Labyrinth seal) on the shaft end of the motor.
- F. For in-line pumps, special high thrust bearings are required for drive motors, except for pumps where the thrust bearings are provided as an integral part of the pump. Thrust bearing shall meet the UP thrust and RPM as required by the pump manufacture

## **2.9 VERTICAL MOTORS (ADDITIONAL REQUIREMENT)**

- A. Solid shaft vertical motors are acceptable for all applications except when the connection to the driven equipment consists of sectional driven shaft which may unscrew and lengthen in the event of reversal of direction.
- B. Design vertical motor thrust bearings conservatively to carry maximum axial thrusts (up and down) imposed by driven equipment. Thrust bearing shall be insulated from magnetic currents.
- C. Vertical motors shall have oil-lubricated, top and bottom bearings and motor base shall be NEMA type P.
- D. Provide vertical motors with a positive, non-reversing, corrosion-resistant (“anti-ratchet”) mechanism. Do not equip well motor with an anti-reverse ratchet. Provide a time-delay relay that does not allow the motor to be energized while the shaft is spinning backwards.
- E. Where new motors are being provided for existing pumps, motor mounting must match the existing pump and new shaft couplings shall be provided to couple the pump to the new motor.

## **2.10 COUPLINGS**

The manufacturer of the equipment to be driven will provide all necessary coupling devices required between the motor and the driven equipment.

## **2.11 HARDWARE**

All structural bolts, washers, nuts, pins and similar items must be manufactured of high strength steel. Protect hardware from corrosion by galvanizing or chrome plating.

## **2.12 NAMEPLATES**

Provide each motor with a stainless steel nameplate meeting the requirements of NEMA MG-1, 10.37 and the National Electric Code, Section 430-7. When the motor and equipment are installed, the nameplate must be in full view in accordance with the intent of NEC requirements. Attach the nameplate to the motor with stainless steel fastening pins or screws.

## **2.13 ACCESSORIES**



- A. Terminal Boxes. Provide each motor with a diagonally split conduit box amply dimensioned for the motor lead terminations, including a grounding lug. Supply a gasket suitable for the enclosure type and motor location. Make motor terminal boxes weatherproof and with threaded conduit entrances with water-resistant seals between boxes and motor frame. Design the line-terminal box to allow box to be rotated in four 90 degree steps for bottom, side or top entry of conduit or cable. The line terminal box shall match the location indicated on project drawings. Locate a separate terminal box for space heaters adjacent to the line terminal box. Provide a separate terminal box for RTD's, space heater, current transformer, and other similar accessories when supplied.
1. Size the line terminal box so that feeder cables can be connected to motor leads for terminals without damage to the cable or the leads. Oversize the terminal box to exceed the minimum volumes shown in the NEMA MG1-11.06 and 20-62 by 200% and provide adequate space to mount and enclose all devices mounted within.
  2. Furnish the line terminal box with suitable compression ring-type, permanently numbered, cable connectors for incoming bolted-cable connections and one clamp-type ground terminal lug of sufficient size to contain a conductor the same size as motor leads.
- B. Resistance Temperature Detectors (RTDs)
1. Provide motors larger than 200 horsepower with a minimum of six, three-wire, 120 ohm, RTDs, two per phase, spaced equally around the circumference of the stator. Include three additional spare RTD's, one per phase, as spares and label as spares.
  2. Provide motors larger than 200 horsepower with three-wire, 120 ohm, nickel RTDs, one per bearing.

## 2.14 NOISE AND VIBRATION

- A. Determine motor noise level in accordance with IEEE 85. Levels or noise generated by a motor shall not exceed 85dbA at a distance of 1 m/3.3 ft unless specified otherwise on the data sheet. Noise level requirement may be also covered by a separate noise requirements specification included with the driven equipment specification.

## PART 3 – EXECUTION

### 3.1 INSTRUCTION BOOKS

Provide five (5) sets of bound "Motor Instruction Books," including service and maintenance manual, renewal parts catalog and outline drawing for each different type of motor rated 40 horsepower or more.

### 3.2 SETTINGS

- A. Where GE Multilin Motor Protection Relays are provided for motor protection, provide all setting for the Multilin Relays.
- B. Where PMC/Beta Vibration Switches are required, provide all settings.

### 3.3 INSTALLATION

- A. Install each motor in accordance with the Manufacturer's published instruction using the necessary tools and instrument to ensure proper fit and alignment with the driven machine.
- B. Before coupling up with the driven machine, the following work should be performed.
1. Test the motor winding insulation resistance in accordance with IEEE 43.
  2. Terminate cables to the motor leads.
  3. Energize motor momentarily to check rotation.

4. Check shaft of driven machine to ensure free movement.
  5. Perform motor vibration tests.
- C. Couple motor up with driven machine and perform motor vibration tests.

**END OF SECTION**

## SECTION 01130

### PAYMENT PROCEDURES

#### 1.00 GENERAL

#### 1.01 WORK INCLUDED

- A. Payments for Work shall conform to the provisions of the General Conditions, the Supplementary Conditions, the Agreement, and this Section. Apply provisions for payments in the Section to all Subcontractors and Suppliers.
- B. Submit Applications for Payment at the amounts indicated in the Agreement:
1. Amounts for each item in the Agreement shall include but not be limited to cost for:
    - a. Mobilization, demobilization, cleanup, bonds, and insurance.
    - b. Professional services including but not limited to engineering and legal fees.
    - c. The products to be permanently incorporated into the Project.
    - d. The products consumed during the construction of the Project.
    - e. The labor and supervision to complete the Project.
    - f. The equipment, including tools, machinery, and appliances required to complete the Project.
    - g. The field and home office administration and overhead costs related directly or indirectly to the Project.
    - h. Any and all kinds, amount or class of excavation, backfilling, pumping or drainage, sheeting, shoring and bracing, disposal of any and all surplus materials, permanent protection of all overhead, surface or underground structures; removal and replacement of any poles, conduits, pipelines, fences, appurtenances and connections, cleaning up, overhead expense, bond, public liability and compensation and property damage insurance, patent fees, and royalties, risk due to the elements, and profits, unless otherwise specified.
  2. Provide Work not specifically set forth as an individual payment item but required to provide a complete and functional system. These items are a subsidiary obligation of the Contractor and are to be included in the Cost of Work.
  3. Payment will be made for materials on hand.
    - a. Store materials properly on-site per Section 01041 "Project Management and Coordination."
      - 1). Payment will be made for the invoice amount less the specified retainage.
      - 2). Provide invoices at the time materials are included on the materials-on-hand tabulation.
    - b. Provide documentation of payment for materials-on-hand with the next payment request. Adjust payment to the amount actually paid if this differs from the invoice amount. Remove items from the materials on hand tabulation if this documentation is not provided so payment will not be made.

- c. Payment for materials-on-hand is provided for the convenience of the Contractor and does not constitute acceptance of the product.
- 4. The Work covered by progress payments becomes the property of the Owner at the time of payment.

**1.02 SCHEDULE OF VALUES AND PAYMENTS**

- A. Submit a detailed Schedule of Values for the Work to be performed on the Project.
  - 1. Submit schedule within 10 days prior to submitting the first Application for Payment.
  - 2. Line items in the Agreement are to be used as line items in the schedule.
  - 3. Payment will be made on the quantity of Work completed per Contract Documents during the payment period and as measured per this Section.
    - a. Payment amount is the Work quantity measured multiplied by the unit prices for that line item in the Agreement.
    - b. Payment on a unit price basis will not be made for Work outside finished dimensions shown in the Contract Documents.
    - c. Partial payments will be made for lump sum line items in the Agreement.
      - 1). Lump sum line items in the Agreement are to be divided into smaller unit prices to allow more accurate determination of the percentage of the item that has been completed.
        - a). Provide adequate detail to allow more accurate determination of the percentage of Work completed for each item.
        - b). Provide amounts for items that do not exceed \$50,000.00. An exception may be made for equipment packages that cannot be subdivided into units or subassemblies.
        - c). Separate product costs and installation costs.
          - (1). Product costs include cost for product, delivery and unloading costs, royalties and patent fees, taxes, and other cost paid directly to the Subcontractor or Supplier.
          - (2). Installation costs include cost for the supervision, labor and equipment for field fabrication, erection, installation, start up, initial operation and overhead and profit.
      - d). Lump sum items may be divided into an estimated number of units.
        - (1). The estimated number of units times the cost per unit must equal the lump sum amount for that line item.
        - (2). Payment will be made for all of the lump sum line item amount.
      - e). Include a directly proportional amount of overhead and profit for each line item.
      - f). Divide principal subcontract amounts into an adequate number of line items to allow determination of the percentage of Work completed for each item.
    - 2). These line items may be used to establish the value of Work to be added or deleted from the Project.

- 3). Correlate line items with other administrative schedules and forms:
    - a). Progress schedule.
    - b). List of Subcontractors.
    - c). Schedule of allowances.
    - d). Schedule of alternatives.
    - e). List of products and principal Suppliers.
    - f). Schedule of Submittals.
  - 4). Costs for mobilization shall be listed as a separate line item in accordance with SAWS Specification 100. Mobilization may not exceed 8% of the total Contract Price. Cost for mobilization may be submitted only in accordance with SAWS Specification 100.
  - 5). The sum of all values listed in the schedule must equal the total Contract Price.
4. Submit a schedule indicating the anticipated schedule of payments to be made by the Owner. Schedule shall indicate:
    - a. The Application for Payment number.
    - b. Date the request is to be submitted.
    - c. Anticipated amount of payment to be requested.
  5. Update the Schedule of Values quarterly or more often if necessary to provide a reasonably accurate indication of the funds that the Owner will need to have available to make payment to the Contractor for the Work performed.
- B. Provide written approval of the Schedule of Values, Application for Payment form, and method of payment by the Surety Company providing performance, and bonds prior to submitting the first Application for Payment. Payment will not be made without this approval.

### **1.03 PAYMENT PROCEDURES**

- A. All Applications for Payment shall be submitted and handled through CPMS and SPUR. Complete monthly application for payment should include supporting documentation, scratch sheet, updated schedule, and redlines for work completed.
- B. Submit Applications for Payment per the procedures indicated in Section 01310 "Submittals." Submit a Schedule of Values in the Application for Payment format to be used.
- C. Progress payments shall be made as the Work progresses on a monthly basis.
  1. End the payment period on the day indicated in the Agreement and submit an Application for Payment for Work completed and materials received since the end of the last payment period.
  2. At the end of the payment period, submit a draft copy of the Application for Payment for that month through CPMS. Agreement is to be reached on:
    - a. The percentage of Work completed for each lump sum item.
    - b. The quantity of Work completed for each unit price item.
    - c. The percentage of Work completed for each approved Change Order item.

- d. The amount of materials-on-hand.
- 3. On the basis of these agreements the Contractor is to prepare a final copy of the Application for Payment and submit it to the Engineer for approval.
- 4. The Engineer will review the Application for Payment and if appropriate will recommend payment of the application to the Owner.
- D. Provide a revised and up-to-date Progress Schedule, redlines for work completed during the period per SAWS Specification 1110 with each Application for Payment. The application for payment will not be considered complete if any of the items are missing.

**1.04 MEASUREMENT PROCEDURES**

- A. Measure the Work described in the Agreement for payment. Payment will be made only for the actual measured and/or computed length, area, solid contents, number and weight, unless otherwise specifically provided. No extra or customary measurements of any kind will be allowed.

**1.05 BASIS OF PAYMENT**

The Basis of Payment will be as established in the Contract Documents and as described below:

**A. Item No. 1: Tank Construction**

- 1. Measurement — Measurement of Item No. 1 will be by lumpsum. This item shall include construction of one (1) 0.5 MG pre-cast, prestressed concrete ground storage tank including foundation, internal riser piping and fittings, underground piping and fittings located under foundation, and subgrade preparation, complete as specified and shown in the Drawings.
- 2. Payment of the full lump sum price shall be paid for the work performed and in accordance with the Schedule of Values. Payment shall constitute full compensation to the CONTRACTOR for furnishing all: labor, equipment, tools, and materials; mobilization and demobilization; and for performing all operations required to furnish to the Owner the project, complete in place, as specified and as indicated on the Contract Drawings and Specifications.

**B. Item No. 2: Pump Station**

- 1. Measurement — Measurement of Item No. 2 will be by lumpsum. This item shall include construction of two (2) hydropneumatic tanks including foundations; five (5) booster pumps including foundations, motors, and five (5) cans; metering station; split-faced CMU block control building including foundation; plant piping, valves, fitting, thrust blocks and pipe supports; electrical and control work, motor control center including service; security system; protective coating; disinfection equipment; miscellaneous equipment; chain link fencing; site work including drainage and concrete pavement; concrete access roads; plant site grading and drainage swales; retaining wall; diesel generator with subbase fuel tank; electrical conduit and wire for generator, main breaker, automatic transfer switch, and secondary containment; and all else specified and shown on the Drawings but not addressed in separate bid items required for a complete and operational Pump station facility, complete as specified and shown in the Drawings.
- 2. Payment of the full lump sum price shall be paid for the work performed and in accordance with the Schedule of Values. Payment shall constitute full compensation to the CONTRACTOR for furnishing all: labor, equipment, tools, and materials; mobilization and demobilization; and for performing all operations required to furnish to

the Owner the project, complete in place, as specified and as indicated on the Contract Drawings and Specifications.

C. Item No. 3: Erosion and Stormwater Pollution Control

1. Measurement — Measurement of Item No. 3 will be by lumpsum.
2. Payment of the full lump sum price shall be paid for the work performed and in accordance with the Schedule of Values. Payment shall constitute full compensation to the CONTRACTOR for furnishing all: labor, equipment, tools, and materials; mobilization and demobilization; and for performing all operations required to furnish to the Owner the project, complete in place, as specified and as indicated on the Contract Drawings and Specifications.

D. Item No. 4: Trench Excavation and Protection

1. Measurement — Measurement of Item No. 4 will be by linear foot.
2. Payment of the price shall be paid for per linear foot of the work performed and in accordance with the Schedule of Values. Payment shall constitute full compensation to the CONTRACTOR for furnishing all: labor, equipment, tools, and materials; mobilization and demobilization; and for performing all operations required to furnish to the Owner the project, complete in place, as specified and as indicated on the Contract Drawings and Specifications.

E. Item No. 5: Revegetation of Disturbed Areas

1. Measurement — Measurement of Item No. 5 will be by lumpsum.
2. Payment of the full lump sum price shall be paid for the work performed and in accordance with the Schedule of Values. Payment shall constitute full compensation to the CONTRACTOR for furnishing all: labor, equipment, tools, and materials; mobilization and demobilization; and for performing all operations required to furnish to the Owner the project, complete in place, as specified and as indicated on the Contract Drawings and Specifications.

F. Item No. 6: Mobilization and Demobilization:

1. Description – This item shall be for the mobilization and demobilization costs associated with construction of the Meghan Pump Station in accordance with SAWS specification section 100. This shall include furnishings and labor, material, 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.
2. Measurement – Measurement for Item No. 6 shall be by lump sum work progresses in accordance with SAWS specification section 100.
3. Payment – Partial payments of the lump sum price for mobilization will be in accordance with SAWS specification section 102.

G. Item No. 7: Intermediate Demobilization and Remobilization:

1. Description — This item shall be for the intermediate mobilization and demobilization costs when requested by SAWS in accordance with SAWS Specification 102.
2. Measurement — Measurement for Item No. 7 shall be per each and in accordance with SAWS specification section 102.
3. Payment — Partial payments of the lump sum price for demobilization and remobilization will be as described in SAWS specification section 102.

H. Item No. 8: Preparation of Right-of-Way

1. Description — This item shall include preparing the right-of-way for construction operations by removing and disposing all obstructions from the right-of-way and from designated easements where removal of such obstructions is not otherwise provided in the contract documents in accordance with SAWS Specification 101.
2. Measurement — Measurement for Item No. 8 will be by lump sum and shall not exceed 5% of line items 1-5 in accordance with SAWS Specification 101.
3. Payment — Partial payments of the lump sum price for preparation of right-of-way will be as described in SAWS specification section 101.

I. Item No. 9: On-site Security Guard Allowance (once chlorine is on site)

1. Description — This item shall be an allowance for payment for an on-site security guard at the Meghan Pump Station site. An on-site security guard will be required 24 hours a day, 7 days a week once chlorine is located at the site and until security devices (fences, gates, and cameras) are installed and working. The guard should be a commissioned guard from a SAWS Security approved security contractor. This allowance shall reimburse the Contractor for the direct cost for all fees associated with the contracting of an on-site security guard. Any unused portion of the allowance will be credited to the Owner by a deductible change order.
2. Measurement — Measurement for Item No. 9 will be by lump sum and shall not exceed \$30,000.00.
3. Payment of the lump sum price shall be paid for the work. Payment shall constitute full compensation to the Contractor. Contractor shall provide permit receipts to SAWS for reimbursement for work performed. Any unused portion of the allowance will be credited to the Owner by a deductible change order.

J. Item No. 10: Permitting Allowance

1. Description — This item shall be an allowance for any permitting fees required by the City of San Antonio (COSA) or Bexar County. This allowance shall reimburse Contractor for the direct cost for all fees imposed by COSA or Bexar County for required permits. Any unused portion of the allowance will be credited to the Owner by a deductible change order.
2. Measurement — Measurement for Item No. 10 will be by lump sum and shall not exceed \$10,000.00.
3. Payment of the lump sum price shall be paid for the work. Payment shall constitute full compensation to the Contractor. Contractor shall provide permit receipts to SAWS for reimbursement. Any unused portion of the allowance will be credited to the Owner by a deductible change order.

K. Item No. 11: CPS Energy Allowance

1. Description – This item shall be an allowance for any fees from CPS Energy associated with the connection and disconnection of electrical power at the Meghan Pump station, including fees and power cost associated with the 30-day commissioning period. This allowance shall reimburse Contractor for the direct cost for all fees imposed by CPS Energy. Any unused portion of the allowance will be credited to the Owner by a deductible change order. Fees associated with additional connections and disconnections of electrical power due to contractor error shall not be paid under this allowance and are the responsibility of the contractor.



2. Measurement – Measurement for Item No. 11 will be by lump sum and shall not exceed \$40,000.00.
- L. Item No. 12: Foundation Subgrade Allowance
1. Description – This item shall be an allowance for any significant differences in the required subgrade preparation for the GST (i.e. over excavation, structural fill, etc.) based on the recommendations of the geotechnical investigation performed during construction compared to the geotechnical report prepared during design.
  2. Measurement – Measurement for Item No. 12 will be by lump sum and shall not exceed \$100,000.00.
  3. Payment of the lump sum price shall be paid for the work. Payment shall constitute full compensation to the Contractor. Any unused portion of the allowance will be credited to the Owner by a deductible change order.

**2.00 PRODUCTS (NOT APPLICABLE)**

**3.00 EXECUTION (NOT APPLICABLE)**

END OF SECTION

**SECTION 15240**  
**PRECAST, PRESTRESSED CONCRETE GROUND STORAGE TANK**

**PART I – GENERAL**

**1.1 SCOPE**

- A. The work to be performed under this specification consists of furnishing all materials, tools, equipment, and necessary labor for the construction and testing of AWWA D-110 Type III circular precast, prestressed concrete ground storage tanks (herein referred to as the Tank(s)), complete with a cast-in-place reinforced concrete floor, a precast, prestressed concrete wall with a continuous mechanically bonded steel diaphragm, and a precast or cast-in-place prestressed concrete dome with no interior columns. Deviations from the requirements of this section will not be considered. In the case of conflict between this and other sections, the requirements of this section shall govern. Any additional soil exploration should be included in the bidding price for the tank. The tank manufacturer shall perform a geotechnical investigation and provide a Geotechnical Engineering Report. The tank manufacturer shall design the tank and foundation in accordance with the recommendations of the Geotechnical Engineering Report.

**1.2 RELATED SECTIONS**

- A. All sections of the Contract Documents and technical specifications are related sections. Failure to review Contract Documents and technical specifications does not relieve the Contractor supplier or manufacturer of complying with the requirements herein.
- B. San Antonio Water System (SAWS) Standard Specifications for Construction
- (1) Item No. 300 – Concrete (Natural Aggregate)
  - (2) Item No. 307 – Concrete Structures
  - (3) Item No. 301 – Reinforcing Steel
  - (4) Item No. 839 – Anchorage/Thrust Blocking and Joint Restraint

**1.3 REFERENCES**

- A. Design, manufacture, and assembly of elements of the equipment herein specified shall be in accordance with, but not limited to the latest published standards of the following as applicable:
- 1. American Association of State Highway and Transportation Officials. The latest edition of the following:
    - a. AASHTO, T-260 Method of Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials
  - 2. American Concrete Institute. The latest edition of the following:
    - a. ACI 301 Specifications for Structural Concrete for Buildings
    - b. ACI 304R Guide for Measuring, Mixing, Transporting and Placing Concrete

## PRECAST, PRESTRESSED CONCRETE GROUND STORAGE TANK

- c. ACI 305R Hot Weather Concreting
- d. ACI 306R Cold Weather Concreting
- e. ACI 318 Building Code Requirements for Structural Concrete
- f. ACI 372R Design and Construction of Circular Wire and Strand Wrapped Prestressed Concrete Structures
- g. ACI 506R Guide to Shotcrete
3. American Society of Civil Engineers. The latest edition of the following:
  - a. ASCE Standard 7-93 Minimum Design Loads for Buildings and Other Structures
  - b. ASCE Standard 7-98 Minimum Design Loads for Buildings and Other Structures
4. American Society of Testing and Materials. The latest edition of the following:
  - a. ASTM A185 Specification for Steel Welded Wire, Fabric, Plain for Concrete Reinforcement
  - b. ASTM A366/A366M Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
  - c. ASTM A416 Specification for Steel Strand Uncoated Seven-Wire for Prestressed Concrete
  - d. ASTM A615M Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - e. ASTM A821 Specification for Steel Wire, Hard-Drawn for Prestressing Concrete Tanks by Redrawing
  - f. ASTM C31 Practice for Making and Curing Concrete Test Specimens in the Field
  - g. ASTM C39 Test Methods for Compressive Strength of Cylindrical Concrete Specimens
  - h. ASTM C920 Specification for Elastomeric Joint Sealants
  - i. ASTM D1056 Specification for Flexible Cellular Materials – Sponge or Expanded Rubber
  - j. ASTM D1556 Test Method of Density and Unit Weight of Soil in Place by Sand Cone Method
  - k. ASTM D1557 Test Method for Laboratory Compaction, Characteristics of Soil Using Modified Effort
  - l. ASTM D1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
  - m. ASTM D2000 Classification System for Rubber Products in Automotive Applications
5. American Water Works Association. The latest edition of the following:
  - a. AWWA C652 Standard for Disinfection of Water Storage Facilities
  - b. AWWA D-110 Standard for Wire Wound, Circular, Prestressed, Concrete Water Tanks, Type III: Precast Concrete with a Steel Diaphragm, latest revision
6. Texas Commission on Environmental Quality
  - a. Title 30 Texas Administrative Code, Rules and Regulations for Public Water Systems.
7. National Sanitation Foundation
  - a. NSF 61 Drinking Water System Components – Health Effects
8. United States Army Corps of Engineering
  - a. Specification CRD-572

### 1.4 SUBMITTALS

- A. Provide shop drawings and product data, including schematic piping and detailed installation instructions and drawings. Submit as specified in the section on Shop Drawings, Products Data and Samples, Division 1 – General Requirements.
  1. **Submit one PDF copy of the design drawings and calculations for the ground storage tank. The drawings and calculations shall be sealed by a Professional Engineer experienced in the design of AWWA D110, Type III wire-wound, prestressed concrete tanks and registered in the state of Texas.**
  2. The submittals shall include:
    - a. Design calculations including buoyancy and uplift.
    - b. Shop drawings showing details and procedures of construction.
    - b. Design proportions for all concrete and shotcrete. Concrete strengths of trial mixtures.

