



TETRA TECH

PROJECT MANUAL

**ORLANDO UTILITIES COMMISSION
ORLANDO, FLORIDA**

**STANTON ENERGY CENTER
CWSA HORIZONTAL EXPANSION CELL 2
BID SET**

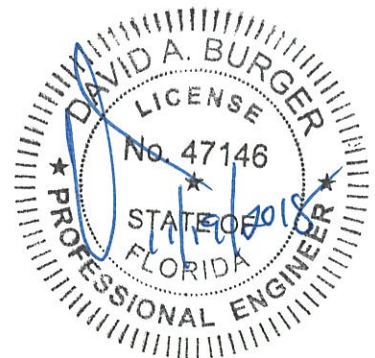
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Prepared For:



Prepared By:

**Tetra Tech
201 East Pine Street, Suite 1000
Orlando, Florida 32801**



**ORLANDO UTILITIES COMMISSION
ASH LANDFILL DESIGN
CELL 2 AND MISCELLANEOUS AREAS**

BID SET

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**ORLANDO UTILITIES COMMISSION
ASH LANDFILL DESIGN CELL 2**

BID SET

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DIVISION 0

PROCUREMENT AND **CONTRACT** **REQUIREMENTS**

SECTION 00115

LIST OF DRAWING SHEETS

PART 1 - GENERAL

1.01 LIST OF DRAWINGS

- A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawing set titled HORIZONTAL EXPANSION OF COMBUSTION WASTE STORAGE AREA CELL 2 dated August 9, 2018, as modified by subsequent Addenda and Contract modifications.
- B. Submittal:
 - 1. As a prequalification to submitting a bid proposal, provide acknowledgement from every proposed contractor, sub-contractor and major equipment supplier that they have received copies of all specifications including the prime contractor's specifications which are binding by reference. Provide acknowledgement from every proposed contractor, sub-contractor and major equipment supplier that they have received copies of all drawing plan sheets including the prime contractors plan sheets which are binding by reference.
 - 2. The purpose of the Prequalification Procedure described in this Document is to provide the Owner (Orlando Utilities Corporation) with a mechanism to evaluate and determine whether Prospective Bidders have all the documents necessary to fully understand their obligations and restrictions under this contract.
 - 3. Prospective Bidders are required to comply with these Requirements for Prequalification. Only those Prospective Bidders who have complied with the Requirements for Prequalification and have been determined to be qualified will be eligible to submit construction bids on Project.
- C. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:
 - 1. G0001 Cover Page
 - 2. M1001 Mechanical Legend and Abbreviations
 - 3. M2001 Leachate Collection System P&ID
 - 4. M3001 Leachate Collection System Overall Plan
 - 5. M4001 Leachate Collection System Enlarged Plan
 - 6. M4002 Leachate Collection System Enlarged Plan

7.	M5001	Mechanical Details
8.	M5002	Mechanical Details
9.	M6001	Leachate Collection System Sections
10.	M9001	Leachate Collection System Isometric
11.	E0001	Electrical Legend
12.	E1001	Electrical Single Line Diagram
13.	E2000	Electrical Overall Site Plan
14.	E2001	Cell #2 Electrical Site Plan
15.	E2002	Cell #1 Electrical Site Plan
16.	E2003	CWSA Ponds Electrical Site Plan
17.	E3001	Site Photos
18.	E4001	Panel Board Schedules
19.	E4002	Conduit List
20.	E5001	Electrical Details
21.	E5002	Electrical Details
22.	E5003	Electrical Plan and Elevation Cell #2 and Cell #3
23.	E5004	Electrical Plan and Elevation Cell #1
24.	E5005	Sunshade Detail
25.	I0001	Instrumentation Legend
26.	I1001	Duplex Pump Control Panel Layout
27.	I1002	Internal Duplex Pump Control Panel Layout
28.	I1003	Duplex Pump Termination Junction Box Layouts
29.	I1004	Leachate Duplex Pump Panel Wiring Schematic
30.	I1005	Leachate Duplex Pump Panel UPS Wiring Schematic
31.	I1006	Simplex Pump Control Panel Layout