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- Concrete mix designs for approval.
- c. Admixtures to be used in the concrete or shotcrete and their purpose.
- d. Reinforcing steel shop drawings showing fabrication and placement.
- e. Catalog cuts or shop drawings of all accessories, i.e. hatch, vent, ladders, waterstops, overflow box, and riser pipe.
- f. General arrangement plan and sections
- g. Construction sequence and schedule
- h. Hydrostatic test procedure
- i. Certification of compliance with NSF 61
- j. Geotechnical Engineering Report signed and sealed by a Professional Engineer experienced in geotechnical engineering and licensed in the state of Texas. The geotechnical report shall include recommendations for the design of the tank foundation, excavation, over-excavation, backfill, and any other required site preparation.

### 1.5 QUALITY ASSURANCE

#### A. Qualifications and Experience

1. All tank material and work shall be supplied and installed by a company which specializes in the design and construction of Type III circular, precast, wire wound prestressed concrete tanks, and is capable of meeting all the requirements of these specifications. No company is considered qualified unless it has designed and built in its own name at least 30 precast, prestressed concrete tanks conforming to AWWA D-110, Type III in the last fifteen years of equal size or greater which have been in successful service for a minimum of five years in the surrounding San Antonio metro area. Experience in the design and construction of AWWA D110 Type I, Type II, or Type IV tanks will not be considered.

#### B. Prequalification

1. All tank contractors are required to be prequalified.
  - a. Preload, LLC, Louisville, Kentucky, and DN Tanks Corporation, Wakefield, Massachusetts, are prequalified for precast, prestressed concrete tank construction.

#### C. Singular Responsibility

1. It is the express intent of this specification to create a singular responsibility for the design and construction of the Tank. The design and construction of all aspects of the floor slab, wall, prestressing, shotcrete, and roof of the prestressed concrete tank must be performed by the Tank Contractor.

#### D. Provide capable and experience personnel and suitable equipment to perform this work.

#### E. Provide adequate safety equipment and enforce its use of hard hats by all personnel, and the use of proper safety equipment by the construction crew while on the job site.

#### F. Notify the Engineer and Owner 72 hours prior to proceeding with each phase of construction.

### 1.6 OPERATION AND MAINTENANCE DATA

#### A. The manuals shall be prepared specifically for this installation and shall include all required cut sheets, drawings, equipment lists, descriptions, etc. In addition to the requirements of Section 01720, the manuals shall include the following at a minimum:

1. Complete parts list, cross-referenced to exploded view of assembly drawings
2. Dimensional drawings for all provided components with their respective weights
3. Final elevation of overflow weir and finished floor

**1.7 WARRANTY**

- A. For a period of 24 months from final completion, the manufacturer shall warrant that the equipment shall be free of defects in material and workmanship under normal use and service, and when properly installed along with a required inspection after the first year of operation. The manufacturer shall repair or replace, any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer. Replace or repair any material or workmanship which proves to be defective within the warranty period.

**1.8 PERMITS**

- A. The Contractor shall obtain any necessary building permits before commencing field operations.

**PART II – PRODUCTS**

**2.1 GENERAL**

- A. Design Criteria
1. One 500,000-gallon (25-foot high 24-foot side water depth} x 60-foot internal diameter) circular precast, prestressed concrete ground storage tank.
  2. Fill Rate = 500 gpm
  3. Drain Rate =4,500 gpm
  4. Max Head Over Weir = 3-inches
  5. Tank Floor Depth = 1.5 feet (below finished grade)
- B. Acceptable manufacturers:
1. DN Tanks Corporation
  2. Preload, LLC
- C. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to these Specifications.

**2.2 DESIGN CONDITIONS**

- A. Horizontal prestressing shall be continuous. Discontinuous prestressing tendons or strands will not be allowed.
- B. Allowable Stresses
1. Compressive stresses in concrete and shotcrete shall not exceed 0.55  $f_c$  initial (immediately after prestressing) and 0.45  $f_c$  final (after all losses have taken place) where  $f_c$  is the 28-day compressive strength of concrete or shotcrete. Vertical tensile stresses shall be taken fully by reinforcing steel and/or diaphragm.
  2. Maximum permissible initial stress  $f_{si}$  in any prestressing wire on the wall shall not exceed 0.75  $f_{pu}$ , where  $f_{pu}$  equals the ultimate tensile strength of the wire. Stress losses due to shrinkage, plastic and elastic shortening of concrete or shotcrete, and relaxation in steel shall be assumed as 25,000 psi.
  3. Reinforcing steel shall be designed in accordance with requirements of ACI 318 Appendix A – Alternate Design Method. The strength requirements of ACI 318 shall also be satisfied. The reinforcement value of steel wall diaphragm parallel to the direction of its channels may also be used. Mild steel reinforcement shall not be used to resist any portion of circumferential tension.

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C. The prestressed tank wall shall be designed as a composite concrete wall incorporating a continuous watertight and embedded mechanically-bonded steel diaphragm in combination with vertical mild steel reinforcement.

1. The prestressed tank wall shall be designed using elastic cylindrical shell analysis, with no reduction in hoop tension or compression taken due to edge restraint at the wall base.
2. The prestressed tank wall shall be reinforced vertically by deformed steel reinforcing rods and welded wire fabric. The horizontal cross-sectional area of the steel diaphragm may be included as part of the effective vertical reinforcing. The minimum concrete or shotcrete cover over steel reinforcement or diaphragm shall be 1-inch. Shotcrete coats over circumferential prestressing shall be considered as part of the minimum diaphragm cover.
3. The prestressed tank wall shall be of precast construction. Shotcrete or cast-in-place concrete core walls are not permitted.
4. A stress plate shall be required at all above grade locations where prestress wires are displaced by wall openings of 12-inches or greater. The stress plate shall be designed to transfer stress force across the opening.
5. Minimum precast wall thickness shall be four inches which includes a minimum shotcrete cover of ½-inch which shall be applied to the exterior of the steel diaphragm prior to wire winding. Shotcrete or cast-in-place walls are not permitted.
6. No reduction in ring compression or tension in the wall will be taken due to restraint at the bottom.
7. Circumferential prestressing steel shall be furnished to resist all forces due to internal loads, after accounting for stress losses and residual compression. Minimum residual compression in the core wall under tank full condition shall be 200 psi.

D. The floor slab shall be designed as a membrane-type concrete slab designed to transfer loads directly to the subbase. It must be sufficiently flexible to deflect to the settlement shape of the underlying soil without excessive stresses. The floor shall be designed so that loads from the encased inlets and outlets are distributed in such a way that they do not cause cracking on the floor slab. Minimum floor thickness shall be four inches. Wall footings may be above or below floor grade, but shall be placed monolithically with the floor. The wall footing shall be proportioned to resist imposed loads. The minimum amount of mild steel reinforcement in the floor shall be 0.5% of the concrete area in each of the two perpendicular directions. The slab shall be designed to resist uplift with the condition of standing water at finished grade elevation with the tank empty. The tank floor shall also be designed to resist uplift during construction activities.

E. The dome roof shall have a rise to span ratio within the range of 1:8 to 1:12. Minimum shell thickness shall be proportioned for buckling, but not less than 3-inches for cast-in-place and 4-inches for precast domes. The dome shall be fixed to the tank wall. Columns or interior supports will not be allowed. Dome design shall be based on elastic spherical shell analysis and shall include a circumferentially prestressed dome ring. Mild steel reinforcement in each of two perpendicular conditions shall be placed at the mid-depth of the shell, except the edge region where two layers of reinforcement are required; and except in domes with thickness greater than 5-inches where reinforcement shall be placed in two layers each direction. The minimum concrete cover over steel reinforcement shall be 1-inch.

### 2.3 MATERIALS

A. Concrete

1. Concrete materials shall meet the requirements of ACI 301. Cement shall be Portland Type I, II, or IL-ASTM C 595.
2. Admixtures shall comply with the requirements of ACI 301 and shall not contain chlorides, (except as heretofore stipulated) fluorides, sulfides, or nitrates. Concrete for tank construction shall be air entrained.

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3. Concrete for tank wall and roof construction shall have a minimum compressive strength of 4,000 psi after 28 days. All wall and dome concrete shall be air-entrained.
  4. Concrete for the tank floor and footings shall have a minimum compressive strength of 4,000 psi after 28 days and shall not be air-entrained. Pipe encasement and other non-structural concrete shall have a minimum compressive strength of 4,000 psi after 28 days and shall not be air-entrained. The coarse and fine aggregate shall meet the requirements of ASTM C33. Coarse aggregate shall be No. 467 with 100% passing the 1-1/2-inch sieve. Superplasticizer and water-reducing admixtures shall be incorporated into the floor concrete. Refer to Division 3, Concrete.
  5. Proportioning for concrete tanks shall produce concrete which meets the specified minimum compressive strength and shall be in accordance with ACI 301.
  6. Concrete or shotcrete in contact with prestressing steel shall have a maximum water soluble chloride ion concentration in the concrete or shotcrete of 0.06% by weight of cement.
  7. Concrete for floor and footing construction shall contain polypropylene fibrillated fibers, (Grace Fibers or equal) or polypropylene monofilament fibers (Grace MicroFiber or equal). The amount of fibers added to the concrete mix shall conform to the manufacturer's recommendations.
- B. Shotcrete
1. Shotcrete materials shall meet the requirements of ACI 506R. Cement shall be Portland Type I or II.
  2. Shotcrete for tank construction shall not contain chloride ions in excess of 0.06% of the weight of the cement in the mix.
  3. Shotcrete wire coat used for covering intermediate layers of prestressing wire shall consist of not more than three parts sand to one part Portland cement by loose volume weight; additional coats of shotcrete shall consist of not more than four parts sand to one part Portland cement by loose volume weight. Either the dry mix or wet mix process referred to in ACI 506R for shotcreting may be employed.
  4. Shotcrete shall have a minimum strength of 4,500 psi at 28 days.
- C. Reinforcing Steel
1. Reinforcing steel shall be new billet steel Grade 40 or 60, meeting the requirements of ASTM A615. Welded wire fabric shall conform to ASTM A185.
  2. Reinforcing steel shall be accurately fabricated and shall be free from loose rust, scale, and contaminants which reduce bond.
  3. Reinforcing steel shall be accurately positioned on supports, spacers, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips. Concrete block bar supports are not allowed. Rebar chair supports may be either steel or plastic.
- D. Mortar Fill and Non-shrink Grout
1. Mortar fill and non-shrink grout shall have a minimum compressive strength of 4,000 psi at 28 days.
- E. Steel Diaphragm
1. The steel diaphragm shall conform to ASTM A366 or ASTM A1008 and thickness shall be a minimum of 26 gauge. It shall be vertically ribbed with re-entrant angles. The back of the channels shall be wider than the front, thus providing a mechanical keyway anchorage with the concrete and shotcrete encasement.
  2. The steel diaphragm shall extend within one inch of the full height of the wall panel with no horizontal joints. Vertical joints within a wall panel shall be roll seamed or otherwise fastened in a fashion which results in a firm mechanical lock. Wall panel joints that are not roll seamed shall be edge sealed with polysulfide sealant.
  3. No punctures will be permitted in the diaphragm except those required for pipe sleeves, temporary construction openings, or special appurtenances. Details of such openings, as are necessary, shall be approved by the Engineer. All such openings shall be completely edge sealed with polysulfide

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- 4. Diaphragm steel may be considered as contributing to the vertical reinforcement of the wall.
- F. Elastomeric Materials
- 1. 9-inch plastic waterstops with centerbulbs shall be polyvinyl chloride meeting the requirements of the Corp of Engineers Specification CRD-C-572. Splices shall be in accordance with the manufacturer's recommendations.
  - 2. Bearing pads shall be neoprene or natural rubber.
    - a. Neoprene bearing pads shall have a hardness of 40 to 50 durometer, a minimum ultimate tensile strength of 1500 psi, a minimum elongation of 500%, and a maximum compressive set of 50%. Pads shall meet the requirements of ASTM D2000 Line Call-Out M2BC4105A14B14 for 40 durometer material.
    - b. Natural rubber bearing pads shall contain only virgin natural polyisoprene as the raw polymer and the physical properties shall comply with ASTM D2000 Line Call-Out M4AA414A13.
  - 3. Sponge rubber filler shall be closed-cell neoprene or rubber conforming to the requirements of ASTM D1056, Type 2 Class A Grade 1 with compression deflection limited to 25% at 2 to 5 psi.
  - 4. Polysulfide sealant used to seal diaphragm joints between precast wall panels shall be a two or three-component elastomeric compound meeting the requirements of ASTM C920, type M and must have permanent characteristics of bond-to-metals surfaces, flexibility, and resistance to extrusion due to hydrostatic pressure. Air-cured sealants shall not be used.
- G. Prestressing Steel
- 1. Steel for prestressing shall be cold drawn, high carbon wire, meeting the requirements of ASTM A821, having a minimum ultimate strength of 210,000 psi.
  - 2. Splices and anchor clamps for prestressed wire shall be ferrous material compatible with the reinforcement and shall develop the full strength of wire. Wire splice and anchorage accessories shall not nick or otherwise damage the prestressing.
- H. Decorative Coating
- 1. The above-grade decorative coating shall consist of two coats of water-based acrylic emulsion.
  - 2. The coating shall be "Tammscoat Smooth", "Modac Acrylic Texture Coating Smooth", or equal.
  - 3. The color shall be selected by the Owner during construction.

### 2.4 ACCESSORIES

- A. Vent
- 1. Provide an AST type roof vent, with a Type 316 stainless steel 16 gage mesh insect screen, adequately sized, as shown.
  - 2. The vent should be sized to handle the maximum draw down rate of 4,500 gallons per minute and a maximum fill rate of 500 gallons per minute.
- B. Overflow Pipe and Weir
- 1. Include a 12-inch overflow pipe with adequately sized weir as shown.
  - 2. The weir should be sized to handle 500 gallons per minute with a max water rise of 3-inches.
- C. Access Manways
- 1. Provide two (2) 36-inch diameter circular chase manways that open in an inward direction.
  - 2. All hardware and materials shall be as shown.
- D. Roof Hatch



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1. Provide one (1) 42" x 36" Bilco dome roof hatch.
  2. The hatch shall have a raised curbing at least 4-inches in height with a lockable cover that overlaps the curbing at least 2-inches in a downward direction.
  3. A gasket shall be provided to make a positive seal when the hatch is closed.
  4. All hardware shall be stainless steel.
- E. Tank Ladder
1. Furnish a tank ladder both inside and outside.
    - a. Interior Ladder
      - i. A stainless steel ladder shall extend from the hatch to the floor.
      - ii. The ladder shall have a fall prevention device attached consisting of a cable, clips, a sliding, locking mechanism and safety belt and complying with applicable OSHA standards.
      - iii. The ladder shall have a stainless steel safety extension capable of extending a minimum of three feet above the roof hatch.
      - iv. All miscellaneous hardware shall be stainless steel.
      - v. Provide OSHA approved safety harnesses to be used with it.
    - b. Exterior Ladder
      - i. A stainless steel ladder shall extend from the tank roof to 1-foot above the final grade.
      - ii. Equip the ladder with an 8' tall aluminum gate by North Safety Products to attach to side rail as shown on the drawings.
      - iii. Tank ladder shall conform to OSHA requirements.
      - iv. Provide OSHA approved safety harnesses to be used with it.
- F. Drain
1. Include a 12-inch drain pipe that shall discharge to the drainage structure.
- G. Pipe Connections
1. Provide the pipe connections at the locations shown.
- H. Pipe
1. Provide welded steel pipe for the overflow, drain, and water fill inlet which meets SAWS specification 816 and as specified in the plans.
  2. All interior or exterior fill lines are to be supported from wall as shown on the drawings or encased in concrete if determined to be necessary by the tank manufacturer.
- J. Handrails
1. Provide handrails around roof hatches and outlet pipes as shown on the SAWS Standard Details.
  2. Railing sections shall be constructed of aluminum piping and rolled to the curvature of the GST shell.
  3. Securely brace railings to the GST roof and shell in compliance with the most current OSHA rules and regulations.
  4. Open ends of railings shall be closed with watertight, properly fitted steel end caps.
- K. Identification Plates
1. Provide plaque as shown on the drawings.
- L. Pads for Riser Pipe Supports
1. Provide pads as shown on the drawings.

- M. Dome Safety Cable
  - 1. Provide a type 316 stainless steel cable and hardware anchored to the dome as recommended by the Tank Manufacturer and approved by Engineer.

### **PART III – EXECUTION**

#### **3.1 REMOVAL OF UNSUITABLE SOILS**

- A. The contractor is responsible for removing unsuitable soils and providing an engineered subbase as shown on the contract documents. The foundation area shall be excavated to the design subgrade elevation of 1434.5' and extend 3' laterally outside the perimeter of the tank foundation.
- B. After the required excavation is completed, the exposed subgrade should be thoroughly rolled with at least a 20-ton roller or heavy loaded dump truck weighing at least 20 tons. A minimum of 20 passes should be performed with passes alternating directions perpendicular to each other. Any area that yields under the roller loading shall be undercut and replaced with TxDOT Item 247, Type A, Grade 1 or 2 Crushed Limestone-Base Material compacted to 98% according to Standard Proctor ASTM D 698. Any deleterious material, rubble, or debris encountered shall be removed to firmer materials and replaced with TxDOT Item 247, Type A, Grade 1 or 2 Crushed Limestone-Base Material compacted to 98% according to Standard Proctor ASTM D 698.
- C. The excavation and subgrade preparation shall be observed and tested by a licensed geotechnical engineer.
- D. The tank manufacturer may propose additional over-excavation and select fill requirements for tank design in accordance with the tank manufacturer's Geotechnical Engineering Report. Tank manufacturer must adequately demonstrate the need for additional requirements and those additional requirements must be agreed upon by the Engineer and Owner. Any significant changes to these requirements will be paid from the Foundation Subgrade Allowance.

#### **3.2 GRANULAR SUBBASE**

- A. After the subgrade is properly proof rolled, select fill shall be placed within the excavation in loose lifts with a maximum 8-inch thickness. Each lift should be compacted to at least 98% of the maximum dry density determined by ASTM D 698 at moisture contents between -1 and +3 percent of optimum moisture content. The select fill shall be placed within 48 hours of completion of the subgrade preparation.
- B. Select Fill shall be TxDOT Item 247, Type A, Grade 1 or 2 Crushed Limestone-Base Material.
- C. Compaction shall be by capable vibratory roller with a minimum of two passes in each direction.
- D. Prior to construction of the floor, a 6-mil polyethylene vapor barrier shall be placed over the subbase. Edges of polyethylene shall be overlapped a minimum 6-inches

#### **3.3 CONCRETE**

- A. All concrete shall be conveyed, placed, finished, and cured as required by pertinent ACI standards.

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### B. Weather Limitations

1. Unless specifically authorized in writing, concrete shall not be placed without special protection during cold weather when the ambient temperature is below 35 degrees Fahrenheit and when the concrete is likely to be subjected to freezing temperature before the initial set has occurred and the concrete strength has reached 500 psi. Concrete shall be protected in accordance with ACI 306R. The temperature of the concrete shall be maintained in accordance with the requirements of ACI 301 and 306R. All methods and equipment for heating and for protecting concrete in place shall be subject to the approval of the Engineer.
2. During hot weather, concrete shall not be placed when concrete temperature exceeds 95 degrees Fahrenheit. Hot weathering concrete shall be in accordance with the requirements of ACI 305R.
3. Placement of concrete during periods of low humidity (below 50%) shall be avoided when feasible and economically possible, particularly when large surface areas are to be finished. Surfaces exposed to drying wind shall be covered with polyethylene sheets immediately after finishing, or flooded with water, or shall be water cured continuously from the time concrete has taken initial set. Curing compounds may be used in conjunction with water curing, provided they are compatible with coatings that may later be applied, or they are degradable.

### C. Finishes

1. The tank shall be given the following finishes:
  - a. The floor slab shall be given a mechanical steel or bull float finish.
  - b. The interior of precast wall panels, the exterior of precast dome panels, dome slots, and cast-in-place domes shall be given a light broom finish.
  - c. The dome soffit shall be given a form finish.
  - d. Exterior shotcrete shall be given a nozzle or a natural gun finish.
  - e. The exterior dome surface shall be given a light broom finish.

### D. Curing

1. Concrete shall be cured using water methods, sealing materials, or curing compounds. Curing compounds shall not be used on surfaces to which decorative coatings, mortar or shotcrete is to be applied. Curing compounds used within the tank shall be suitable for use with potable water.

### E. Testing

1. For concrete placed in precast panels or wall slots, a set of three cylinders shall be made for each truck load of concrete placed. For concrete placed in the floor, dome ring, or dome slots, two sets of three cylinders for the first 50 cubic yards, and one set of three cylinders for every 150 cubic yards thereafter placed in the same day. One cylinder shall be tested at 7 days, one at 28 days, and one held as a spare.
2. Slump tests on each delivery shall be made prior to placement. Slump shall not exceed 4-inches unless a high range water reducer is being used.
3. All concrete testing shall be in accordance with ASTM C-31 and C-39, at the expense of the Contractor and shall be conducted by an independent testing agency approved by the Engineer.

## 3.4 SHOTCRETE

### A. Weather Limitations

1. Shotcrete shall not be placed in freezing weather without provisions for protection of the shotcrete against freezing. Shotcrete placement can start without special protection when the temperature is 35 degrees Fahrenheit and rising, and must be suspended when the temperature is 40 degrees Fahrenheit and falling. The surface to which the shotcrete is applied must be free from frost. Cold weather shotcreting shall be in accordance with ACI 301 and ACI 306R.

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2. Shotcrete shall not be placed when shotcrete temperature exceeds 95 degrees Fahrenheit. Hot weather shotcreting shall be in accordance with the requirements of ACI 301 and ACI 305R.
- B. Shotcrete Coating Over Steel Diaphragm
1. The steel diaphragm shall be covered with a layer of shotcrete at least ½-inch thick prior to prestressing.
  2. Total minimum shotcrete coating over the outside face of the steel diaphragm shall be 1-1/2-inches including diaphragm cover, wire cover, and finish covercoat.
- C. Shotcrete Coating Over Prestressing Wire
1. Each layer of circumferential prestressing shall be protected by a shotcrete wire coat of not less than ¼-inch.
  2. Each prestressing wire shall be individually encased in mortar.
  3. Finish covercoat shotcrete shall be applied as soon as practical after the last application of wire coat.
  4. The outer layer of wire shall be protected by the wire coat plus two or more additional coats of shotcrete, in accordance with AWWA D110-13, totaling at least 1-inch in thickness over the outer layer of wire.
- D. Placement of Shotcrete
1. Dust, efflorescence, oil, and other foreign material shall be removed from surfaces to be shotcreted.
  2. Shotcrete shall be applied with the nozzle held at a small upward angle not exceeding five degrees and constantly moving during the application in a smooth motion with the nozzle pointing in a radial direction toward the center of the tank. The nozzle distance from the prestressing shall be such that the shotcrete does not build up or cover the front face of the wire until the spaces behind and between the prestressing elements are filled.
  3. Total shotcrete covercoat thickness shall be controlled by shooting guide wires.
    - a. Vertical wires shall be installed under tension and spaced no more than 2-feet apart to establish uniform and correct coating thickness.
    - b. Wires of 18 or 20 gauge high tensile strength or a minimum of 100 lb. monofilament line shall be used.
    - c. Wires shall be removed after placement of shotcrete covercoat.
  4. Applied by ACI 506 certified nozzelman.
- E. Curing
1. All exposed shotcrete coatings shall be kept moist for at least three days.
  2. Moist curing shall be started as soon as possible without damaging the shotcrete.
  3. Curing shall be fog spraying or sprinkling.
  4. Curing may be interrupted for subsequent application of prestressing and shotcreting.
- F. Testing
1. Testing of shotcrete shall be in accordance with ACI 506, except as specified herein.
  2. One test panel shall be made for each of the following operations: corewall, cove, wire cover, and covercoat.
  3. Test panels shall be made from the shotcrete as it is being placed, and shall, as nearly as possible, represent the material being applied.

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4. The method of making a test sample shall be as follows:
  - a. A frame of wire fabric (one foot square, three inches in depth) shall be secured to a plywood panel and hung or placed in the location where shotcrete is being placed.
  - b. This form shall be filled in layers simultaneously with the nearby application.
5. After 24 hours, the fabric and plywood backup shall be removed and the sample slab placed in a safe location at the site.
6. The sample slab shall be moist cured in a manner identical with the regular surface application.
7. The sample slab shall be sent to an approved testing laboratory and tested at the age of 7 days and 28 days. Nine three-inch cubes shall be cut from the sample slab and subjected to compression tests in accordance with current ASTM Standards. Three cubes shall be tested at the age of 7 days, three shall be tested at the age of 28 days, and three shall be retained as spares.
8. Testing shall be by an independent testing laboratory, at the expense of the Contractor, and approved by the Engineer.

### **3.5 NONPRESTRESSED STEEL REINFORCEMENT**

- A. Steel reinforcement shall be placed to proper tolerances.
- B. The minimum concrete or shotcrete cover over steel diaphragm and non-prestressed steel reinforcement shall be 1-inch. Shotcrete cover over prestressing wires shall be counted as part of cover.
- C. If wall base cables are required they shall be installed between the base of the wall and the footing. Sleeves of rubber or other suitable material shall surround the strands at the joint to permit radial wall movements.

### **3.6 FLOOR**

- A. The floor and wall footings shall be constructed to the dimensions shown on the approved submittals.
- B. Prior to placement of the floor, a 6-mil polyethylene moisture barrier shall be placed over the subbase. Joints in the polyethylene shall be overlapped a minimum of 6-inches.
- C. Prior to placement of floor, all piping that penetrates the floor shall be set and encased in concrete.
- D. The vertical waterstop shall be placed and supported so that the bottom of the center bulb is at the elevation of the top of the footing. The vertical waterstop shall be located to a tolerance of plus or minus ¼-inch vertically and plus or minus ½-inch radially, and secured to insure positive positioning. The waterstop shall be supported without puncturing any portion of the waterstop unless it is manufactured with holes for tying. The waterstop shall be spliced using a thermostatically controlled sealing iron, and each splice shall be successfully spark tested prior to encasement in concrete. The horizontal waterstops shall be secured in a manner allowing them to be bent up while concrete is placed and compacted underneath, thereby facilitating proper embedment. All waterstops shall be spliced in a manner which provides complete continuity as a water barrier.
- E. The floor shall have a minimum thickness of four inches and be poured monolithically with no cold joints in the floor or between the floor and footing. Horizontal waterstops shall be installed in all construction joints and the floor thickened as necessary for proper placement.
- F. As soon as possible after final finishing operations, the concrete floor shall receive one coat of nontoxic, NSF 61 approved, curing compound and shall be kept moist for a period of seven days.

**3.7 PRECAST CORE WALL**

- A. The core wall shall be constructed of precast panels and vertical joints filled with shotcrete or cast-in-place concrete.
- B. A continuous waterproof steel diaphragm shall be provided throughout and within the tank wall, located between the stored tank contents and the prestressing wires. The steel diaphragm shall be full length without horizontal joints. Vertical diaphragm joints shall be mechanically seamed except where located between wall panels, where either mechanical seaming or sealing with polysulfide may be employed. All vertical diaphragm joints shall be sealed to be fully watertight. Piercing of the diaphragm shall not be permitted except by design.
- C. No holes for form ties, nails, or other punctures will be permitted in the wall. Bearing pads shall be located and held in their proper position prior to erection of wall panels.
- D. Temporary wall openings may be provided for access and removal of construction materials from the tank interior subject to the approval of the Engineer.
- E. Wall and dome panel beds shall be located around the periphery of the tank as required. The beds shall be constructed to provide finished panels with the proper curvature of the tank.
- F. After each precast panel has firmed sufficiently, polyethylene sheeting shall be placed between successive pours to provide a high moisture environment and a long slow cure for the concrete.
- G. The erection crane and lifting equipment shall be capable of lifting and placing the precast panels to their proper location without causing damage to the panel.
- H. The precast panels shall be erected to the correct vertical and circumferential alignment. The edges of adjoining panel shall not vary inwardly or outwardly by more than  $\frac{3}{8}$ -inch and shall be placed to the tank radius within plus or minus  $\frac{3}{8}$ - inch.
- I. Precast panels shall be fabricated to the curvature of the tank radius. The tolerance in panel wall thickness shall be plus or minus  $\frac{1}{4}$ -inch. Concrete for each panel shall be placed in one continuous operation.
- J. The precast panels shall be erected around the circumference of the tank and aligned to proper tolerances.
- K. Joints between precast wall panels shall be bridged with a 10 gauge steel plate edge sealed with polysulfide and filled with mortar or shotcrete.
- L. Sponge filler pads shall be properly secured. All voids around bearing pads and sponge shall be caulked with an approved non-toxic sealant to prevent mortar seepage.
- M. Minimum precast dome and wall thickness shall be 4-inches.

**3.8 DOME ROOF**

- A. The dome roof shall be constructed to proper spherical curvature. Construction joints shall be located and configured to result in adequate strength.
- B. Dome forms shall be designed to resist all forces acting with respect to its sloped surface. No portion of formwork for domes shall be removed until the concrete is of sufficient strength and until the full

circumferential prestressing force has been applied to the dome ring.

- C. The exterior dome surface shall receive a coat of membrane-forming curing compound immediately after completion of the final finishing operation.

### 3.9 PRESTRESSING

- A. Circumferential prestressing shall be accomplished by the application of high tensile steel wire. An essential feature of the wire wound stressing system is the proper application of tension to the prestressing element before it is placed on the wall.
- B. Prestressing wire will be placed on the wall with a wire winding machine capable of consistently producing a stress in the wire at any point around the wall within a range of plus or minus 7% of the stress required by the design. No circumferential movement of the wire along the tank wall will be permitted during or after stressing the wire. Stressing may be accomplished by drawing the wire through a die or by other means that results in uninterrupted elongation, thus assuring uniform stress throughout its length and over the periphery of the tank.
- C. The Contractor shall furnish a calibrated stress-measuring device which can be easily recalibrated shall be used to determine wire stress levels on the wall during and after the prestressing process. At least one stress reading for each coil or foot of wall height, whichever is greater, shall be taken immediately after application on the wall, and all such readings shall be on straight lengths of wire. Readings shall be recorded and shall refer to the applicable height and layer of wire for which the stress is being taken. A written record of stress readings shall be maintained by the Contractor.
- D. If applied stresses fall below the design stress in the steel, additional prestress wire shall be provided to bring the force on the corewall up to the required design force. If the stress in the steel is more than 7% over the required design stress, the wrapping operation should be discontinued immediately upon discovery, and satisfactory adjustment made to the stressing equipment before proceeding. The total prestress force measured on the wall per vertical foot of height shall not be less than the specified force, nor more than 5% or greater.
- E. Each coil of prestressing wire shall be temporarily anchored at sufficient intervals to minimize the loss of prestress in case a wire breaks during wrapping. Ends of the individual coils shall be joined by suitable steel splicing devices capable of developing the full strength of the wire.
- F. The average minimum clear space between prestressing wires on the wall shall be ¼-inch or 1.5 diameters, whichever is greater. Any wires not meeting the spacing requirements shall be respaced. Prestressing shall be placed no closer than two inches from the top of the wall, edges of openings, or inserts, and no closer than 3-inches from the base of walls or floors where radial movement may occur.
- G. The band of prestressing normally required over the height of an opening shall be displaced into circumferential bands immediately above and below the opening to maintain the required prestressing force. Bundling of wires shall be prohibited.
- H. A properly designed stress plate shall be used at all permanent wall penetrations greater than 12-inches in height. The stress plate shall accommodate a portion of the prestressing wires normally required over the height of the penetration. The remaining prestressing wires normally required shall be displaced into circumferential bands immediately above and below the penetration. The effect of banded prestressing shall be taken into account in the design.

**3.10 DISINFECTION**

- A. Prior to disinfection, the interior of the tank shall be thoroughly clean. See Specification 09920 for the procedure to disinfect the tank.
- B. Payment.
  - 1. The disinfection shall be paid by the Contractor. Re-disinfection due to failed bacteriological tests is also to be paid by the Contractor, including additional water used to re-fill the tank.

**3.11 WATERTIGHTNESS TEST**

- A. Upon completion, the tank shall be filled with potable water to the maximum level and tested to determine watertightness. The tank manufacturer shall recommend a rate at which to fill the tank in order to minimize risk of cracking when the tank is filled. Water will be furnished by the Owner. The tank shall remain filled for a period of at least 48 hours to allow for absorption and initial settlement. After the initial period, makeup water shall be added as required to the depth of the overflow weir and the tank shall be allowed to stand for a minimum of 24 hours to allow swell and slosh to abate.
- B. Measure the drop in liquid level below the depth of the overflow weir, over the next 72 hours. The liquid volume loss for a period of 24 hours shall not exceed the maximum allowable of one-twentieth of one percent of the tank capacity,  $0.0005 \times \text{tank volume}$ .
- C. If the net drop in the liquid level exceeds the maximum allowable, the liquid level test shall be extended to a total of five days. If at the end of 5 days, the average net drop in liquid level does not exceed the maximum allowable, the test shall be considered satisfactory. If the liquid volume loss exceeds this amount, it shall be considered excessive, and the tank shall be repaired at the source of the leakage and then retested. Water used for the re-test shall be paid for by the Contractor.
- D. Damp spots on the exterior wall surface shall not be permitted. Damp spots are defined as spots where moisture can be detected by dry hand. The source of water movement through the wall shall be located and permanently sealed in an acceptable manner. No leakage that includes visible flow through the wall-floor joint shall be permitted. Damp spots and standing water on the footing may occur upon tank filling and are permissible within the allowable volume loss. However, measurable flow in this area is not permissible and must be corrected.
- E. Upon completion and in the presence of the Engineer and Owner, test all pipelines for tightness in an acceptable manner. Furnish suitable testing plugs, and caps, all necessary pipe connections, gauges, or other equipment and all labor required.

**3.12 TANK BACKFILL**

- A. Backfill material around the tank shall be placed in uniform layers and compacted as specified for the material and site conditions so that water drains away from the tank. Avoid asymmetrical backfill placement except as may be required by design and site conditions. Tank may be backfilled after filing. All fill shall consist of TxDOT Item 247, Type A, Grade 1 or 2 Crushed Limestone-Base Material.
- B. Tank backfill requirements may be modified in accordance with the tank manufacturer's Geotechnical Engineering Report. Tank manufacturer must adequately demonstrate the need for modified requirements and those modified requirements must be agreed upon by the Engineer and Owner. Any significant changes to these requirements will be paid from the Foundation Subgrade Allowance.



PRECAST, PRESTRESSED CONCRETE GROUND STORAGE TANK

**3.13 DECORATIVE COATING**

- A. The decorative coating shall be applied to all exposed wall and roof surfaces in accordance with the manufacturer's recommendations.

**END OF SECTION**

**SECTION 15201  
MISCELLANEOUS EQUIPMENT**

**1.0 GENERAL**

This work includes furnishing all plant, labor, equipment and materials and performing all operations required for installation of miscellaneous equipment specified herein or as shown on the drawings.

**2.0 PRODUCTS**

**2.1 WALL-MOUNTED FANS AND ACCESSORIES**

- a. The contractor shall install one (1) wall-mounted, automatic shutter mounted fiberglass air intake fan with fiberglass reinforced polypropylene propellers, capable of delivering a minimum 320 cfm free air flow at ¼ inch (0.25") static pressure (SP), and rated at no more than one twentieth horsepower ( $\frac{1}{20}$  HP) in the spare room. Contractor shall furnish an OSHA approved, corrosion resistant, wire mesh safety guard and a corrosion and UV resistant weatherproof fan shroud with removable aluminum framed fiberglass (FRP) insect screen for the wall fan. The fan motor shall be a single speed, totally enclosed, sleeve or ball bearing 115-volt, 60-hertz, 1-phase type or approved substitute.
- a. The contractor shall install one (1) wall-mounted, automatic shutter mounted corrosion resistant air exhaust fan with corrosion-resistant propellers, capable of delivering a minimum 799 cfm free air flow at ¼ inch (0.25") static pressure (SP), and rated at no more than one eighth horsepower ( $\frac{1}{8}$  HP) in the spare room. Contractor shall furnish an OSHA approved, corrosion resistant, wire mesh safety guard and a corrosion and UV resistant weatherproof fan shroud with removable aluminum framed insect screen for the wall fan. The fan motor shall be a single speed, totally enclosed, sleeve or ball bearing 115-volt, 60-hertz, 1-phase type or approved substitute.
- b. Provide and install two (2) twelve-inch (12") square, wall mounted fiberglass supply shutters in the spare room and air compressor room. Locate the shutters as shown in the contract drawings and details. The shutter shall open automatically when the fan is running. The shutter should close freely when the fan stops running. Provide and install a removable fiberglass insect screen with an aluminum frame attached to the weatherproof fan shroud to cover the open end outside for the fan.
- c. Contractor shall mount the air intake fan in treated wood framed square opening through the building wall as specified by the fan manufacturer. The wall fan, interior insect screen, and weatherproof fan shroud shall be attached to the treated wood frame using stainless steel or corrosion resistant hardware and the pre-drilled holes provided in the mounting flange of each component.
- d. After verifying that the wall fan is rotating correctly, weatherproof seal the unit around wall openings with an approved non-hardening, weatherproof caulk for a finished, aesthetically pleasing installation. Paint the exposed portion of the wood trimmed opening to match the building color.

**2.2 AIR CONDITIONER**

- a. Provide and install two (2) Bard Model No. W24BB-XC05X5X electric heat air conditioner. Air conditioner and heater are to have automatic temperature control. Air conditioner output: 24,000 BTU. Heater output: 20,460.

- b. Contractor shall install unit in CMU wall block-out using an approved galvanized steel through-the-wall builder sleeve kit. Wall sleeve kit shall include internal supports, brackets, protective grill, weather-tight seals and non-corrosive hardware required for a finished, neat installation. If an approved equal wall sleeve kit is provided with a non-galvanized wall sleeve, the steel wall sleeve shall be protective coated to match the exterior finished building color as specified under Division 9 – Protective Coating & Disinfection for Potable Water Systems.

**END OF SECTION**

## SECTION 16000

### ELECTRICAL - GENERAL PROVISIONS

#### PART 1 GENERAL

##### 1.01 SCOPE OF WORK

- A. Furnish all labor, materials and equipment required to install, test and provide an operational, electrical system as specified and as shown on the Drawings.
- B. All equipment described herein shall be submitted and furnished as an integral part of equipment specified elsewhere in these Specifications.
- C. The work shall include furnishing, installing and testing the equipment and materials detailed in each Section of Division 16.
- D. The work shall include furnishing and installing the following:
  - 1. Electrical service from the Power Company.
  - 2. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions. The Contractor shall coordinate his construction schedule and electrical interface with the supplier of electrical equipment specified under other Divisions.
  - 3. Conduit, wiring and terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators and control panels. Lightning and surge protection equipment wiring at process instrumentation transmitters. Install vendor furnished cables specified under other Divisions.
  - 4. A complete raceway system for the Data Highway Cables and specialty cable systems. Install the Data Highway Cables and other specialty cable systems, furnished under the Instrumentation Division in accordance with the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the Process Control System supplier and the cable manufacturer to ensure raceway compatibility with the systems and materials being furnished. Where redundant cables are furnished, install the cables in separate raceways.
  - 5. Furnish and install precast electrical and instrumentation manholes, handholes and light pole foundations. Pole foundations shall be designed

and installed in accordance with the structural Divisions of these Specifications.

6. Telephone service from the Telephone Company.

## 1.02 RELATED WORK

- A. Where references are made to the Related Work paragraph in each Specification Section, referring to other Sections and other Divisions of the Specifications, the Contractor shall provide such information or work as may be required in those references, and include such information or work as may be specified.
- B. All raceways, power and control wiring related to Mechanical Division equipment that is shown on the Electrical Drawings, shall be provided under Division 16.
- C. All electrical work provided under any Division of the Specifications shall fully comply with the requirements of Division 16.

## 1.03 SUBMITTALS

- A. Submit Shop Drawings, in accordance with Division 1 requirements, for equipment, materials and all other items furnished under each Section of Division 16, except where specifically stated otherwise. An individually packaged submittal shall be made for each Section, and shall contain all of the information required by the Section. Partial submittals will not be accepted and will be returned unreviewed.
- B. Submittals will not be accepted for Section 16000.
- C. Each Section submittal shall be complete, contain all of the items listed in the Specification Section, and shall be clearly marked to indicate which items are applicable on each cut sheet page. The Submittal shall list any exceptions to the Specifications and Drawings, and the reason for such deviation. Shop drawings, not so checked and noted, will be returned unreviewed.
- D. The Contractor shall check shop drawings for accuracy and contract requirements prior to submittal to the Engineer. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by the Specifications and Drawings. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to Specifications and Drawings. Only one Specification Section may be made per transmittal.

- E. Material shall not be ordered or shipped until the shop drawings have been approved.
- F. Shop Drawings, O&M Manuals, and other documentation, shall be submitted as listed in each of the individual Electrical Specification Sections.
  - 1. Submit operations and maintenance data for equipment furnished under this Division, in accordance with Division 1. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists, etc, to instruct operating and maintenance personnel unfamiliar with such equipment.
  - 2. Manuals shall include the following as a minimum:
    - a. A comprehensive index.
    - b. A complete "As-Built" set of approved shop drawings.
    - c. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.
    - d. A table listing of the "as left" settings for all timing relays and alarm and trip setpoints.
    - e. System schematic drawings "As-Built", illustrating all components, piping and electric connections of the systems supplied under this Section.
    - f. Detailed service, maintenance and operation instructions for each item supplied.
    - g. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
    - h. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
    - i. Complete parts list with stock numbers, including spare parts.
- G. As-built records shall be provided by the contractor monthly with each payment application. Each month, the contractor shall provide a complete application for payment including scratch sheet (and all supporting documents), updated construction schedule, and redlines for all work completed during that period. Refer to the general conditions for full requirements.

- H. At the time of jobsite delivery of the equipment, the Contractor shall have an approved shop drawing in his possession for the Owner's Inspector and Owner's Engineer, for verification.

**1.04 REFERENCE CODES AND STANDARDS**

- A. Electric 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. Occupational Safety and Health Administration (OSHA)
  - 3. National Fire Protection Association (NFPA)
  - 4. National Electrical Manufacturers Association (NEMA)
  - 5. American National Standards Institute(ANSI)
  - 6. Insulated Cable Engineers Association (ICEA)
  - 7. Instrument Society of America (ISA)
  - 8. Underwriters Laboratories (UL)
  - 9. Factory Mutual (FM)
  - 10. City of San Antonio Electrical Codes
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.
- C. All material and equipment, for which a UL standard exists, shall bear a UL label. No such material or equipment shall be brought onsite without the UL label affixed.
- D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Owner/Engineer.

- E. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times.

**1.05 ELECTRICAL EQUIPMENT ENCLOSURE TYPES FOR AREA CLASSIFICATIONS**

- A. Unless otherwise specified herein or shown on the Drawings, electrical equipment enclosures and associated installations shall have the following ratings:
  - 1. Provide NEMA 7/8 combination enclosures for either indoor or outdoor use in hazardous (classified as Class 1, Division 1, Groups B, C and D), as defined in NFPA 70.
  - 2. Provide Non-metallic type NEMA 4X enclosures, of PVC or fiberglass reinforced polyester, for Chlorine, Caustic and other Chemical Rooms. Fiberglass enclosures shall not be used in the presence of sodium hypochlorite.
  - 3. Provide NEMA 12 enclosures, unless otherwise specified herein or shown on the Drawings, for all dry, indoor above grade locations. These areas shall be limited to electrical rooms, administration areas, control rooms and storage rooms.
  - 4. Provide NEMA 4X Aluminum Enclosures where specifically designated herein or shown on the Drawings.
  - 5. Provide NEMA 4X 316 Stainless Steel enclosures for all other locations.
  - 6. NEMA Types 1 or 1A enclosures will not be permitted, unless specifically stated in the Specification for the equipment, or shown on the Drawings.

**1.06 SERVICE AND METERING**

- A. The power company serving this project is CPS Energy. Service shall be obtained at 480 Volts, 3 Phase, 4 Wire, 60 Hz from a pad mounted transformer furnished and installed by CPS Energy.
- B. The power company shall be responsible for the following work:
  - 1. Furnishing and installing the primary overhead conductors and pole lines.
  - 2. Furnishing and installing the riser pole, primary cutouts, lightning arresters and grounding.



3. Furnishing and installing primary cables.
4. Furnishing and installing transformer.
5. Termination of underground primary cables at riser poles.
6. Termination of underground primary cables at the transformer.
7. Furnishing meter base and enclosures.
8. Furnishing and installing of current and potential transformers in pad mounted transformers for metering.