32.	I1007	Internal Simplex Pump Control Panel Layout
33.	I1008	Simplex Pump Termination Junction Box Layouts
34.	I1009	CWSA Ponds Simplex Pump Panel Wiring Schematic
35.	I1010	CWSA Ponds Simplex Pump Panel UPS Wiring Schematic
36.	I1011	Remote Network Panel
37.	I1012	Fiber Termination Box
38.	I2001	Network System Architecture CWSA, Leachate and Underdrains
39.	I2002	Duplex Pump System Controls and Instrumentation
40.	I2003	Simplex Pump System Controls and Instrumentation
41.	I3001	Electrical Photos
42.	I4001	Leachate Duplex Pump Panel Surge Protector #1 Wiring Diagram
43.	I4002	Leachate Duplex Pump Panel DC Power Distribution
44.	I4003	Leachate Duplex Pump Panel Slot #1 & Slot #2 Discrete Input
45.	I4004	Leachate Duplex Pump Panel Slot #3 Discrete Output
46.	I4005	Leachate Duplex Pump Panel Slot #4 Analog Input
47.	I4006	CWSA Ponds Simplex Pump Panel Surge Protector #1 Wiring Diagram
48.	I4007	CWSA Ponds Simplex Pump Panel DC Power Distribution
49.	I4008	CWSA Ponds Simplex Pump Panel Slot #1 and #2 Discrete Input
50.	I4009	CWSA Ponds Simplex Pump Panel Slot #3 Discrete Output
51.	I4010	CWSA Ponds Simplex Pump Panel Slot #4 Analog Input

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 00120

LIST OF SCHEDULES

PART 1 - GENERAL

1.01 LIST OF SCHEDULES

A. Schedules: Included in the following sections:

1. Section 00437 Proposed Schedule of Values Form
2. Section 01330 Submittal Procedures
3. Section 15110 Process Valves
4. Refer to sheet E4002 for conduit schedule.
5. Refer to sheets E2001, 2002, 2003 for Duct Bank Schedules.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 00153

REQUEST FOR QUALIFICATIONS

1.01 PURPOSE, LAWS, AND REGULATIONS

- A. The purpose of the Prequalification Procedure described in this Document is to provide the Owner (Orlando Utilities Corporation) with a mechanism to evaluate and determine whether Prospective Bidders are qualified to participate in the construction of this Project. Evaluation will be limited to that office of the Prospective Bidder that is proposed to perform the Work.
- B. Prospective Bidders are required to comply with these Requirements for Prequalification. Only those Prospective Bidders who have complied with the Requirements for Prequalification and have been determined to be qualified will be eligible to submit construction bids on Project.

1.02 DEFINITIONS

- A. Financial Statement: The requirement for submitting a financial statement as an attachment to AIA Document A305, "Contractor's Qualification Statement" shall be understood to mean a certified annual audit, prepared according to generally acceptable accounting practices and signed by an independent certified public accountant. A self-prepared annual compiled financial statement or balance sheet is unacceptable.
- B. Prospective Bidder: A Prospective Bidder is a person or entity who submits a Submittal of Qualifications to Owner.
- C. Project: Generally described in the Plans and Specifications.

1.03 PREQUALIFICATION DOCUMENTS

- A. Prequalification Documents: Consist of this Request for Qualifications document; AIA Document A305, "Contractor's Qualification Statement"; and additional documents issued by Owner.
- B. Interpretation or Correction of Prequalification Documents: If the Prospective Bidder is in doubt as to the interpretation of any part of the Prequalification Documents or finds discrepancies in or omissions from any part of the Prequalification Documents, it must submit a written Request for Interpretation thereof no later than seven days prior to acceptance of Submittals of Qualifications. Address all communications to Owner.

1.04 PREQUALIFICATION PROCEDURES

A. Form of Prequalification Submittal:

1. Submittals of Prequalification must be submitted in duplicate on AIA Document A305, "Contractor's Qualification Statement," properly executed and with all items filled out in ink or typed, and all additional data, attachments, and forms provided. Do not change or add words to the Qualification Statement or forms. All signatures must be original (and sealed if a corporation) and must be notarized and sealed by a Notary Public.

B. Modification to Requirements for Prequalification:

1. Clarifications, alterations, or changes made by Owner to the Requirements for Prequalification shall be in writing only. Verbal information is not valid or binding.
2. Modifications will be mailed or delivered to those Prospective Bidders having obtained Prequalification Documents from the issuing office.