C. The Contractor shall be responsible for the following work:

1. Obtain an estimate from the power company for the work described in this SERVICE AND METERING paragraph and include the cost of the power company work in the Bid Price.
2. Furnishing and installing the primary conduits and coordinating with power company to ensure installation of primary cables.
3. Furnishing and installing the transformer pad and grounding.
4. Termination of underground primary cables at the riser pole.
5. Furnishing and installing secondary conduits and cables.
6. Installing meter base.
7. Furnishing and installing an empty conduit with pull line from the metering equipment to the meter enclosure. Conduit size and type shall be approved by the power company.
8. Coordinate the electrical service installation with the Power Company.

D. Submit shop drawings for the following items to the power company for approval:

1. Meter base
2. Secondary cables/conductors.
3. Metering instrument and installation.

**1.07 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.
- C. The Owner will negotiate with the electric utility for the costs of new or revised services and make payment to the electric utility for such costs, but the Contractor shall be responsible for the coordination with the electric utility during the installation of such services.
- D. Make all arrangements with the power company for obtaining electrical service, pay all power company charges and furnish all labor and material required for the electrical service.

**1.08 SIZE OF EQUIPMENT**

- A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.
- B. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

**1.09 RECORD DRAWINGS**

- A. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings". The Record Drawings and Specifications shall be kept up to date throughout the project.
- B. The Record Drawings shall be reviewed in a meeting with the Owner/Engineer on a monthly basis.
- C. Record Drawings shall accurately show the installed (as-built) condition of the following items:
  - 1. One-line Diagram(s).
  - 2. Raceways and pullboxes.
  - 3. Conductor sizes and conduit fills.
  - 4. Panel Schedule(s).
  - 5. Control Wiring Diagram(s).

6. Lighting Fixture Schedule(s).
  7. Lighting fixture, receptacle and switch outlet locations.
  8. Underground raceway and duct bank routing.
  9. Plan view, sizes and locations of switchgear, distribution transformers, substations, motor control centers and panelboards.
- D. Submit a typical example of a schedule of control wiring raceways and wire numbers, including the following information:
1. Circuit origin, destination and wire numbers.
  2. Field wiring terminal strip names and numbers.
- E. As an alternate, submit a typical example of point-to-point connection diagrams showing the same information, may be submitted in place of the schedule of control wiring raceways and wire numbers.
- F. Submit the record drawings and the schedule of control wiring raceways and wire numbers (or the point-to-point connection diagram) to the Owner/Engineer.
- G. The Contractor's retainage shall not be paid until the point-to-point connection diagrams have been furnished to the Owner/Engineer.

#### 1.10 EQUIPMENT INTERCONNECTIONS

- A. Review shop drawings of equipment furnished under other related Divisions and prepare coordinated wiring interconnection diagrams or wiring tables. Submit copies of wiring diagrams or tables with Record Drawings.
- B. Furnish and install all equipment interconnections.

#### 1.11 MATERIALS ANDEQUIPMENT

- A. Materials and equipment shall be new, except where specifically identified on the Drawings to be re-used.
- B. The Contractor shall not bring onsite, material or equipment from a manufacturer, not submitted and approved for this project. Use of any such material or equipment, will be rejected, removed and replaced by the Contractor, with the approved material and equipment, at his own expense.
- C. Material and equipment shall be UL listed, where such listing exists.

- D. The Contractor shall be responsible for all material, product, equipment and workmanship being furnished by him for the duration of the project. He shall replace the equipment if it does not meet the Contract Documents.

1.12 **JOBSITE DELIVERY, STORAGE AND HANDLING**

- A. Prior to jobsite delivery, the Contractor shall have successfully completed all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, or equipment which failed any factory tests, will not be permitted.
- B. Equipment and materials shall be handled and stored in accordance with the manufacturer's instructions, and as specified in the individual Specification Sections.

1.13 **WARRANTIES**

- A. Manufacturer's warranties shall be as specified in each of the Specification Sections.

1.14 **EQUIPMENT IDENTIFICATION**

- A. Identify equipment (disconnect switches, separately mounted motor starters, control stations, etc) furnished under Division 16 with the name of the equipment it serves. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc, shall have nameplate designations as shown on the Drawings.

PART 2 **PRODUCTS (NOT USED)**

PART 3 **EXECUTION**

3.01 **INTERPRETATION OF DRAWINGS**

- A. The Drawings are not intended to show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.
- B. Install each 3 phase circuit in a separate conduit unless otherwise shown on the Drawings.
- C. Unless otherwise approved by the Owner/Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.
- D. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.

- E. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
- F. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Owner/Engineer during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Owner/Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown.
- H. Redesign of electrical or mechanical work, which is required due to the Contractor's use of a pre-approved alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Owner/Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.
- I. Raceways and conductors for lighting, switches, receptacles and other miscellaneous low voltage power and signal systems as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Refer to riser diagrams for signal system wiring. Homeruns, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.
- J. The Contractor shall run all conduit and wire to RTU and/or PLC termination cabinets, where designated on the Drawings. The conduit and wire as shown on the interface drawings may not necessarily be shown on the floor plan.
- K. Install conductors carrying low voltage signals (typically twisted shielded pair cables) in raceways totally separate from all other raceways containing power or 120 volt control conductors.
- L. Raceways and conductors for thermostats controlling HVAC unit heaters, exhaust fans and similar equipment are not shown on the Drawings. Provide raceways and conductors between the thermostats, the HVAC equipment and the motor

starters for a complete and operating system. All raceways and power conductors shall be in accordance with Division 16. Raceways shall be installed concealed in all finished space and may be installed concealed or exposed in process spaces. Refer to the HVAC drawings for the locations of the thermostats and controls.

- M. Raceways and conductors for the fire alarm, sound and page party systems are not shown on the Drawings. Provide raceways and conductors as required by the system manufacturer for a complete and operating system. All raceways and power conductors shall be in accordance with Division 16. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in process spaces.

**3.02 EQUIPMENT PADS AND SUPPORTS**

- A. Electrical equipment pads and supports, of concrete or steel including structural reinforcing and lighting pole foundations, are shown on the Structural Drawings.
- B. No electrical equipment or raceways shall be attached to or supported from, sheet metal walls.

**3.03 SLEEVES AND FORMS FOR OPENINGS**

- A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.
- B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.
- C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Owner/Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.
- D. Seal all openings, sleeves, penetration and slots as specified in Section 16110.

**3.04 CUTTING AND PATCHING**

- A. Cutting and patching shall be done in a thoroughly workmanlike manner. Saw cut all concrete and masonry prior to breaking out sections.
- B. Core drill holes in concrete floors and walls as required. Contractor shall obtain written permission from the Owner/Engineer before core drilling any holes larger than 2 inches.
- C. Install work at such time as to require the minimum amount of cutting and patching.

- D. Do not cut joists, beams, girders, columns or any other structural members.
- E. Cut opening only large enough to allow easy installation of the conduit.
- F. Patching to be of the same kind and quality of material as was removed.
- G. The completed patching work shall restore the surface to its original appearance or better.
- H. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.
- I. Remove rubble and excess patching materials from the premises.
- J. When existing conduits are cut at the floor line of wall line, they shall be filled with grout of suitable patching material.

**3.05 INSTALLATION**

- A. Any work not installed according to the Drawings and this Section shall be subject to change as directed by the Owner/Engineer. No extra compensation will be allowed for making these changes.
- B. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.
- C. Electrical equipment shall be protected at all times against mechanical injury or damage by water. Electrical equipment shall not be stored outdoors. Electrical equipment shall be stored in dry permanent shelters as required by each Specification Section. Do not install electrical equipment in its permanent location until structures are weather-tight. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and tested as directed by the Owner/Engineer, or shall be replaced at no additional cost at the Owner/Engineer's discretion.
- D. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the Owner/Engineer's discretion.
- E. Repaint any damage to the factory applied paint finish using touch-up paint furnished by the equipment manufacturer. If the metallic portion of the panel or section is damaged, the entire panel or section shall be replaced, at no additional cost to the Owner.

**3.06 PHASE BALANCING**

- A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on motor control centers and panelboards shall be field connected to result in evenly balanced loads across all phases.
- B. Field balancing of circuits shall not alter the conductor color coding requirements as specified in Section 16120.

**3.07 MANUFACTURER'S SERVICE**

- A. Provide manufacturer's services for testing and start-up of the equipment as listed in each individual Specification Section. All settings, including those settings and arc flash labels required by the Power System Study, shall be made to the equipment and approved by the Owner/Engineer prior to energizing of the equipment.
- B. Testing and startup shall not be combined with training. Testing and start-up time shall not be used for manufacturers warranty repairs.

**3.08 TESTS AND SETTINGS**

- A. Test systems and equipment furnished under Division 16 and repair or replace all defective work. Make adjustments to the systems as specified and/or required.
- B. Prior to energizing electrical equipment, make all tests as required by the individual specification Sections. Submit a sample test form or procedure and submit the required test reports and data to the Owner/Engineer for approval at least two weeks prior to the startup of the tested equipment. Include names of all test personnel and initial each test.
- C. Check motor nameplates for correct phase and voltage. Check bearings for proper lubrication.
- D. Check wire and cable terminations for tightness.
- E. Check rotation of motors prior to energization. Disconnect driven equipment if damage could occur due to wrong rotation. If the motor rotates in the wrong direction, the rotation shall be immediately corrected, or tagged and locked out until rotation is corrected.
- F. Verify all terminations at transformers, equipment, capacitor connections, panels, and enclosures by producing a 1 2 3 rotation on a phase sequenced motor when connected to "A", "B" and "C" phases.
- G. Mechanical inspection, testing and setting of circuit breakers, disconnect switches, motor starters, control equipment, etc for proper operation.



- H. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by schematic and wiring diagrams.
- I. Check the ampere rating of thermal overloads for motors and submit a typed record to the Owner/Engineer of same, including MCC cubicle location and load designation, motor service factor, horsepower, full load current and starting code letter. If inconsistencies are found, new thermal elements shall be supplied and installed.
- J. Verify motor power factor capacitor ratings.
- K. Testing shall be scheduled and coordinated with the Owner/Engineer at least two weeks in advance. Provide qualified test personnel, instruments and test equipment.
- L. Refer to the individual equipment sections for additional specific testing requirements.
- M. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

**3.09 TRAINING**

- A. The Contractor shall provide manufacturer's training as specified in each individual section of the Specifications.

-END OF SECTION-

**SECTION 13300  
INSTRUMENTATION AND CONTROLS - GENERAL PROVISIONS**

**PART 1 – GENERAL**

**1.1 SCOPE OF WORK**

A. The Contractor shall procure the services of a Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor and services, required to achieve a fully integrated and operational system as specified herein, in the Specification Sections listed below, and in related drawings, except for those services and materials specifically noted.

1.	Section No	Title
	13311	Programmable Logic Controller
	13330	Control Panels and Panel Mounted Equipment
	13340	Instruments
	13550	Integrated Security System

B. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Drawings or not.

C. All equipment and installations shall satisfy applicable Federal, State and local codes.

D. Use the equipment, instrument, and loop numbering scheme shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify the numbering scheme without the Engineer's approval.

**1.2 RELATED WORK**

A. Instrumentation and Controls conduit systems are specified in Section 16010.

B. Instrumentation signal cable and alarm and status wiring are specified in Section 16121.

C. Relevant equipment Sections in Divisions 11, 13, and 15.

**1.3 SUBMITTALS**

A. General Requirements:

1. Refer to Section 01340 for general submittal requirements.
2. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.
3. Submittals shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.
4. Substitutions on functions or type of equipment specified shall not be acceptable unless specifically noted.

B. Qualifications Submittal:

1. Contractor shall provide a Process Control System Supplier (PCSS) with a history of past performances on SAWS water construction projects with a scope similar to the project for which the contractor is submitting

a bid. The PCSS shall be familiar with SAWS organization and requirements. The PCSS shall provide submittal drawings and documents in accordance SAWS requirements and standards. PCSS shall conduct three (3) conferences every two weeks, unless otherwise directed. PCSS shall perform all tasks necessary to complete all contract requirements including, but not limited to, the following:

- a. Preliminary Submittal Conference with examples for Final Submittal
  - i. The preliminary submittal conference shall be attended by the contactor, PCSS, the appropriate parties from SAWS, including SAWS contact Kyle Harvey, at (210) 233-3814.
  - ii. Parties from SAWS shall confirm that the example submittal conforms to all required standards necessary for the project including, but not limited to, submittal drawing format and related requirements.
- b. Final Submittal Conference
  - i. Resolution of submittal comments
  - ii. Project scheduling
  - iii. Project coordination with all phases of the project
  - iv. Formal submittal conferences with completed submittals
  - v. System material procurement
  - vi. System material delivery
  - vii. System material installation
- c. An advance submittal meeting (if required) shall present the final submittal with SAWS acceptance designation.

2. Submit, within 30 calendar days after Notice to Proceed, detailed information on staff and organization to show compliance with the Quality Assurance requirements of this Section. The Qualifications submittal shall be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements shall be grounds for rejection as a PCSS. The Qualifications Submittal shall, as a minimum, contain the following:
  3. Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.
  4. Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
  5. Copy of UL-508 certificate for panel fabrication facilities.
  6. Project references for water or wastewater projects as defined in the Quality Assurance paragraphs.
  7. Documentation to demonstrate the ability to complete this project including: resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.

C. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. The Project Plan shall be submitted and approved before further submittals shall be accepted. The Project Plan shall, at a minimum, contain the following:
  2. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. A discussion of startup, replacement of equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications shall be included as applicable.
  3. Preliminary list of HMI software, PLC software, and PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. Review and approval of software and hardware systems as part of this Project Plan stage shall not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer approval.

4. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each of these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
  5. 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, and I/O wiring diagrams.
  6. Exceptions to the Specifications or Drawings shall be clearly defined in a 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 an evaluation may be made by the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.
  7. Project schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the General Contractor schedule and must meet all field installation, testing, and start-up milestones in that schedule. The project schedule shall illustrate I&C related major project milestones including the following:
    - a. Schedule for all subsequent project submittals. Include 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 instrument and control system equipment.
    - f. Installation of instrument and control system equipment.
    - g. Testing: Schedule for all testing.
    - h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
    - i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
- D. Input/Output (I/O) List Submittal:
1. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
  2. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.
  3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
  4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O as required in the specifications.
  5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet shall include the following information:
    - a. TAG NUMBER(S): As indicated on the Drawings, 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. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.

- f. 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 are "1."
  - g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
  - h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
    - 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.
6. The I/O list shall be sorted in order by:
    - a. Physical location.
    - b. I/O Type.
    - c. Loop Number.
    - d. Device Tag.
  7. Once the I/O list is approved, the PLC I/O addresses shall not be modified without approval by the Engineer.
  8. For I/O layout requirements, see plans.
- E. Field Instruments Submittal:
1. Refer to the Instruments section for submittal requirements.
- F. Hardware and Software Packages Submittal:
1. Refer to the sections below for specific Hardware and Software Packages submittal requirements:
    - a. 13330 - Control Panels and Panel Mounted Equipment.
  2. For each hardware and software packages component specified in the sections above, submit a cover page that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
- G. Panel Layout Drawings and Wiring Diagrams Submittal:
1. Refer to the Control Panels section for submittal requirements.
- H. Spares, Expendables, and Test Equipment Lists Submittal:
1. Submit a list of, and descriptive literature for, spares, expendables, and test equipment.
  2. Submit a list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the manufacturer.
  3. Submit unit and total costs for the additional spare items specified or recommended for each subsystem.
- I. Operations and Maintenance (O&M) Manuals:
1. Submit in accordance with Section 01340.
  2. The operations and maintenance manuals shall, at a minimum, contain the following information:
    - a. Table of Contents:
      - i. A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.
    - b. Instrument and Equipment Lists:
      - i. The following lists shall be developed in Microsoft Excel format and provided not only as a hardcopy in O&M but also electronically on a CD.
      - ii. An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
      - iii. An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location,

- manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
- c. Equipment Operations and Maintenance Information:
    - i. ISA-TR20.00.01-2001(updated in 2004-2006) data sheets shall be provided for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
    - ii. Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.
  - d. As-Built Drawings:
    - i. Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS.
    - ii. As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.
  - e. Original Licensed Software:
    - i. Submit original software diskettes or CD-ROMs of all software provided under this Contract. Submit original paper based and electronic documentation for all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers and related information. All software provided under this Contract shall be licensed to the Owner at the time of purchase. Provide media in software sleeves within O&M manual.
  - f. Electronic O&M Information:
    - i. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.
    - ii. Provide electronic files for all custom-developed manuals including training manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.
    - iii. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
    - iv. Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the Owner.
    - v. If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format shall be a minimum of 800 by 600 pixels and shall include sound.
3. The cover and edge of each volume shall contain the information as specified in Section 01340.

#### 1.4 COORDINATION MEETINGS

- A. Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the Owner's designated location and shall include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer, and the AESS Project Engineer, if applicable. Other Division 13 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Meeting shall be scheduled a minimum of one week before the requested meeting date.
1. A project kickoff coordination meeting shall be held within two weeks after submitting the Project Plan. The purpose of the meeting shall be to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to one business day.
  2. A submittal review coordination meeting shall be held after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting shall be to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS and AESS. The meeting will last up to one business day.
  3. Regular on-site meetings when the PCSS staff is at the plant site.

### 1.5 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. International Society of Automation (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.
  7. ISA-99, Industrial Automation and Control Systems Security.
- C. National Electrical Manufacturers Association (NEMA).
- D. National Fire Protection Agency (NFPA):
1. NFPA 70, National Electrical Code (NEC).
  2. NFPA 79, Industrial Control Equipment.
- E. Underwriters Laboratories, Inc. (UL):
1. UL 508 - Industrial Control Equipment - for custom fabricated equipment.
  2. A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off the shelf products.

### 1.6 QUALITY ASSURANCE

- A. The Process Control System Supplier (PCSS) shall be a "systems integrator" 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 integrator" shall be interpreted to mean an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.
  2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.
  3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.
- B. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled start up to two months after startup completion.
- C. PCSS shall hold a valid UL-508 certification for their panel fabrication facility.
- D. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS 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.
- E. The selected Process Control System Integrator (PCSI) shall be one of the following:
1. Prime Controls
  2. Control Panels USA
  3. Richardson Logic Control
  4. Walker Industrial
  5. Tesco Controls
  6. or equal. If not listed, the contractor is required to submit the qualifications submittal for consideration.
- F. The selected Process Control System Supplier (PCSS) for the Autosensory Panel (ASP) Shall be one of the following:
1. Prime Controls
  2. Control Panels USA
  3. Signature Automation
  4. Walker Industrial
  5. Tesco Controls
  6. Or equal. If not listed, the contractor is required to submit the qualifications submittal for consideration.
- G. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery, storage, and handling shall be in accordance with manufacturer recommendations.
- B. Shipping Precautions:
1. After completion of shop assembly, factory test and approval of all equipment, cabinets, panels and consoles shall be packed in protective crates and enclosed in heavy duty (5 mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. 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. Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.
  3. None of the HMI control and monitoring equipment shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity. Have qualified personnel accept the equipment on delivery and supervise unloading within the control room areas.
  4. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the Owner.

**1.8 NOMENCLATURE AND IDENTIFICATION**

- A. Field Instrument Tags:
  1. See Section 13340.
- B. Panel Nameplates:
  1. See Section 13330.

**1.9 WARRANTY**

- A. Regardless of equipment start-up date, all control panel enclosures, panel equipment, and field instrument warranties shall remain in effect for a period of twelve (12) months from date of substantial completion.

**1.10 MAINTENANCE CONTRACT**

- A. A written proposal for a maintenance contract executed by the PCSS shall be provided to the Owner for on-site preventive maintenance services related to the Instrumentation and Control system. The cost of this maintenance contract shall not be included in the Contract Price.
- B. This proposal shall be provided within 30 days after final acceptance for the purpose of entering a contract for annual maintenance subsequent to the first year of maintenance. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from date of issue.
- C. This maintenance contract shall include all labor, parts, and emergency calls providing on-site response within 24 hours, to provide complete system maintenance for a period of one year after the date of Substantial Completion of the system for all equipment and software provided as part of the PCSS scope of work.
- D. Provide software updates throughout the maintenance contract period. Provide latest official released version for all software provided under this Contract. Owner shall have the latest software releases at the end of the maintenance contract period.
- E. The maintenance contract shall also include a minimum of 4 preventive maintenance visits by qualified service personnel of the Supplier who is familiar with the type of equipment provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning and lubrication of system equipment and verification of correct operation.
- F. Visits to the sites to correct deficiencies under warranty shall not be included in this preventive maintenance service contract.

- G. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit, however, they shall not replace the work intended to be performed during a preventive maintenance visit. The Supplier shall have full responsibility for the system hardware preventive and corrective maintenance.
- H. During the one-year maintenance period, observation of maintenance operations by plant personnel and the instruction of said personnel in the details of the maintenance work being performed, shall be provided.

### 1.11 PROJECT/SITE REQUIREMENTS

- A. Environmental Requirements. Refer to Electrical Drawings for specific environmental and hazardous area classifications.
- B. Elevation: Equipment shall be designed to operate at the project ground elevation.
- C. Temperature:
  1. Outdoor areas' equipment shall operate between -30 to 50 C degrees ambient.
  2. Equipment located in indoor locations shall operate between 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 operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 5 to 100 percent relative, condensing humidity.

## PART 2 –PRODUCTS

### 2.1 GENERAL

- A. All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.
- B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Section 16000. Provide minimum size anchor of 3/8-inch.
- C. All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.
- D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
- E. All electronic/digital equipment shall be provided with radio frequency interference protection.
- F. Electrical:
  1. Equipment shall operate on a 60 Hertz 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 between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
2. With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (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. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.
  5. Switches and/or signals indicating an alarm, failure or upset condition shall be wired in a fail-safe manner. A fail-safe condition is an open circuit when in an alarm state.
  6. Materials and equipment shall be UL approved whenever such approved equipment and materials are available.
  7. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory, and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.

## 2.2 ELECTRICAL SURGE PROTECTION

- A. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. 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. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20µs impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground.
- B. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate NEMA 4X stainless steel enclosure (plastic is not acceptable) or conduit mounted, and shall be Phoenix Contact PT Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel DLA series, or equal.
- C. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, Citel DS40 series, or equal.
- D. RF Coaxial Cable - Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure in accordance with NEMA and UL standards. Surge protection devices shall be Citel P8AX series, Polyphaser, or equal.
- E. Inductive Loads - Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.
- F. Telephone Circuits - At a minimum, provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.

- G. Telecommunications Grounding – Contractor must follow TIA 607-D standards and related amendments for Telecommunications Bonding and Grounding.