C. Submission of Prequalification Documents:

1. Each Submittal of Prequalification shall be delivered to the location indicated in the Advertisement for Bids on or before the day and hour set for receipt of Submittals. Each Submittal of Prequalification shall be submitted in an opaque, sealed envelope marked in the lower left-hand corner as follows:
 - a. Bidder's Prequalification Statement for Horizontal Expansion of Combustion Waste Storage Area – Cell 2
 - b. **Prospective Bidder's Name.**
 - c. **Prospective Bidder's Address.**
 - d. Contractor's License No.
 - e. Date and Time for Submittal.
2. If not delivered in person, this envelope shall be enclosed in a second envelope for posting to the location indicated for receipt of bids. This envelope shall be addressed as follows:
 - a. Bidder's Prequalification Statement for Horizontal Expansion of Combustion Waste Storage Area – Cell 2
 - b. Date and Time for Submittal.
 - c. Orlando Utilities Commission

- d. 100 W. Anderson Street
 - e. Orlando, Florida 32801
 - f. Contractor's License No. (In return address).
 - 3. Include a completed copy of the Prequalification Checklist attached to the cover of the Submittal.
 - 4. It is the sole responsibility of the Prospective Bidder to ensure that its submittal is received by the submittal date and time. No faxed or e-mail submittal or modification of a submittal will be considered. No submittal submitted after the time fixed for receiving submittals will be considered; late submittals will be returned to the Prospective Bidder unopened.
 - 5. Owner reserves the right to waive any informality and to request additional information from Prospective Bidders, at Owner's discretion.
- D. Status of Prospective Bidders:
- 1. Proprietors submitting bids shall indicate their status as proprietors.
 - 2. Prospective Bidders submitting qualifications for partnerships shall indicate their status as partners and shall submit a certified copy of the power of attorney authorizing the executor of the submittal to bind the partnership.
 - 3. Prospective Bidders submitting qualifications for corporations shall indicate their status as corporations and shall submit a certified copy of the board of directors' authorization for the Prospective Bidder to bind the corporation and shall affix the corporate seal on the submittal.
 - 4. Prospective Bidders shall provide the following:
 - a. Names and addresses of proprietors, of all members of a partnership, or of the corporation's officers.
 - b. Name of jurisdiction where the partnership is registered or where the corporation is incorporated. Corporations must be licensed to do business in Project state at the time of executing the Contract.

1.05 WITHDRAWAL

- A. A Qualification Statement may be withdrawn on personal request received from the Prospective Bidder.

1.06 PREQUALIFICATION CRITERIA

- A. Prospective Bidders must demonstrate the following to the satisfaction of Owner:

1. Proper license under the laws and regulations governing their respective trade(s).
2. Capacity to provide Performance Bond, Labor and Material Payment Bond, and Insurance in a form acceptable to Owner in amounts adequate to bond the Work based on the scope indicated in the Plans and Specifications for the Project.
3. Applicable experience of firm as described in the Contractor's Qualification Statement, including the following:
 - a. Experience of Firm: The firm in its current organization shall have successfully completed minimum of five (5) projects of similar type, quality, and scope, including a minimum of two (2) within the last four (4) years. The firm shall have a record of project completion, credit record, record of judgment claims, arbitration proceedings, and suits pending or outstanding acceptable to Owner.
 - b. Experience of Firm Officers: The firm officers shall have personal record of project completion acceptable to Owner.
 - c. Experience of Project and Field Management Staff to Be Committed by the Prospective Bidder to Carry Out the Work: The assigned project manager and field superintendent must have successfully completed minimum of three (3) projects of similar type, quality, and scope.
 - d. For purposes of this submittal, reference to "key individuals" as described in the Contractor's Qualification Statement shall be understood to mean the principal in charge, the project manager(s), and the project field superintendent(s) committed by the Prospective Bidder to carry out the Work of this Project. Prospective Bidder by submitting qualifications of key individuals agrees that Owner reserves the right to approve or reject subsequent reassignment of key individuals.
 - e. For purposes of this submittal, "successful completion" shall be understood to mean completion of project within project schedule and budget. Provide additional information indicating reasons why any referenced project did not meet project schedule or project budget.
 - f. For purposes of this Qualification, "similar project" shall be understood to include the following project elements:
 - 1) SCADA Systems
 - 2) Cellular wireless WLAN and Hardware VPN
 - 3) Local Area Networks (LANs)
 - 4) PLC Systems