### 2.3 SPARE PARTS

- A. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's contact information (address and phone number), part name, part number, part ordering information, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Owner or Engineer.
- B. Furnish one of each type of installed Surge protection devices.
- C. Other spare parts are specified in each section. An overview follows:
1. Devices within Control Panels - See the control panels section.
  2. PLC spare parts - See the PLC section.
  3. Instrument related Spare Parts - see the Instrument section(s).

### 2.4 TEST EQUIPMENT

- A. Provide all test equipment, instruction manuals, carrying/storage cases, unit battery charger, special tools, calibration fixtures, cord extenders, patch cords, test leads, and miscellaneous items for checking field operation of all supplied equipment.
- B. All test equipment shall be wrapped in bubble wrap, sealed in a polyethylene bag with a dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's part number, and equipment name shall be supplied. The test equipment shall be delivered and stored in a location directed by the Engineer.
- C. As a minimum, furnish the following test equipment:
1. One complete electronic process calibrator sets with rechargeable batteries, cases, spare fuses, test leads, and PC based software. Provide model 830 as manufactured by Altek, or equal.
  2. One portable digital multi-meter (DMM) with rechargeable battery and test leads, and carrying case, Fluke 289 Industrial Digital Multimeter, or equal. Combining the features of the electronic process calibrator and the DMM such as the Fluke 787 Process meter is acceptable.

## PART 3 – EXECUTION

### 3.1 GENERAL INSTALLATION

- A. Instrumentation and accessory equipment shall be installed in accordance with manufacturer instructions. The indicated locations of equipment, transmitters, alarms and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.
- B. Provide brackets and hangers required for mounting of equipment.
- C. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.

- D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. 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. Certify that field wiring associated with the equipment is installed in accordance with best industry practice. Coordinate work under this Section with that of the electrical work specified under applicable sections of Division 16.
- E. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare and ultraviolet exposure on digital readouts.

**3.2 TESTING**

- A. Contractor shall utilize and follow the SAWS standard Control System and I/O Test. All aspects of the system and all I/O points must be tested with the SAWS convention. Provide results of the test as a submittal once the control system has been installed. The test results shall also be included in the O&M manuals and as-built drawings. See the appendix to this specification section for SAWS standard Control System and I/O Test.

**3.3 TRAINING**

- A. Contractor to submit a training outline of topics on which operators and maintenance staff will be trained.

**3.4 PROCESS CONTROLLER INPUT/OUTPUT (I/O) SCHEDULE**

- A. Process controller I/O schedule itemizes the process controller Local and Remote I/O associated with the hardware provided under this contract. Provide additional I/O signals and hardware as required to furnish a complete and functional system and submit that revised list as defined in the submittal section. Process controller I/O schedule is included in plans.
- B. If assigned in this I/O schedule, do not modify the PLC I/O addresses without approval by the Engineer.

**END OF SECTION**

Project Name  
Date:

## CONTROL SYSTEM AND I/O TEST



**Test Procedure: (Step by Step)**

Procedure Name: Fail to Start

#Step	Description	Date	Passed	Initial
1	<b>Example:</b> This procedure assumes the equipment is stopped (Tag_equipment_run=0), in Remote (Tag_equipment_remote=1), set point is 25% (Tag_Equipment_SP=25)			
	<b>Comments:</b>			
2	<b>Example:</b> Set the Hardcoded Timer (Tag_Timer) to 30 Sec in PLC			
	<b>Comments:</b>			
3	<b>Example:</b> From the process screen (Screen name) click the equipment symbol to open the equipment pop up. Click the start Push button			
	<b>Comments:</b>			
4	<b>Example:</b> Do not force ON the equipment Run Status (Tag_equipment_run)			
	<b>Comments:</b>			
5	<b>Example:</b> Verify the start contact (Tag_Start=1) is energized in the PLC. in the field, verify the start relay is de-energized			
	<b>Comments:</b>			

INSTRUMENTATION AND CONTROLS - GENERAL PROVISIONS

6	<b>Example:</b> Verify fail to start time remaining count down from 30 to 0 sec.			
	<b>Comments:</b>			
7	<b>Example:</b> Allow for the hardcoded Fail to start timer to expire in the PLC			
	<b>Comments:</b>			
8	<b>Example:</b> From the equipment Pop up and alarm summary verify the fail to start alarm (Tag_equipment_fail_output) is active			
	<b>Comments:</b>			
9	<b>Example:</b> Verify the Start contact is de-energized (Tag_Start=0) in the PLC. Verify the start relay is de-energized			
	<b>Comments:</b>			
10	<b>Example:</b> From the Process Screen and equipment pop up, verify the equipment is not available for control			
	<b>Comments:</b>			
11	<b>Example:</b> From the process screen click on equipment symbol to open the equipment pop up. Click the reset pushbutton			
	<b>Comments:</b>			
12	<b>Example:</b> From the process screen and equipment pop up, verify the fail to start alarm is no longer active			
	<b>Comments:</b>			

INSTRUMENTATION AND CONTROLS - GENERAL PROVISIONS

<b>Comments:</b>			
13	<p><b>Example:</b> from the process screen and equipment pop up, verify the equipment is now available for control</p>		
<b>Comments:</b>			



## CONTROL SYSTEM AND I/O TEST



Project Name  
Date:

**IO Test:**

**Digital**

	Tag name	Type	Description	PLC point			Date	Initial	Passed
				R	S	P			
1	Tag_Equipment_Start	DO	Equipment start command	1	1	1			
	<b>Comment:</b>								
2	Tag_Equipment_Started	DI	Equipment start Feedback	1	2	1			
	<b>Comment:</b>								
3									
	<b>Comment:</b>								
4									
	<b>Comment:</b>								

**Analog Input**

	Tag name	Description	Type	Range	PLC point			Date	Initial	Passed
					R	S	P			
1	Tank_level	Level of tank	AI	0-40 ft	1	3	1			
	<b>4mA=</b>		<b>8mA=</b>		<b>12mA=</b>		<b>16mA=</b>		<b>20mA=</b>	
	<b>Comment:</b>									
2	Cabinet_Temp	Temperature of Cabinet	AI	0-140 F	1	3	2			
	<b>4mA=</b>		<b>8mA=</b>		<b>12mA=</b>		<b>16mA=</b>		<b>20mA=</b>	
	<b>Comment:</b>									
3			AI							
	<b>4mA=</b>		<b>8mA=</b>		<b>12mA=</b>		<b>16mA=</b>		<b>20mA=</b>	
	<b>Comment:</b>									

INSTRUMENTATION AND CONTROLS - GENERAL PROVISIONS

**Analog Output**

	Tag name	Type	Range	Description	PLC point			Date	Initial	Passed
					R	S	P			
1	Pump_Speed_SP	AO	0-2000 rpm	Set point of pump speed	1	4	1			
<b>Comment:</b>										
2	Tank_Level_SP	AO	10-40 ft.	Set point of Tank level	1	4	2			
<b>Comment:</b>										
3		AO								
<b>Comment:</b>										
4		AO								
<b>Comment:</b>										

**Com. (Modbus, RS232, RS 485,...)**

	Tag name	R/W	Com. Type	Description	Range	Date	Initial	Passed
1	Flow_Meter_No1	R	M-RS485	Flow meter No.1	0-200 GPM			
<b>Comment:</b>								
2	Valve_opening_cmd	W	M	%Valve Opening	0-100			
<b>Comment:</b>								
3								
<b>Comment:</b>								
4								
<b>Comment:</b>								

Project Name  
Date:

## CONTROL SYSTEM AND I/O TEST



**Comments:**

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The results were satisfactory

The results were unsatisfactory

**Test Witness:**

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INSTRUMENTATION AND CONTROLS - GENERAL PROVISIONS

Contractor

Owners Representative

Date

**Retest Witness: (if original test result were unsatisfactory)**

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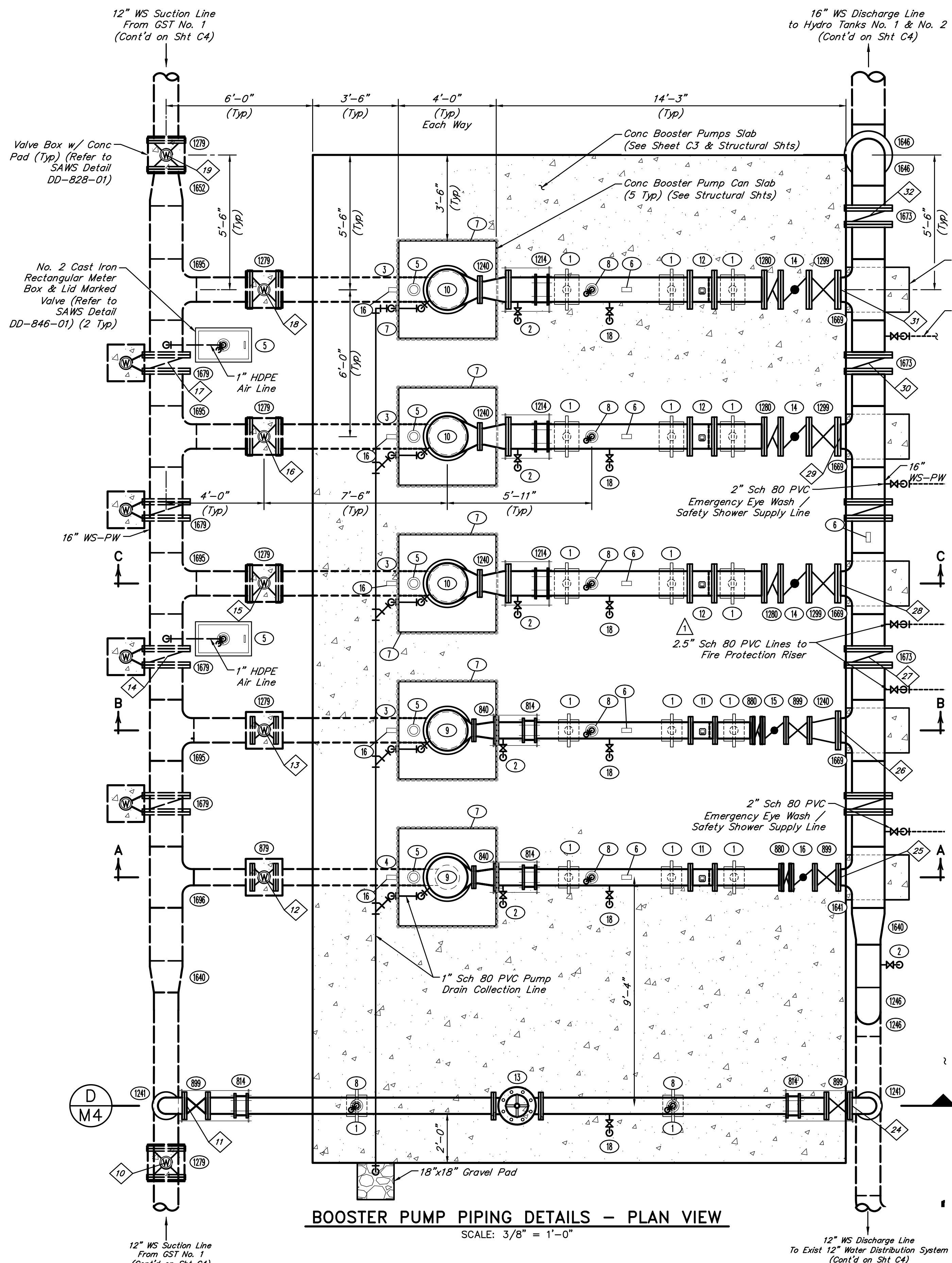
Contractor

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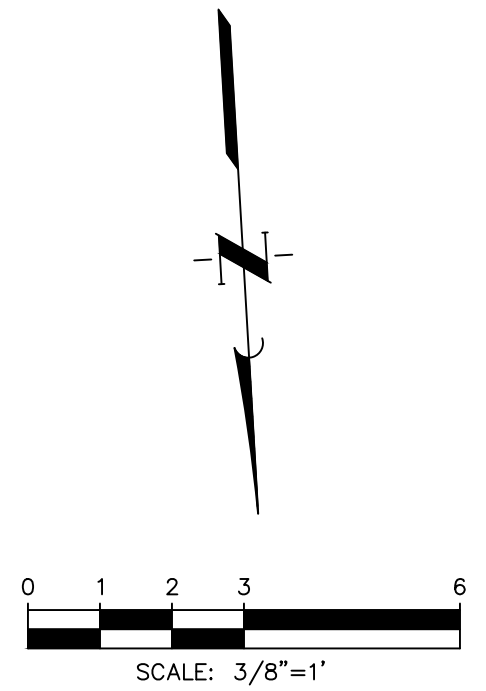
Owners Representative

-----

Date



**BOOSTER PUMP PIPING DETAILS - PLAN VIEW**  
SCALE: 3/8" = 1'-0"



**PIPING CHART:**

- 804 8" Restrained Flanged Coupling Adapter
- 890 8"x8" Concentric Reducer, FJ
- 879 8" NRS Gate Valve, FJ (GTV-03-101)
- 880 8" Double Disk Check Valve, FJ (DCV-03-101, DCV-03-201)
- 889 8" OS & Y Gate Valve, FJ (GTV-03-001, GST-03-002, GST-03-102, GTV-03-202)
- 1274 12" Restrained Flanged Coupling Adapter
- 1240 12"x8" Concentric Reducer, FJ
- 1241 12"x8" Tee, PE
- 1246 12"x90° Bend, PE
- 1278 12" NRS Gate Valve, FJ (GTV-03-201 to GTV-03-501)
- 1280 12" Double Disk Check Valve, FJ (DCV-03-301 to DVC-03-501)
- 1288 12" OS&Y Gate Valve, FJ (GTV-03-302, GTV-03-402 & GTV-03-502)
- 1640 16"x12" Concentric Reducer, PE
- 1641 16"x8" Tee, PEXFJ
- 1646 16"x90° Bend, PE
- 1662 16"x12" Concentric Reducer, PE x FJ
- 1669 16"x12" Tee, PE x FJ
- 1673 16" Butterfly Valve, FJ (BFV-03-005 to BFV-03-009)
- 1678 16" NRS Butterfly Valve, FJ (BFV-03-001 to BFV-03-004)
- 1685 16"x12" Tee, PE
- 1686 16"x8" Tee, PE

**BOOSTER PUMP ACCESSORY CHART:**

- 1 4" Adjustable Steel Pipe Support (See Detail Sheet M7)
- 2 3/4" Sample Cock Assembly (SC-03-001 & SC-03-101 to SC-03-501) (Refer to SAWS Detail DD-901-03)
- 3 18" Booster Pump Can w/ 12" Welded Steel Inlet.
- 4 12" Booster Pump Can w/ 8" Welded Steel Inlet Pipe.
- 5 1/2" Air Release Valve, APCO Model No. 50, w/ 3/32" Orifice, No. 16 Mesh, 316 Stainless Steel Screen on Discharge and Shut-Off Ball Valve. Attach to Discharge Head. (ARV-03-101 to ARV-03-501 and ARV-03-003 to ARV-03-004)
- 6 Pressure Transmitter (0-200 psi) w/ Shut-Off Ball Valve and High Pressure Cut-Off Switch (PI-03-001 to PI-03-501)
- 7 Isolation Joint (See Detail Sheet C5)
- 8 2" Combination Air Release Valve, APCO Model No. 145C, 316 Stainless Steel Screen on Discharge and Shut-Off Ball Valve. (ARV-03-102 to ARV-03-502 and ARV-03-001 to ARV-03-002)
- 9 300-gpm Jockey Booster Pump w/ 50-HP Motor (BP-03-101 to BP-03-201)
- 10 1,050-gpm Vertical Turbine Booster Pump w/ 125-HP Motor (BP-03-301 to BP-03-501)
- 11 8" Magnetic Flow Meter, FJ
- 12 12" Magnetic Flow Meter, FJ
- 13 8" Pressure Relief Valve, Cla-Val Model No. 52-01 or Approved Equal
- 14 12" Motor Operated Butterfly Valve, FJ
- 15 8" Motor Operated Butterfly Valve, FJ
- 16 Low Pressure Cut-Off Switch (PSL-03-101 to PSL-03-501)
- 17 2" Drain Tap w/ Globe Valve (Refer to SAWS Detail DD-901-03) (GLB-03-001 & GLB-03-101 to GLB-03-501)

**CATHODIC PROTECTION LEGEND**

- XX Test Station (See Sheet C6)
- A-X Galvanic Anode Bed (See Sheet C6)

**PIPING NOTES:**

1. All pipe shall be welded steel (WS) pipe unless otherwise noted.
2. Denotes the use of a restrained joint connection.
3. Small diameter piping is shown schematically. Contractor shall field route piping, providing offsets, fittings, etc., as required.
4. All pipe penetrations shall be made through a pipe saddle.

1	10/2/23	REISSUED PER ADDENDUM NO. 1	TWM
NO.	DATE	REVISIONS	APP.

SAN ANTONIO WATER SYSTEM

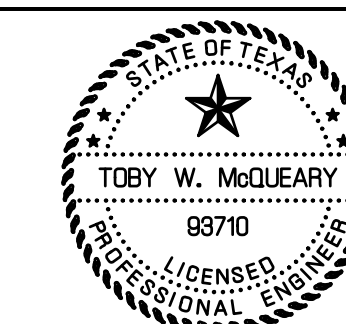
MEGHAN PUMP STATION

**BOOSTER PUMP PIPING & DETAILS**

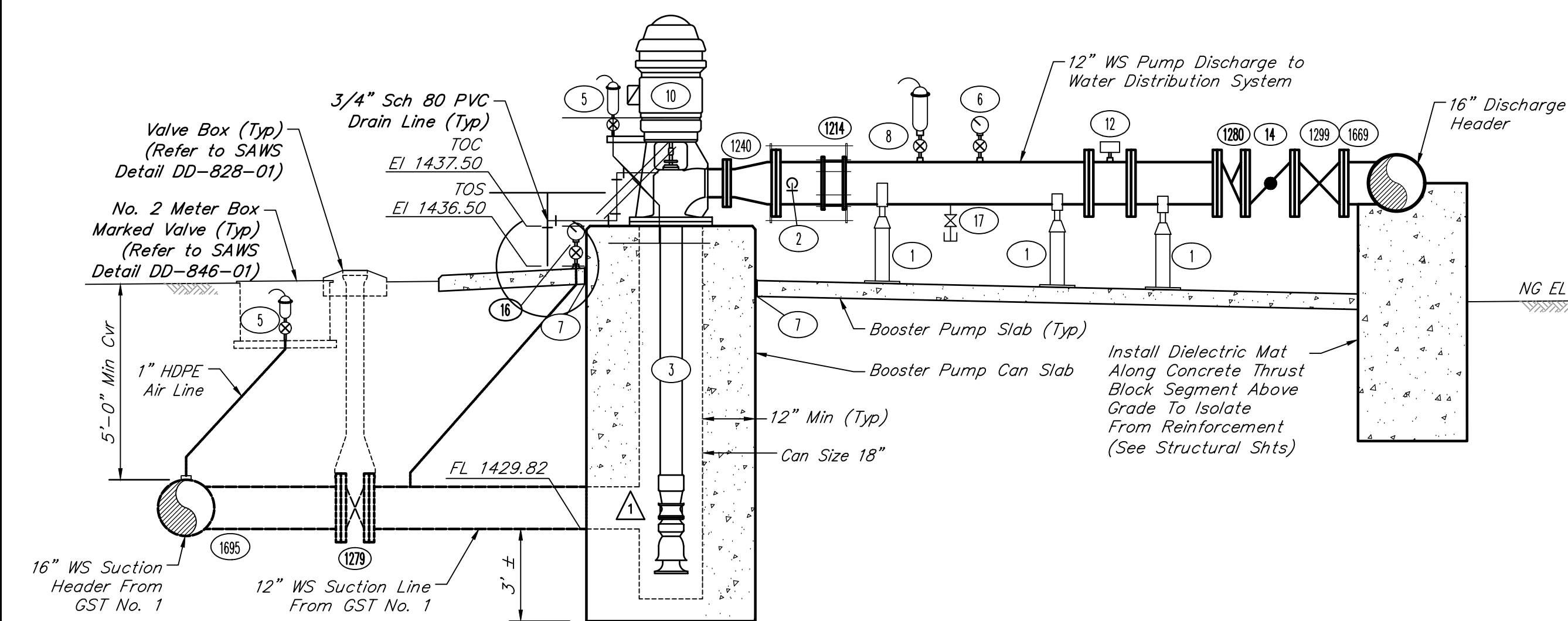


Texas Board of Professional Engineers and Land Surveyors Reg. No. F-23290  
4302 Locks-Serra Road, Suite 100-A, San Antonio, Texas 78249-1104

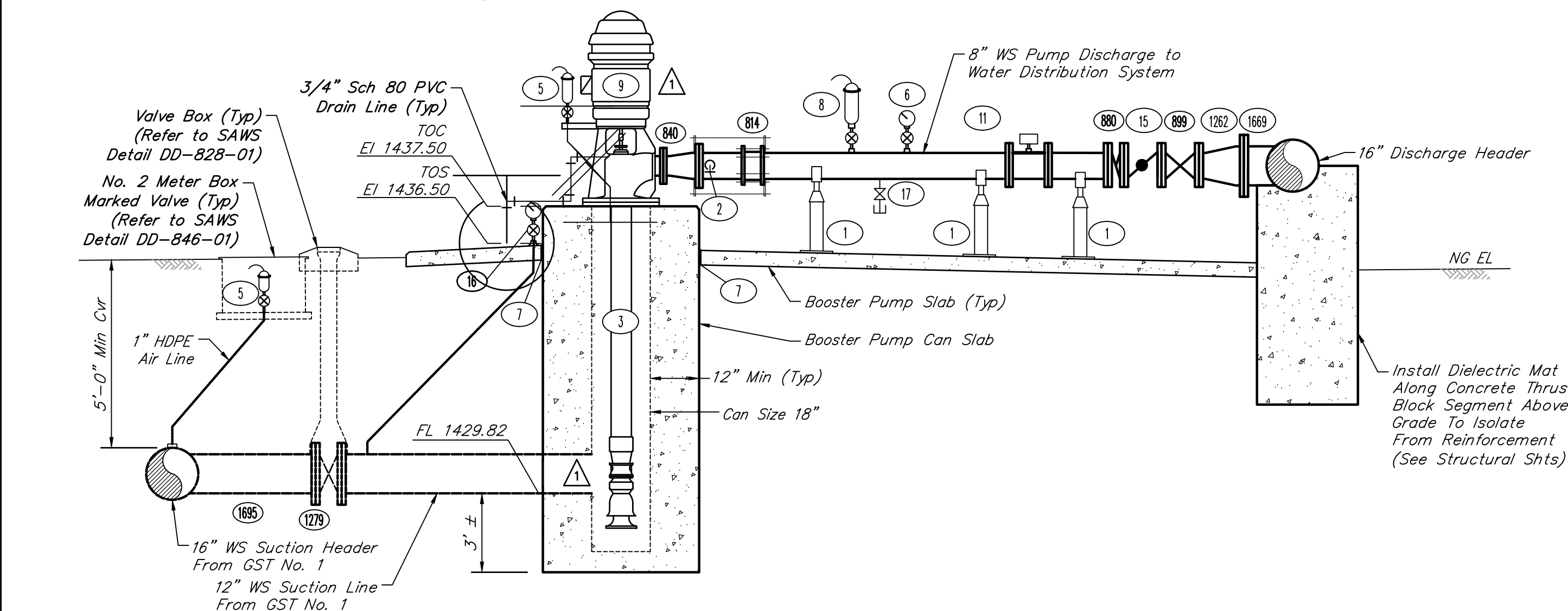
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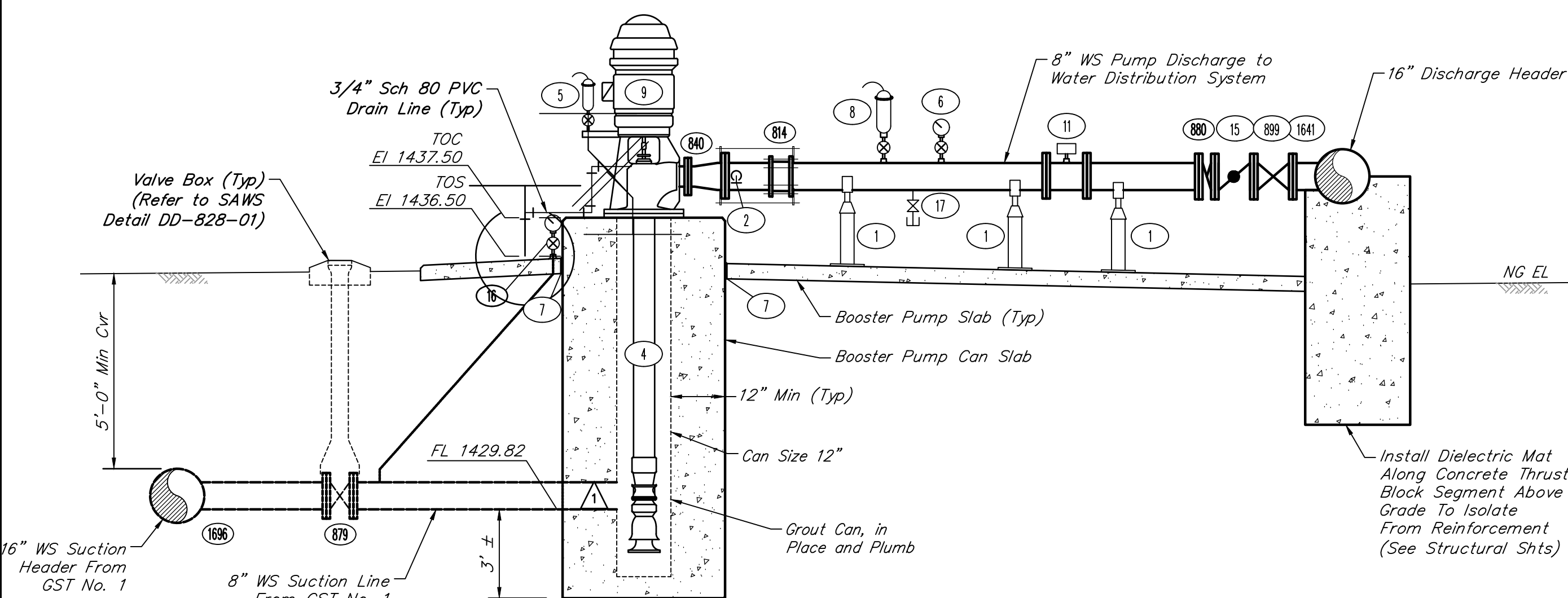
10-17-2023 SHEET NO. M3  
21 OF 67



**C 12" PIPING PROFILE VIEW**  
SCALE: 3/8" = 1'-0"



**B 8" PIPING PROFILE VIEW**  
SCALE: 3/8" = 1'-0"



**A 8" PIPING PROFILE VIEW**  
SCALE: 3/8" = 1'-0"

- ① 4" Adjustable Steel Pipe Support (See Detail Sheet M7)
- ② 3/4" Sample Cock Assembly (SC-03-001 & SC-03-101 to SC-03-501) (Refer to SAWS Detail DD-901-03)
- ③ 18" Booster Pump Can w/ 12" Welded Steel Inlet.
- ④ 12" Booster Pump Can w/ 8" Welded Steel Inlet Pipe.
- ⑤ 1/2" Air Release Valve, APCO Model No. 50, w/ 3/32" Orifice, No. 16 Mesh, 316 Stainless Steel Screen on Discharge and Shut-Off Ball Valve. Attach to Discharge Head. (ARV-03-101 to ARV-03-501 and ARV-03-003 to ARV-03-004)

**BOOSTER PUMP ACCESSORY CHART:**

- ⑥ Pressure Transmitter (0-200 psi) w/ Shut-Off Ball Valve and High Pressure Cut-Off Switch (PI-03-001 to PI-03-501)
- ⑦ Isolation Joint (See Detail Sheet C5)
- ⑧ 2" Combination Air Release Valve, APCO Model No. 143C, 316 Stainless Steel Screen on Discharge and Shut-Off Ball Valve. (ARV-03-102 to ARV-03-502 and ARV-03-001 to ARV-03-002)
- ⑨ 300-gpm Jockey Booster Pump w/ 50-HP Motor (BP-03-101 to BP-03-201)
- ⑩ 1,050-gpm Vertical Turbine Booster Pump w/ 125-HP Motor (BP-03-301 to BP-03-501)
- ⑪ 8" Magnetic Flow Meter, FJ
- ⑫ 12" Magnetic Flow Meter, FJ

**NOTES:**

1. Apply paint to all welds, threads and any areas scraped during construction.
2. Booster pump can be installed per Hydraulic Institute Standards.
3. Booster pump can elevations represent the minimum required elevations. Actual elevations may vary based on approved manufacturer shop drawings.
4. Contractor to verify the straight pipe length required per Magnetic Flow Meter manufacturer.
5. The Booster Pump Station shall comply with SAWS Details DD-901-01, DD-901-02, and DD-901-03.

**PIPING CHART:**

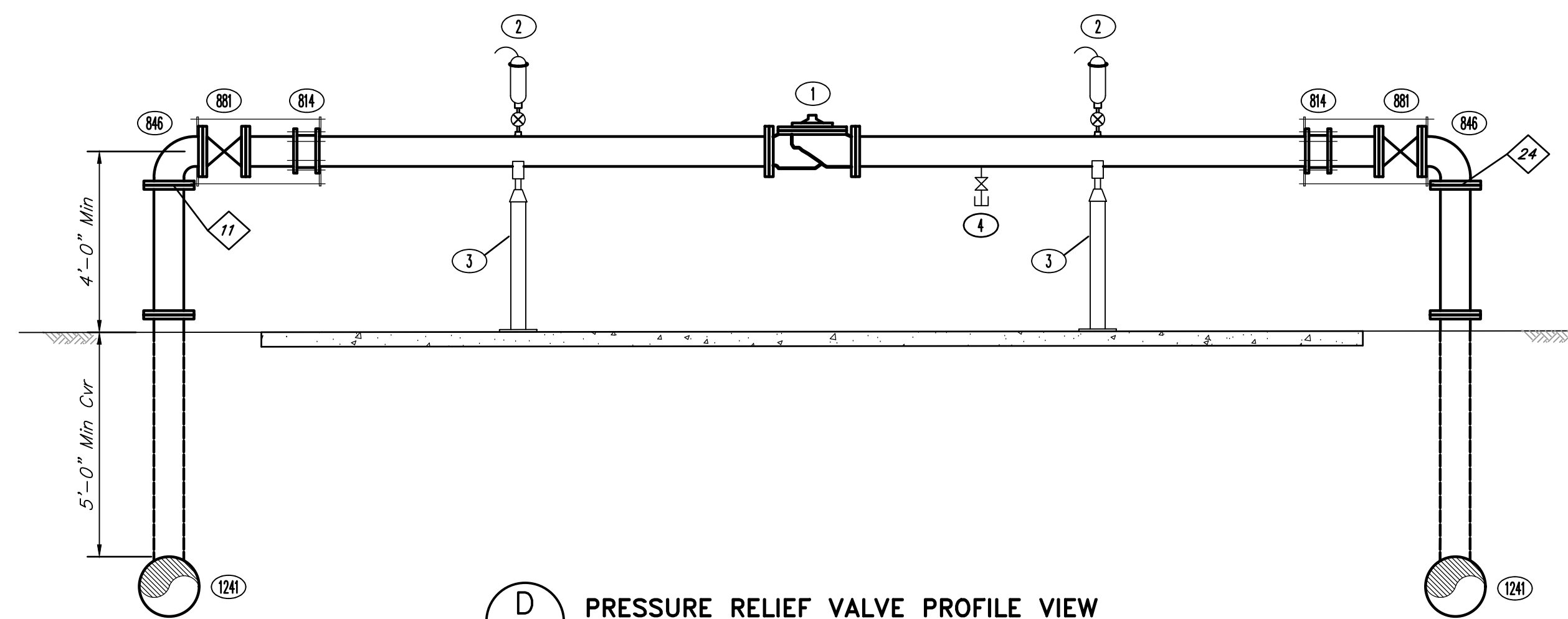
- ⑧4 8" Restrained Flange Coupling Adaptor
- ⑧6 8"x90" Bend, FJ
- ⑧8 8" OS & Y Gate Valve, FJ
- ⑫4 12"x8" Tee, PE

**ACCESSORY CHART:**

- ① 8" Pressure Relief Valve, Cla-Val Model No. 52-01 or Approved Equal
- ② 1" Combination Air Release Valve, APCO Model No. 143C, 316 Stainless Steel Screen on Discharge and Shut-Off Ball Valve.
- ③ 4" Steel Adjustable Steel Pipe Support (See Detail Sheet M8)
- ④ 2" Drain Tap (Refer to SAWS Detail DD-901-03) (GLB-03-001)

**PIPING NOTES:**

1. All pipe shall be welded steel (WS) pipe unless otherwise noted.
2. Small diameter piping is shown schematically. Contractor shall field route piping, providing offsets, fittings, etc., as required.
3. All pipe penetrations shall be made through a pipe saddle.



**D PRESSURE RELIEF VALVE PROFILE VIEW**  
SCALE: 3/8" = 1'-0"

**CATHODIC PROTECTION LEGEND**

- ⊗ Test Station (See Sheet C6)
- ⊗ Galvanic Anode Bed (See Sheet C6)

1	10/2/23	REISSUED PER ADDENDUM NO. 1	TWM
NO.	DATE	REVISIONS	APP.

SAN ANTONIO WATER SYSTEM

MEGHAN PUMP STATION

BOOSTER PUMP DETAILS



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4302 Lockhill-Spring Road, Suite 100 Springtown, Texas 76082 P.O. Box 25311

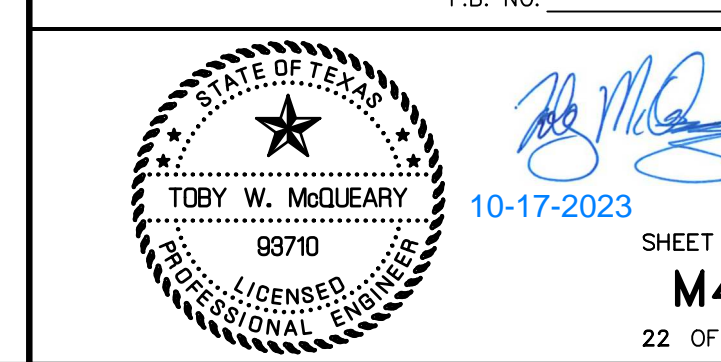
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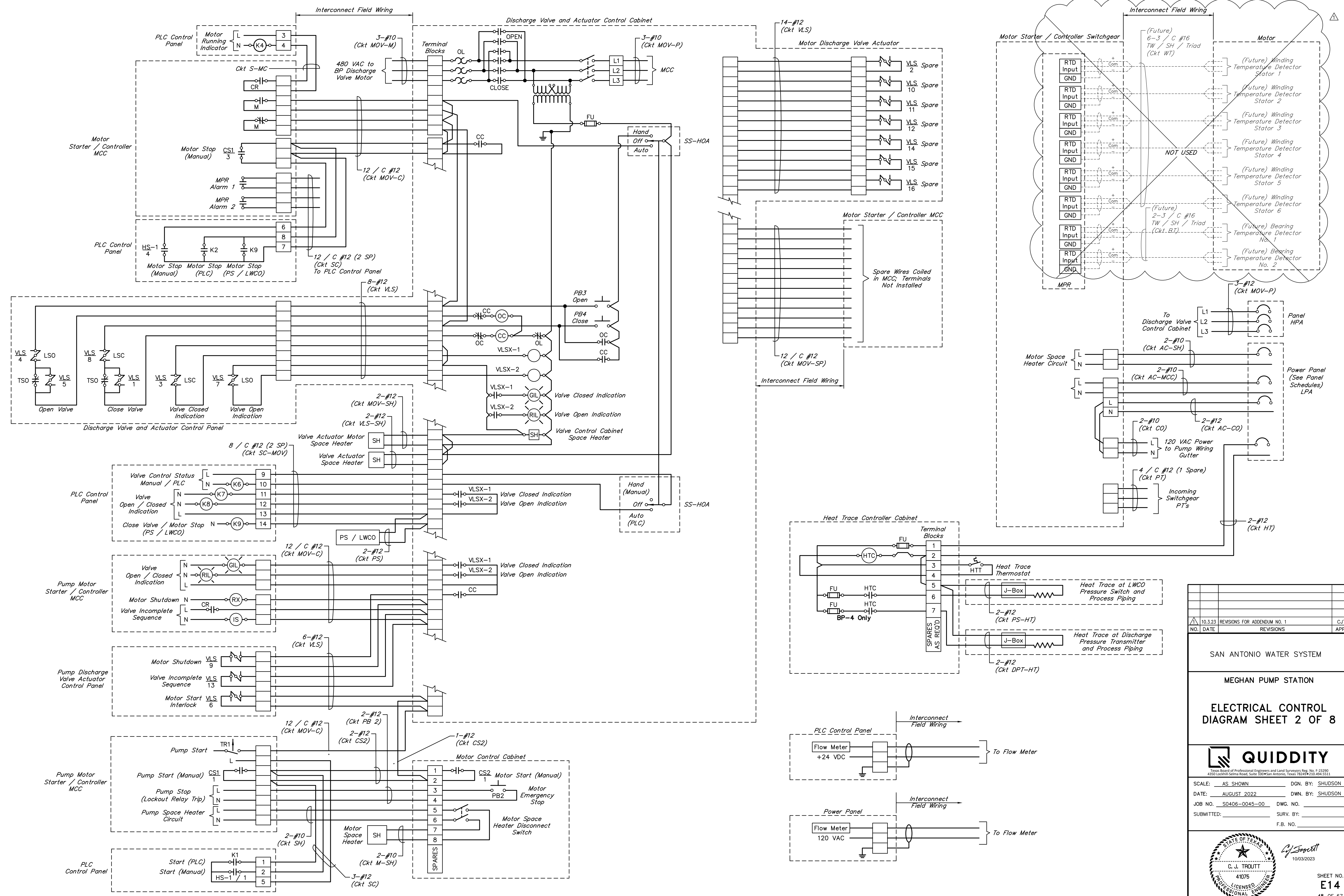
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JOB NO.: S0406-0045-00 DWG. NO.:

SUBMITTED: SURV. BY: F.B. NO.:

10-17-2023 SHEET NO. M4 22 OF 67



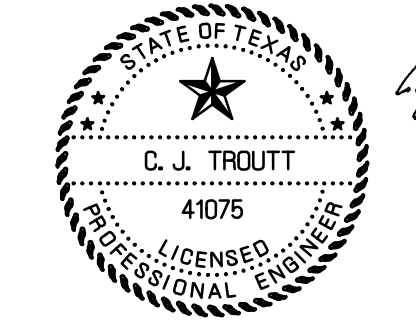


NO.	DATE	REVISIONS	APP.
10.3.23		REVISIONS FOR ADDENDUM NO. 1	CJT

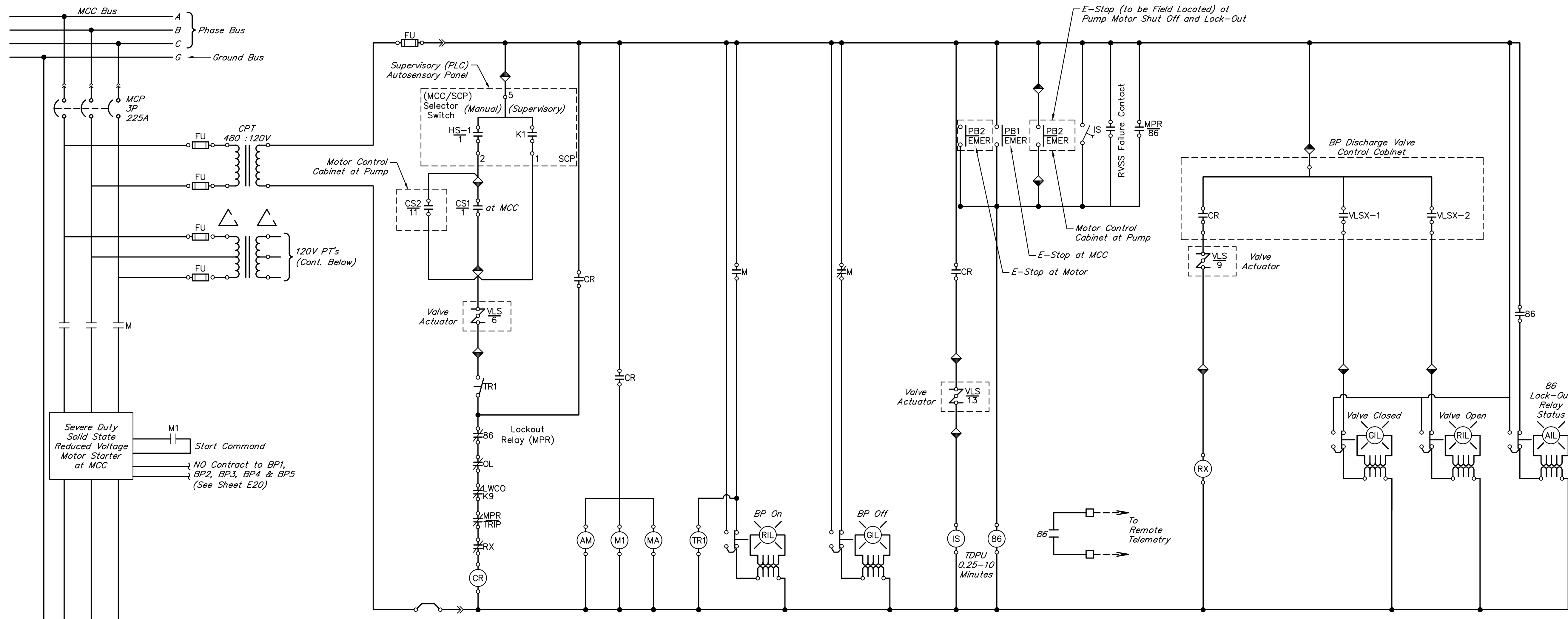
**SAN ANTONIO WATER SYSTEM**  
**MEGHAN PUMP STATION**  
**ELECTRICAL CONTROL**  
**DIAGRAM SHEET 2 OF 8**



SCALE: AS SHOWN DGN. BY: SHUDDON  
 DATE: AUGUST 2022 DWN. BY: SHUDDON  
 JOB NO. S0406-0045-00 DWG. NO. \_\_\_\_\_  
 SUBMITTED: \_\_\_\_\_ SURV. BY: \_\_\_\_\_  
 F.B. NO. \_\_\_\_\_



K:\S0406\S0406-0045-00 Blackback Regional Pump Station, San Ant\2 Design Phase\CAD\Blackback Booster Station\S0406-0045-00 ELEC.dwg



**BP MOTOR STARTER / CONTROLLER CONTROL SCHEMATIC**  
NOT TO SCALE

- CALLOUTS LEGEND:**
- AIL AMBER INDICATING LIGHT
  - AM AMMETER+
  - BP BOOSTER PUMP
  - CAP CAPACITOR
  - CC CLOSED CIRCUIT / COIL
  - CPT CONTROL POWER TRANSFORMER
  - CS CONTROL SWITCH
  - CT CURRENT TRANSFORMER
  - EMER EMERGENCY
  - FU FUSE
  - GIL GREEN INDICATING LIGHT
  - HS-1 2-POSITION SELECTOR SWITCH (SCP / MCC)
  - IS INCOMPLETE SEQUENCE RELAY
  - LWCO / K9 LOW WATER CUTOFF
  - M MAIN CONTACTOR AUXILIARY CONTACT
  - MIN MINUTES
  - MOV MOTOR OPERATED VALVE
  - OL OVERLOAD RELAY
  - OL PRIMARY
  - PB PUSH BUTTON
  - RES RESISTOR
  - RIL RED INDICATING LIGHT
  - RTD RESISTANCE TEMPERATURE DEVICE
  - RX PUMP SHUTDOWN AUXILIARY RELAY
  - SCTB SHORTING CURRENT TRANSFORMER BLOCK
  - SEC SECONDS
  - SUPV SUPERVISORY
  - TRIP TRIP CIRCUIT
  - TDDO TIME DELAY AFTER DROP OUT
  - TDPU TIME DELAY AFTER PICK UP
  - TM TIMING METER
  - TO TIMED OPENING
  - TS TEST SWITCH
  - VLS VALVE LIMIT SWITCH
  - VLSX VALVE LIMIT SWITCH AUXILIARY RELAY
  - 86 LOCK-OUT RELAY

**TERMINAL POINT LEGEND:**

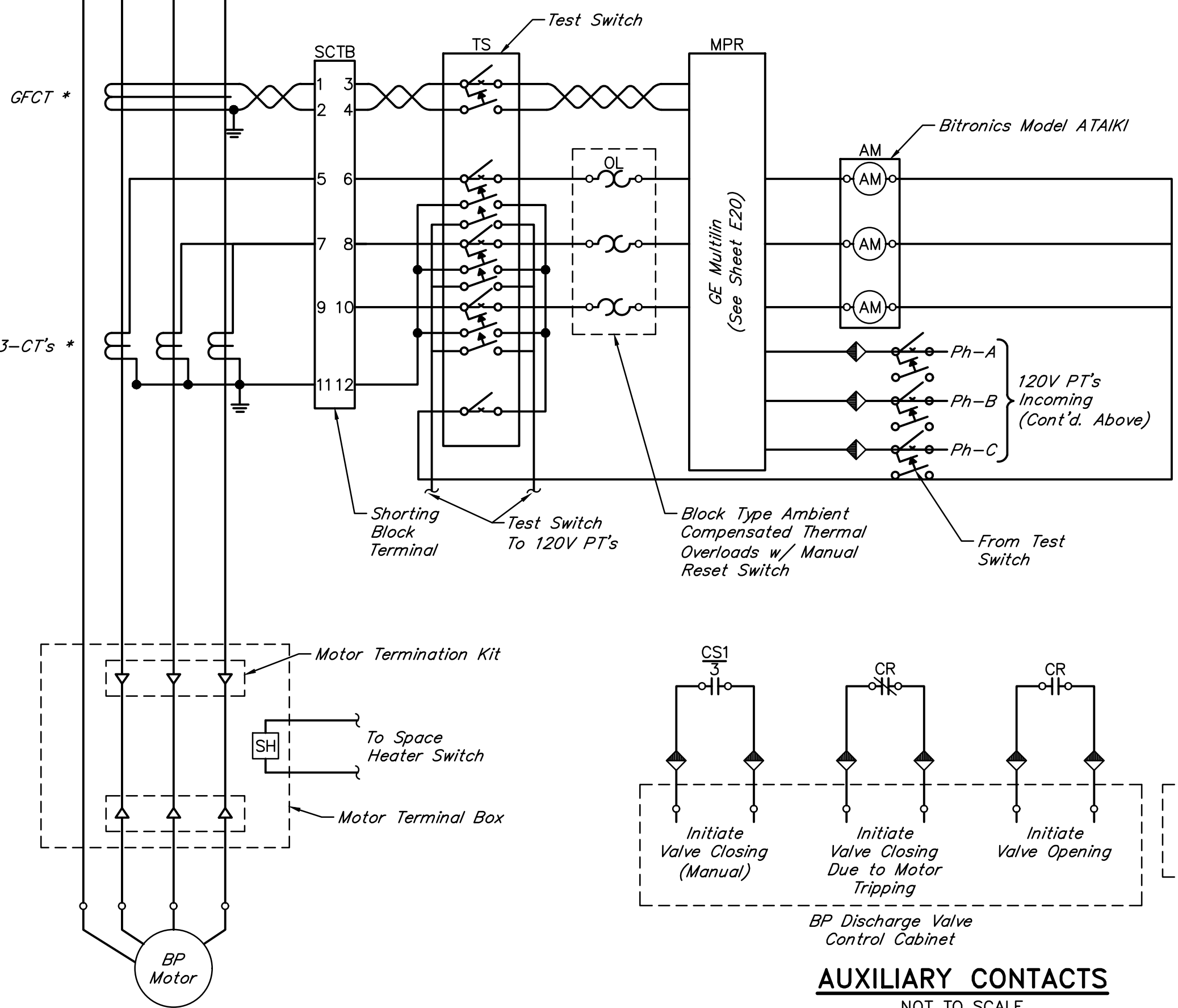
Terminal Point in BP Motor Starter / Controller Cubicle; Dark Side Indicates Connection Internal to Panel

**GENERAL NOTES:**

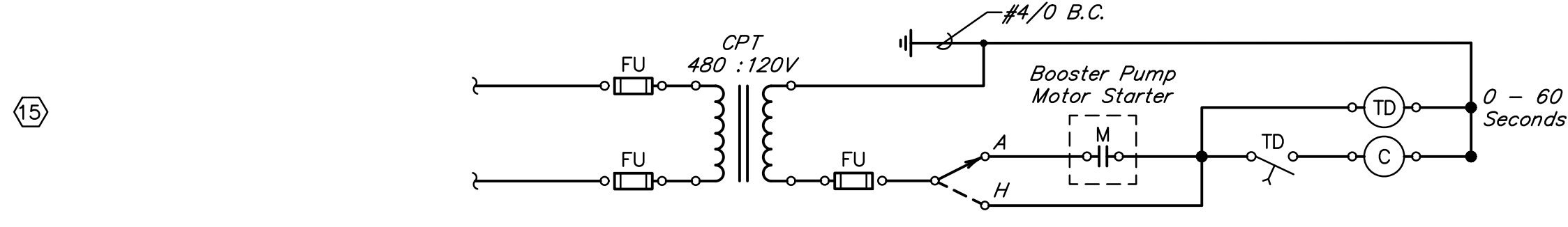
- This drawing is typical for all Booster Pump Motor Starters.

CONTACT	CS1 & CS2			STOP
	START	NORMAL AFTER START	AFTER STOP	
1	X			
2	X			X
3				
4				X

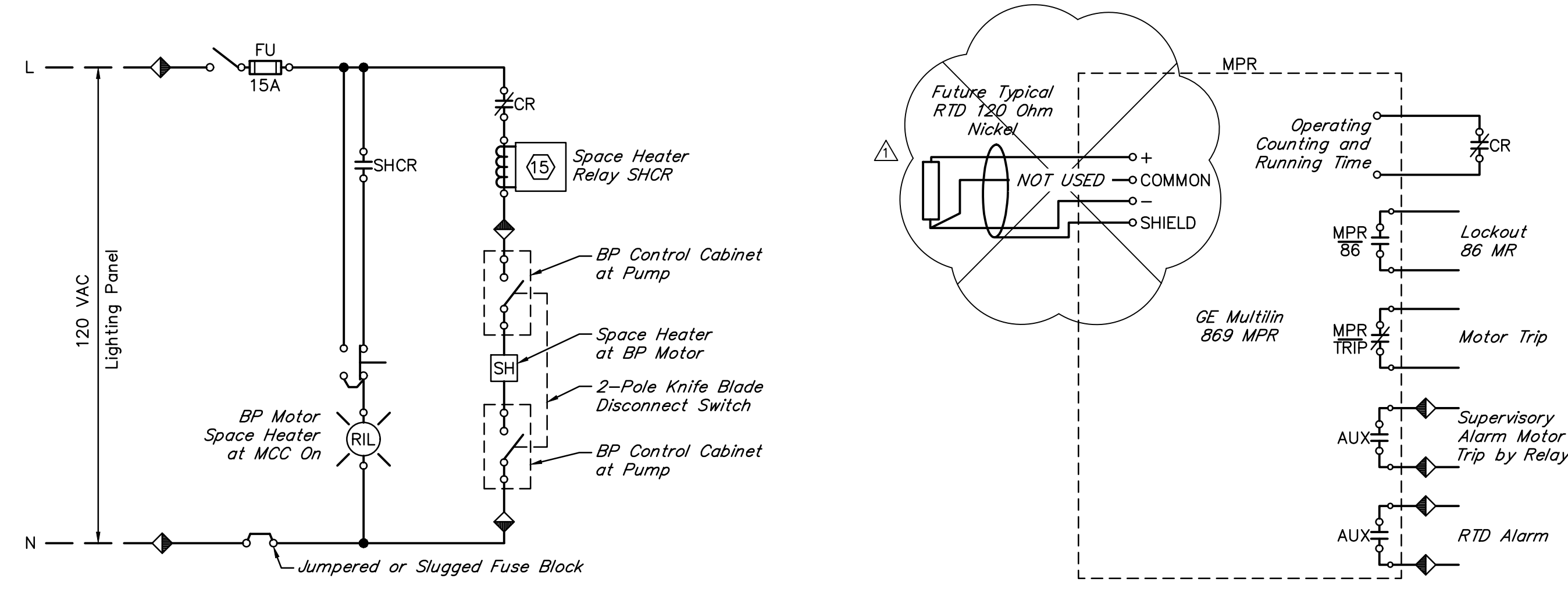
X - INDICATES CONTACT IS CLOSED



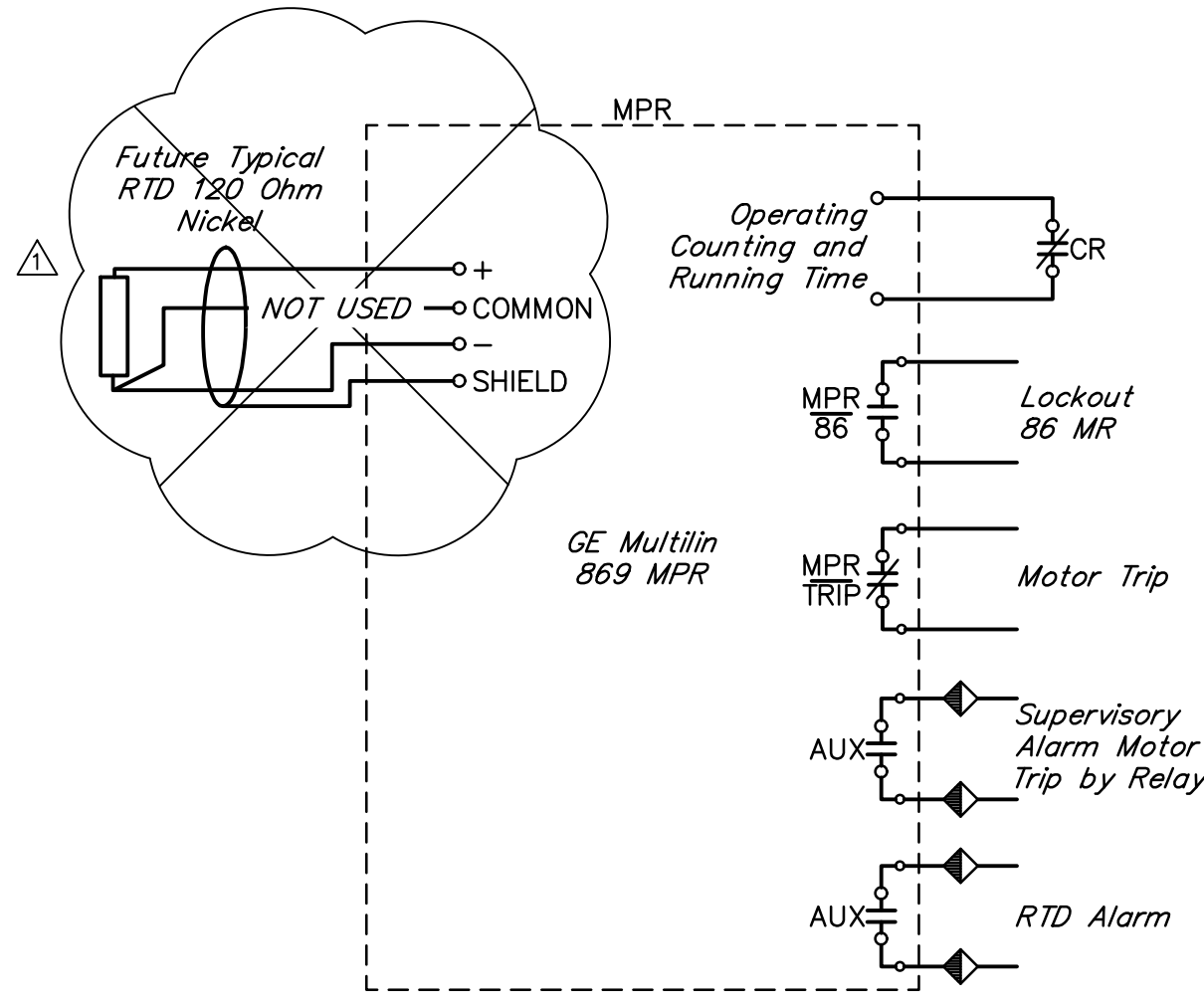
**AUXILIARY CONTACTS**  
NOT TO SCALE



**POWER FACTOR CORRECTION CAPACITOR DIAGRAM**  
NOT TO SCALE



**TYPICAL BP MOTOR SPACE HEATER CIRCUIT**  
NOT TO SCALE



**MOTOR PROTECTION RELAY**  
NOT TO SCALE

10.3.23	REVISIONS FOR ADDENDUM NO. 1	CJT
NO. DATE	REVISIONS	APP.

SAN ANTONIO WATER SYSTEM

MEGHAN PUMP STATION

**ELECTRICAL CONTROL DIAGRAM SHEET 3 OF 8**

**QUIDDITY**  
Texas Board of Professional Engineers and Land Surveyors Reg. No. F-22290  
4301 Lockhart/Arma Road, Suite 100 San Antonio, Texas 78249 P: 210-484-2911

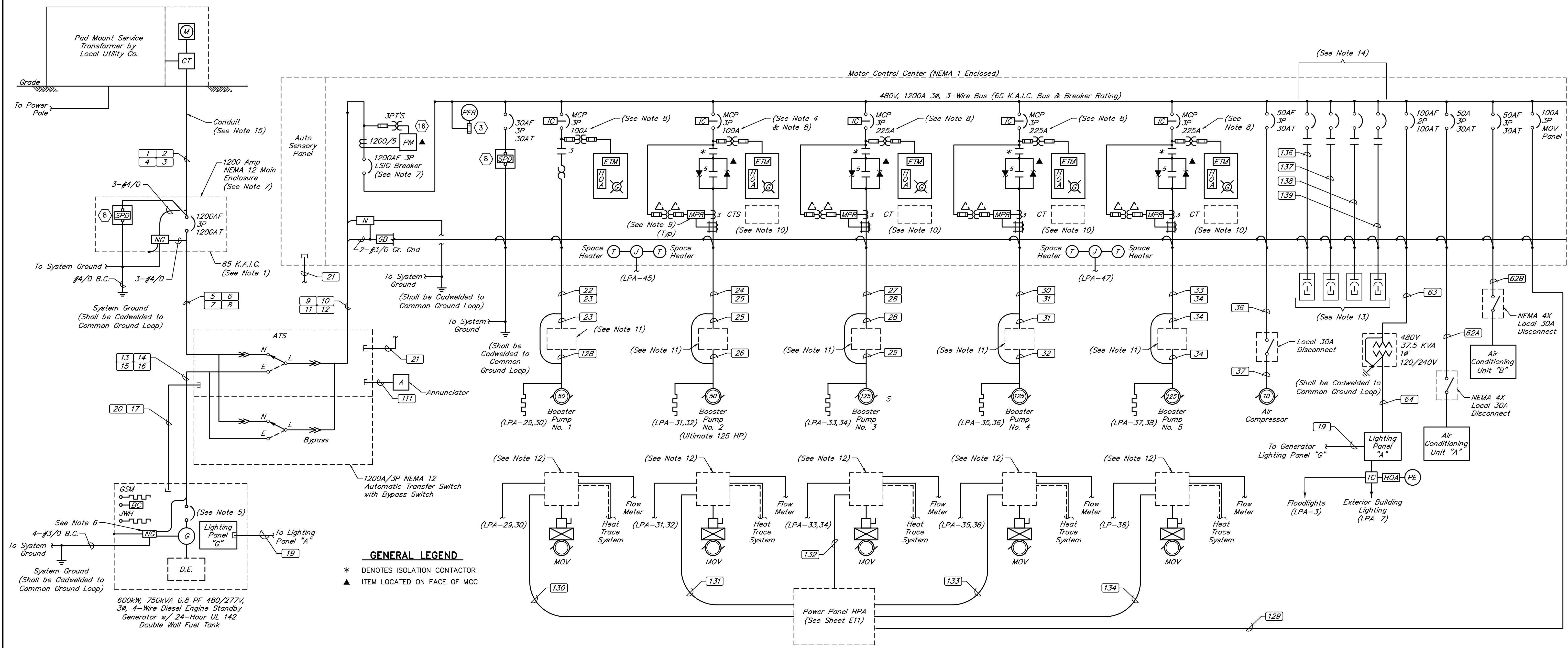
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SUBMITTED: \_\_\_\_\_ SURV. BY: \_\_\_\_\_  
F.B. No. \_\_\_\_\_

STATE OF TEXAS  
C. J. TRUETT  
41075  
LICENSED PROFESSIONAL ENGINEER

10/03/2023

SHEET NO. **E15**  
49 OF 67





**GENERAL LEGEND**  
 \* DENOTES ISOLATION CONTACTOR  
 ▲ ITEM LOCATED ON FACE OF MCC

**NOTES:**

- Provide Switchboard Style 1200A breaker with L.S.I.G. solid state trip with Zero Sequence XFMR, 65 K.A.I.C. 100% rated, suitable as service entrance device.
- Provide all conduit entering MCC & other enclosure from bottom with grounding bushing & bond wire per N.E.C. Do not double lug.
- Provide traditional "NEMA" devices as defined in NEMA Standards Publication No. ICS 2.4-2003. IEC Components are not allowed.
- Provide space for future 225A/3P MCP type breaker.
- Generator breaker to be provided by generator Manufacturer.
- Generator is a separately derived system. Establish a neutral-ground bond at generator.
- Provide Arc Reducing Maintenance System (ARMS) per NEC 240.87. Include Zero Sequence Relay / XFMR.
- Adjust MCP for submitted motor load.
- MPR denotes Motor Protection Relay Multilin 869 with draw-out case.
- Provide Infrared (IR) Viewing Window.
- Pump Control Panel near Motor.
- MOV Control Panel near MOV (See Sheet E14 for interconnecting wiring).
- Provide and install Power Factor Correction Capacitor as provided by motor Manufacturer (30kVAR) as stated for the basis of bid. Mount capacitors to top of Motor Control Center. Provide 30 circuit feet of wire from MCC base.
- Provide 100AF/3P/60AT with Contactors for Power Factor Correction Capacitors.
- Conduit from the secondary side of the CPS pad XFMR to the Main Disconnect is 4-4" Conduit, each with 3-#400MCM & 1-#3/0 NEU / 1-#3/0 GND. Conductors are copper and shall be installed in accordance with CPS Energy and SAWS requirements.

**ONE-LINE DIAGRAM**  
 NOT TO SCALE

LOAD	AMPS			
	ØA	ØB	ØC	SBKW
BOOSTER PUMP No. 1	50 HP	65	65	42
BOOSTER PUMP No. 2	50 HP (125 HP ULTIMATE)	156	156	103
BOOSTER PUMP No. 3	125 HP	156	156	103
BOOSTER PUMP No. 4	125 HP	156	156	103
BOOSTER PUMP No. 5	125 HP	156	156	103
AIR COMPRESSOR	10 HP	14	14	9.0
AIR CONDITIONING UNIT	5 TON	17	17	9.0
TRANSFORMER	37.5 KVA	78	-	78
25% OF LARGEST MOTOR		39	39	39
TOTAL LOAD		837	759	837
SERVICE AMPACITY @ 480 VOLT		1200	1200	1200
SPARE AMPACITY		363	442	363
FAULT CURRENT		< 65KAIC		

NO.	DATE	REVISIONS	APP.
10.9.23	AUGUST 2022	REVISIONS FOR ADDENDUM NO. 1	CJT

SAN ANTONIO WATER SYSTEM  
 MEGHAN PUMP STATION  
**ELECTRICAL ONE LINE DIAGRAM**

**QUIDDITY**  
 Texas Board of Professional Engineers and Land Surveyors, Reg. No. F-23290  
 4300 Lockhill-Spring Road, Suite 100 • San Antonio, Texas 78249-2104/94533

SCALE: NO SCALE DGN. BY: SHUDSON  
 DATE: AUGUST 2022 DWN. BY: SHUDSON  
 JOB NO. S0406-0045-00 DWG. NO. \_\_\_\_\_  
 SUBMITTED: \_\_\_\_\_ SURV. BY: \_\_\_\_\_  
 F.B. NO. \_\_\_\_\_

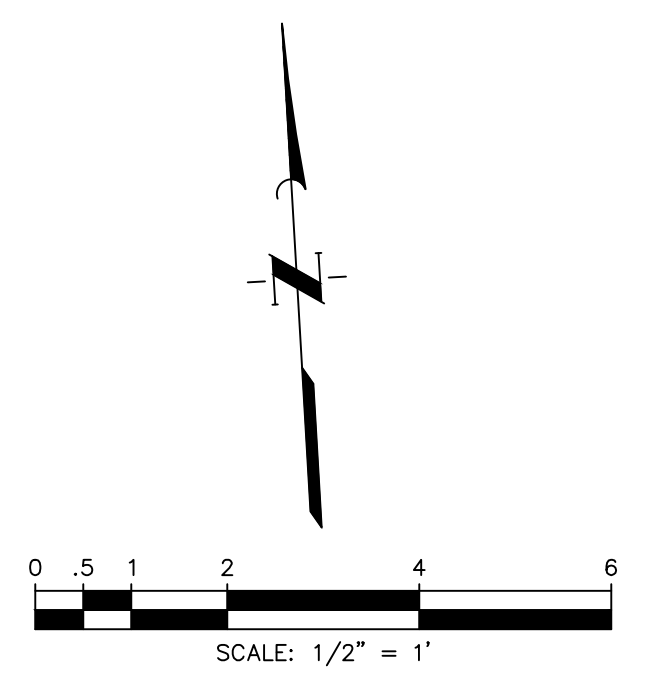
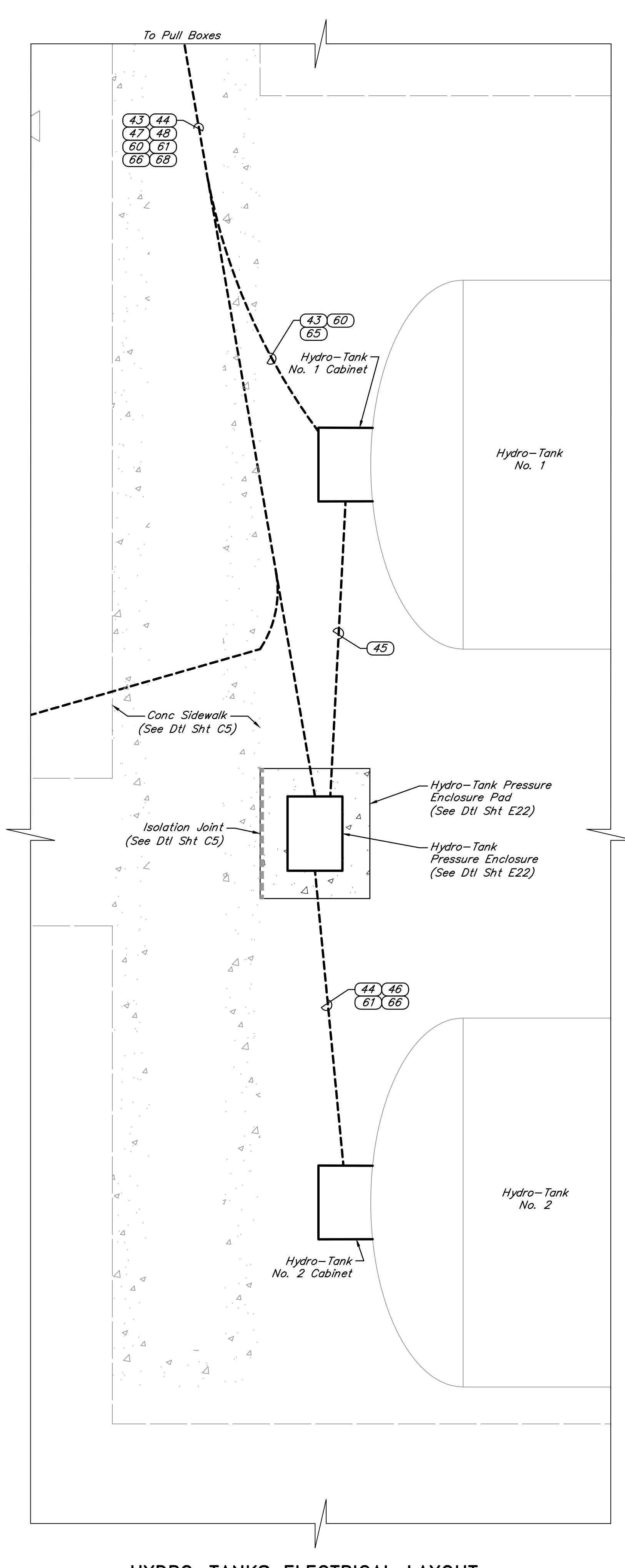
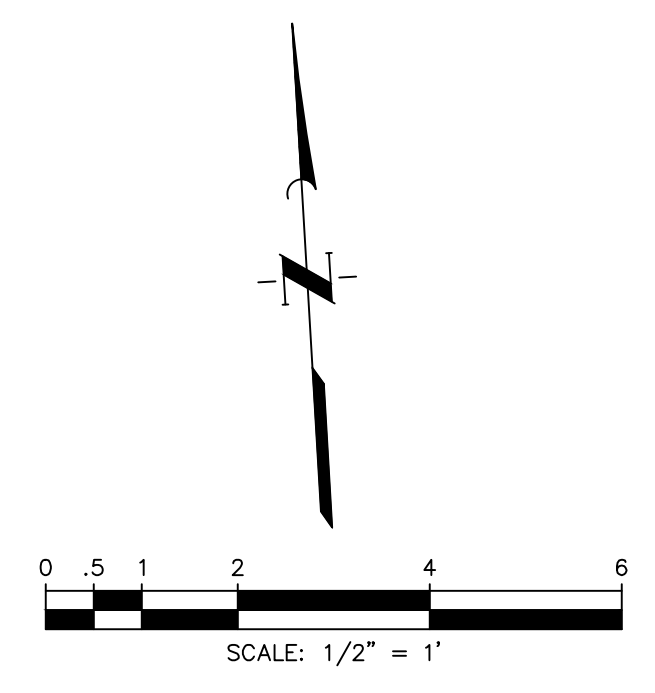
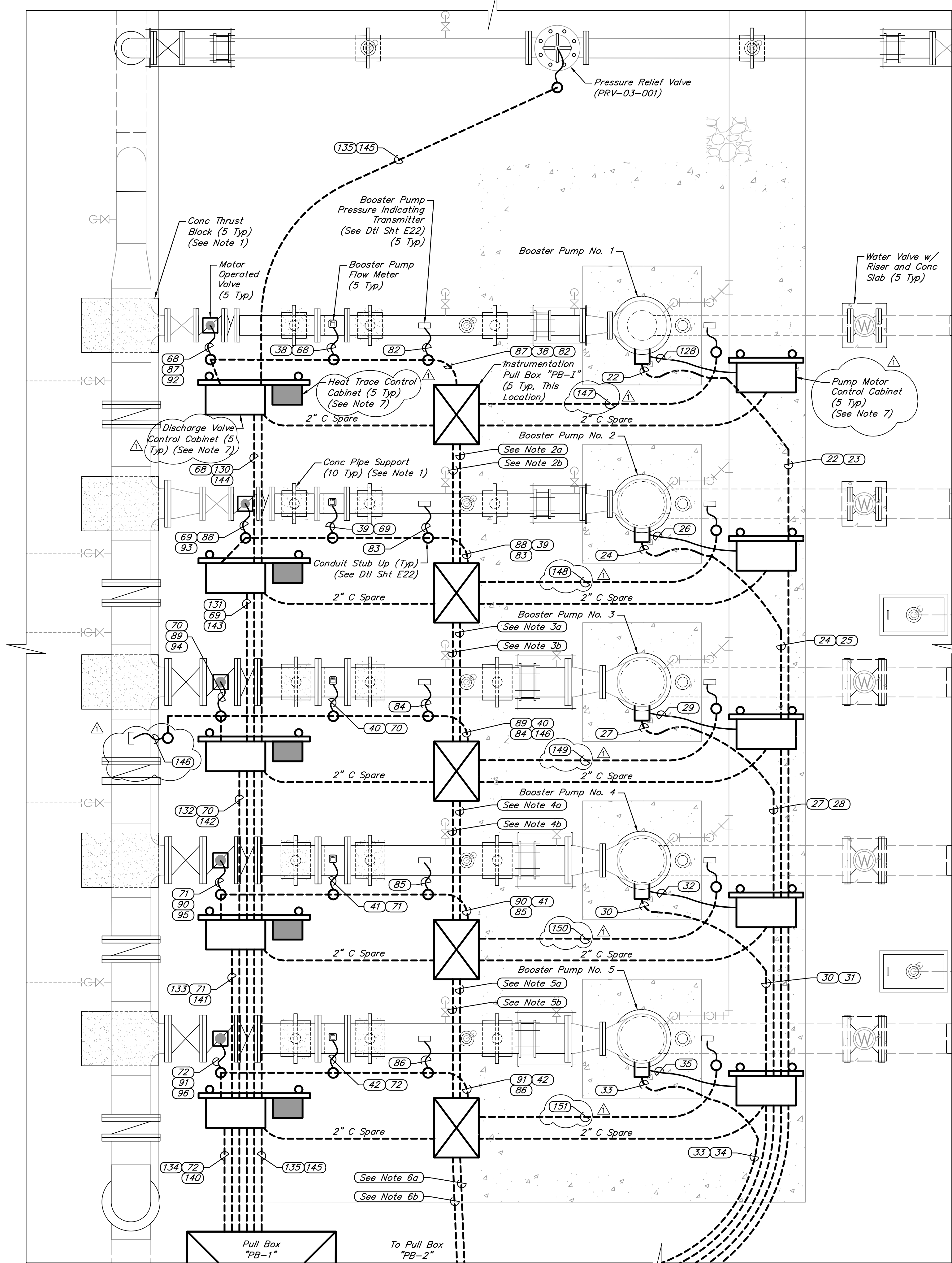
C. J. TROUTT  
 LICENSED PROFESSIONAL ENGINEER  
 41075  
 10/09/2023

SHEET NO. **E12**  
 46 OF 67

Table with columns: No., SIZE, POWER, GROUND, CONTROL, INSTR., DESCRIPTION, ORIGIN, DESTINATION, DUCT BANK. Contains 74 rows of conduit schedule data.

Project information block including: SAN ANTONIO WATER SYSTEM, MEGHAN PUMP STATION, ELECTRICAL CONDUIT SCHEDULE SHEET 1 OF 2, QUIDDITY logo, and project details like DATE: AUGUST 2022, DGN. BY: SHUDDSON.





**NOTES:**

- Contractor shall install underground conduits and duct banks to maintain a minimum horizontal clearance of 1-foot to all concrete thrust blocks and concrete pipe supports.
- 2-2" conduit with:
  - 1-2" conduit with 2-#18 TSP (Flow Meter Signal) and (Pressure Tx) signals and 3-#12 Ground
  - 1-2" conduit with 8-#14 (Control Valve), 4-#14 (Pressure Tx) and 1-#12 Ground
- 2-2" conduit with:
  - 1-2" conduit with 4-#18 TSP (Flow Meter Signal) and (Pressure Tx) signals and 7-#12 Ground
  - 1-2" conduit with 16-#14 (Control Valve), 8-#14 (Pressure Tx) and 1-#12 Ground
- 2-2" conduit with:
  - 1-2" conduit with 7-#18 TSP (Flow Meter Signal) and (Pressure Tx) signals and 12-#12 Ground
  - 1-2" conduit with 24-#14 (Control Valve), 14-#14 (Pressure Tx) and 1-#12 Ground
- 1-2" conduit and 1-3" conduit with:
  - 1-3" conduit with 9-#18 TSP (Flow Meter Signal) and (Pressure Tx) signals and 16-#12 Ground
  - 1-2" conduit with 32-#14 (Control Valve), 18-#14 (Pressure Tx) and 1-#12 Ground
- 1-2" conduit and 1-3" conduit with:
  - 1-3" conduit with 11-#18 TSP (Flow Meter Signal) and (Pressure Tx) signals and 20-#12 Ground
  - 1-2" conduit with 40-#14 (Control Valve), 22-#14 (Pressure Tx) and 1-#12 Ground
- Refer to Sheet E23 for Cabinet Detail.

NO.	DATE	REVISIONS	APP.
10.9.23		REVISIONS FOR ADDENDUM NO. 1	CJT

SAN ANTONIO WATER SYSTEM

MEGHAN PUMP STATION

**ELECTRICAL BOOSTER PUMPS & HYDRO-TANKS LAYOUTS**



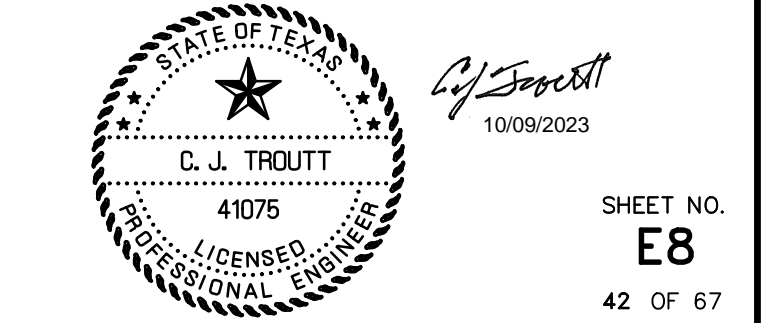
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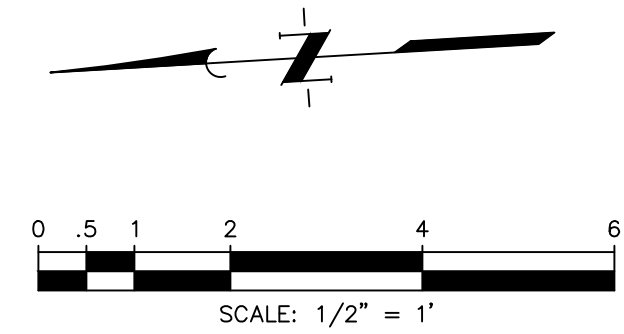
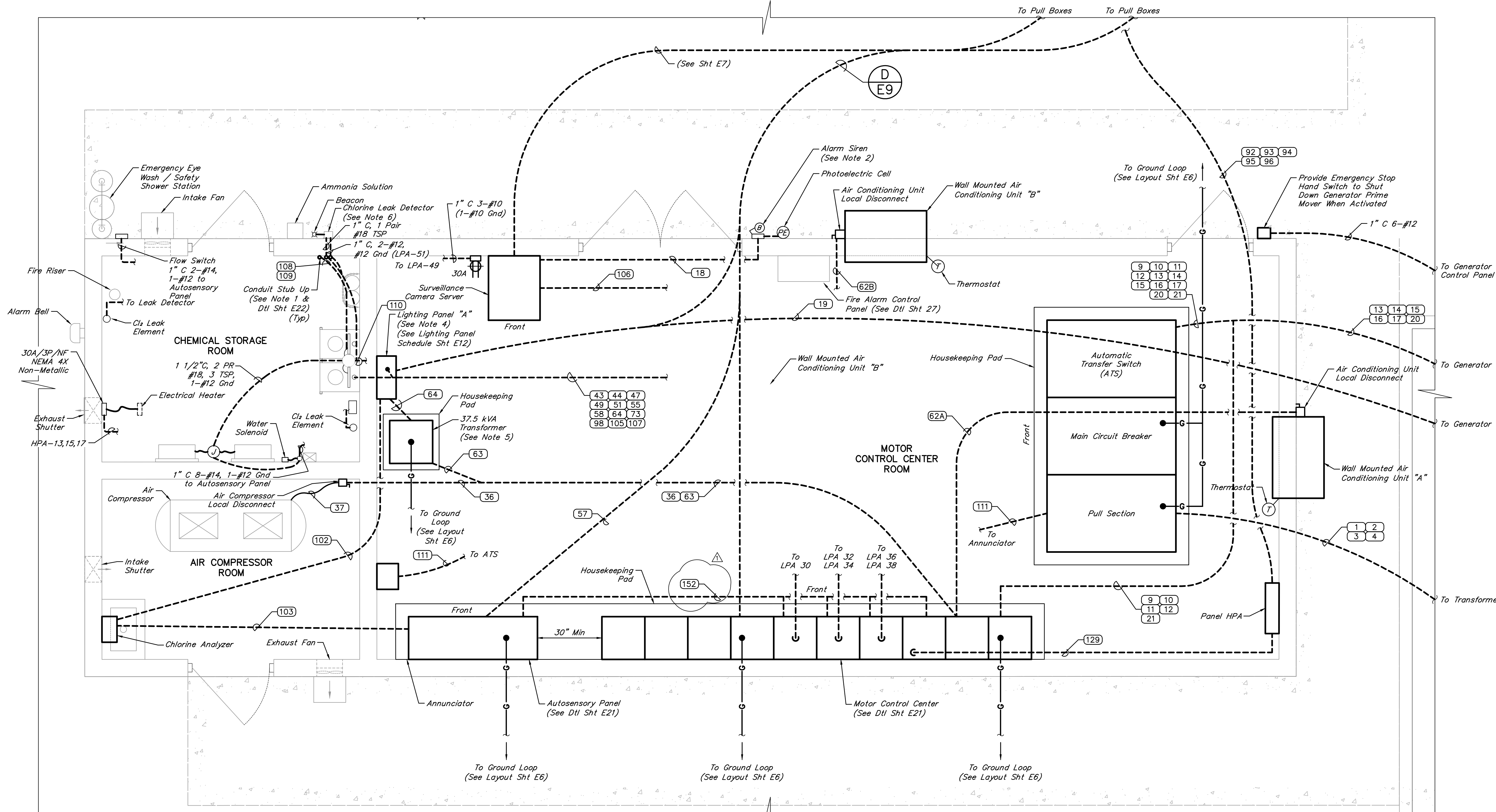
DATE: AUGUST 2022 DWN. BY: SHUDSON

JOB NO. S0406-0045-00 DWG. NO.

SUBMITTED: SURV. BY:

F.B. NO.





**GENERAL NOTES:**

1. Conduit stub ups shall be capped and sealed.
2. Alarm siren shall be mounted to the edge of the roof using stainless steel hardware and straps.
3. All enclosures inside control building to be NEMA 1 Stainless Steel.
4. Provide and install NEMA 1 gutter under lighting panel as needed.
5. See Sheet E6 for grounding. Provide Housekeeping Pad 3" larger than Transformer on all sides. Maintain 3" offset between Housekeeping Pad and adjacent wall.
6. The chlorine leak detection system, including lights, alarms, beacons, horns, and all other components, shall be powered through the autosensory panel UPS.

**CONTROL BUILDING POWER LAYOUT**

SCALE: 1/2" = 1'-0"

NO.	DATE	REVISIONS	APP.
10.9.23		REVISIONS FOR ADDENDUM NO. 1	CJT

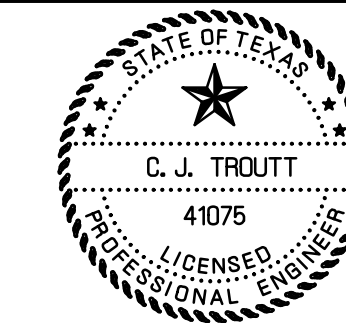
SAN ANTONIO WATER SYSTEM

MEGHAN PUMP STATION

**ELECTRICAL BUILDING  
POWER LAYOUT**

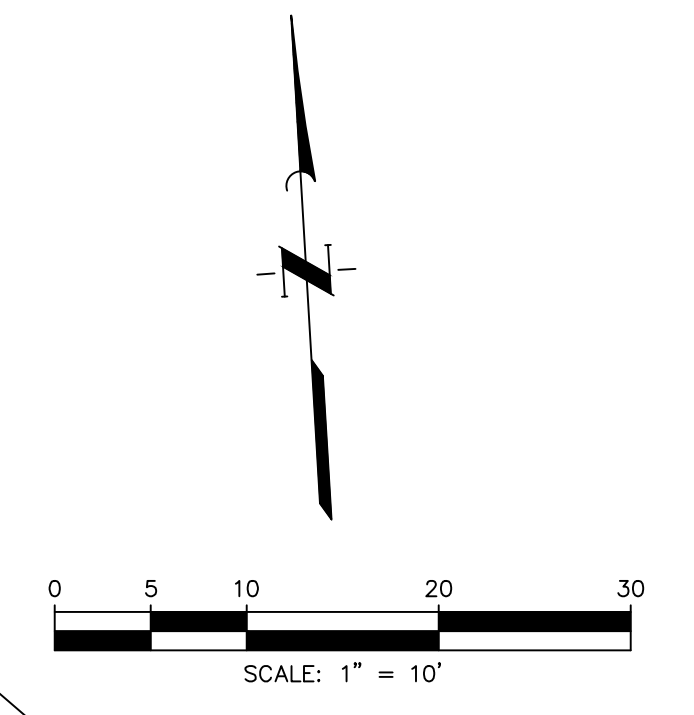
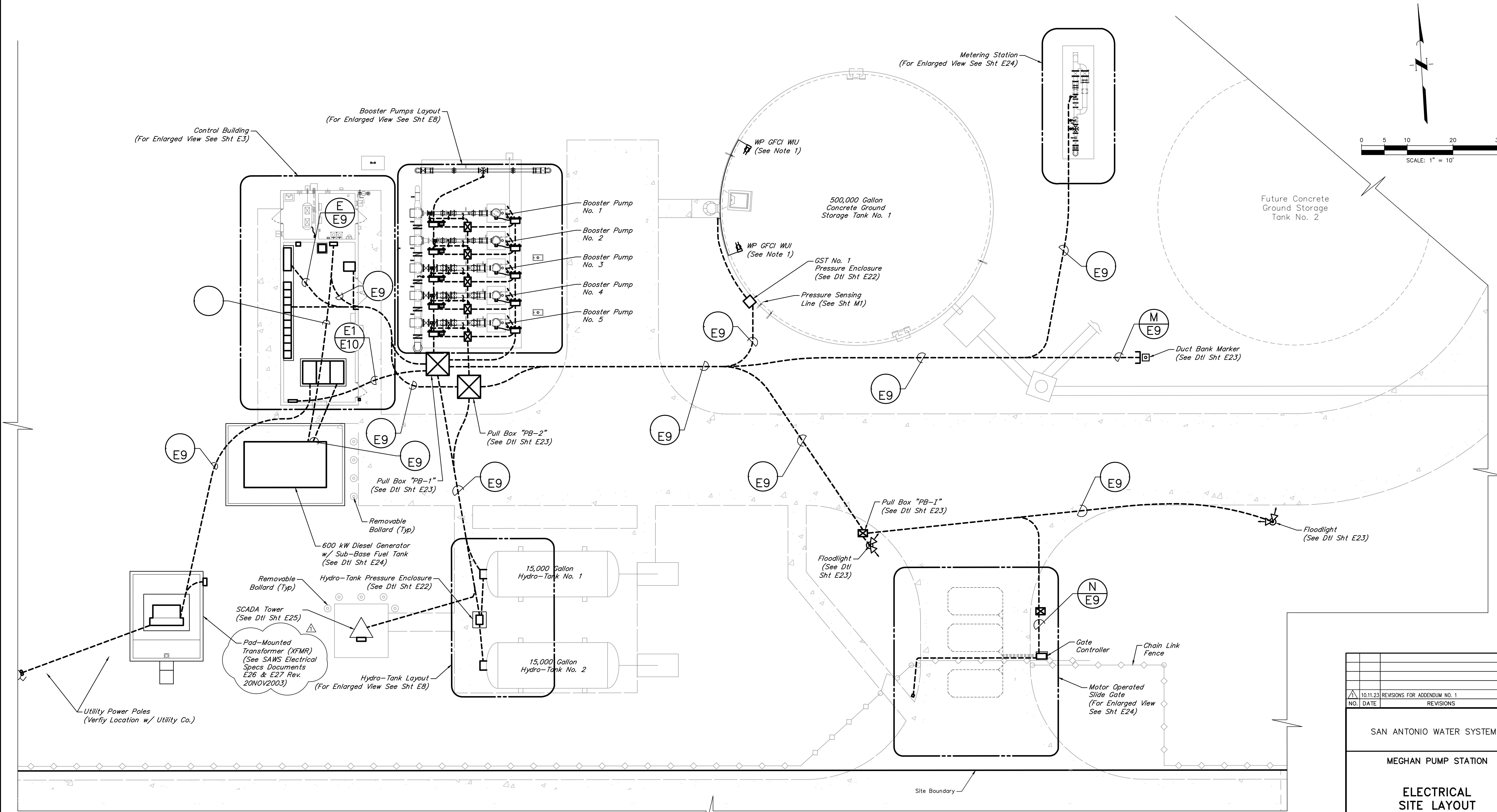


SCALE: 1/2" = 1'-0" DGN. BY: SHUDSON  
 DATE: AUGUST 2022 DWN. BY: SHUDSON  
 JOB NO. S0406-0045-00 DWG. NO. \_\_\_\_\_  
 SUBMITTED: \_\_\_\_\_ SURV. BY: \_\_\_\_\_  
 F.B. NO. \_\_\_\_\_



*C. J. Trojutt*  
 10/09/2023

SHEET NO.  
**E3**  
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**ELECTRICAL SITE LAYOUT**  
SCALE: 1" = 10'-0"

- NOTES:**
1. Ground Storage Tank Receptacles (WP GFCI WIU) to be located on roof hand rail. Verify exact location with Project Representative.
  2. Distance between utility service transformer and main circuit breaker is 50 circuit ft. Verify exact trench distance with contractor prior to buying cable.
  3. Provide conduit from CPS Energy Riser Pole to the primary side of the CPS Pad XFMR will be either 2-4" or 3-4" conduit as required by CPS Energy. Coordinate primary conductor installation with CPS and install primary conduit in accordance with CPS requirements.

NO.	DATE	REVISIONS	APP.
10.11.23		REVISIONS FOR ADDENDUM NO. 1	CJT

SAN ANTONIO WATER SYSTEM  
MEGHAN PUMP STATION  
**ELECTRICAL SITE LAYOUT**

**QUIDDITY**  
Texas Board of Professional Engineers and Land Surveyors Reg. No. P-22950  
4301 Lockhill-Selma Road, Suite 100W San Antonio, Texas 78249-2511

SCALE: 1" = 10'-0" DGN. BY: SHUDSON  
DATE: AUGUST 2022 DWN. BY: SHUDSON  
JOB NO. S0406-0045-00 DWG. NO. \_\_\_\_\_  
SUBMITTED: \_\_\_\_\_ SURV. BY: \_\_\_\_\_  
F.B. NO. \_\_\_\_\_

Professional Engineer Seal for C. J. Trullitt, No. 41075, State of Texas, License No. 41075.

*C. J. Trullitt*  
10/11/2023

SHEET NO. **E2**  
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