- 5) Automated Pumping Systems
 - 6) Industrial Piping
 - 7) Industrial Controls and Automation.
 - 8) Industrial Power Distribution, (Successful projects for large local entertainment companies will be considered as well as work for large municipal water and waste water utilities.)
 - 9) Renovation/addition work on occupied sites.
4. Adequate financial resources, including ability to secure materials and labor necessary for completion of the Work and other work in hand, within the anticipated contract times, and reflecting the anticipated retainage from progress payments.
 5. Work-in-hand capacity, such that the Prospective Bidder demonstrates adequate work under contract to continue its business operations at least at their current level, at the same time indicating the capability to carry out Owner's proposed work.
 6. Adequate organization to complete work of the scope anticipated, including firm management, project management, field superintendence, and field engineering and quality control.
 7. Acceptable past performance as indicated by firm's references, including ability to meet contract time and to monitor, manage, and communicate interim scheduling requirements, to carry out required quality-control activities, to properly prepare interim and final payment requests, and to successfully complete project closeout requirements.
 8. Acceptable documentation of firm's employee screening practices as indicating by affidavit describing background check procedures for firm's employees and requirements for same incorporated in firm's subcontracts.
 9. Certifications on CISCO switches and Allen Bradley or Square D PLC vendor training.
- B. Consideration of qualifications may be withheld if the Qualification Statement shows any unexplained erasures, omissions, alterations of form, additions not called for, added restrictions or qualifying conditions, or other irregularities of any kind.
 - C. Owner may make such investigations as it deems necessary to determine the ability of the Prospective Bidder to perform the Work, and the Prospective Bidder shall furnish to Owner all such information for this purpose as Owner may request. Owner reserves the right to withhold qualification if the evidence submitted by or investigation of such Prospective Bidder fails to satisfy Owner that such Prospective Bidder is properly

qualified to carry out the obligations of the proposed Project. The determination of which bidders are prequalified is not protest-able, except as allowed by law.

- D. Prequalification Submittal and data contained therein is considered privileged and confidential and will not be disclosed to any outside party except as required by law.

1.07 BONDS AND INSURANCE

- A. The Prospective Bidder shall provide as part of the Submittal of Qualifications evidence of its ability to furnish below:
 - 1. Performance Bond, a Payment Bond, and a Labor and Material Bond, each in the amount of 100 percent of the Contract Sum, with a corporate surety authorized to transact business in Project's jurisdiction.
 - 2. Satisfactory certificates of insurance in the amount and types required by statute, but not less than the following:
 - a. Professional design errors and omissions insurance endorsement for delegated design by Contractor's professional engineer.
 - b. Workers' Compensation insurance provisions: statutory limits.

1.08 ACCEPTANCE OF QUALIFICATIONS

- A. Prospective bidders will be notified of Owner's determination, within **30** days from the date of submission.
- B. Evaluations will be confidential. Notifications will be publicly available information.
- C. Owner may deny prequalification if it finds one or more of the following:
 - 1. The Prospective Bidder does not have sufficient financial capacity to perform the Work.
 - 2. The Prospective Bidder does not have the appropriate experience to perform the Work, including, but not limited to, having met the experience criteria set forth herein.
 - 3. The Prospective Bidder or any officer, director, or owner thereof has had judgments entered against him within the past five years for the breach of contracts for governmental or nongovernmental construction work including, but not limited to, design-build or construction management contracts.
 - 4. The Prospective Bidder has been in substantial noncompliance with the terms and conditions of prior construction with Owner, or in documented substantial noncompliance with the terms and conditions of prior construction with another public body without good cause.

5. The Prospective Bidder or any officer, director, owner, or chief financial official thereof has been convicted within the past 10 years of a crime related to governmental or nongovernmental construction or contracting.
 6. The Prospective Bidder or any officer, director, or owner thereof is currently debarred pursuant to an established debarment procedure from bidding or contracting by any public body, agency of another state, or agency of the Federal Government.
 7. The Prospective Bidder failed to provide to Orlando utilities Commission in a timely manner any information required by the six preceding subparagraphs.
 8. The Prospective Bidder provides false, nonresponsive, misleading, or incomplete information for items required herein.
- D. The acceptance of a Prospective Bidder's qualifications will be a Notice of Prequalification, signed by a duly authorized representative of Owner; no other act by Owner or its agents shall constitute the acceptance of qualifications. The acceptance of a Prospective Bidder's qualifications by Owner does not constitute a contract or promise to award a contract to the Prospective Bidder.

1.09 PROSPECTIVE BIDDER'S CHECKLIST

- A. In an effort to assist the Prospective Bidder in properly completing all documentation required, the following checklist is provided for the Prospective Bidder's convenience. The Prospective Bidder is solely responsible for verifying compliance with prequalification requirements.
- B. Attach this completed checklist to the outside of the Submittal envelope.
1. Reviewed the Prequalification Documents prior to preparing this submittal.
 2. Prepared AIA Document A305, "Contractor's Qualification Statement," properly notarized.
 3. Attached: Copy of applicable Contractor's license(s).
 4. Attached: Affidavit of Employee Screening.
 5. Attached: Resumes of key individuals.
 6. Attached: Other attachments as necessary to provide information required.
 7. Envelope shows name and address of the Prospective Bidder.
 8. Envelope shows the Prospective Bidder's Contractor's License No.

9. By submitting notarized statement, the Prospective Bidder certifies that the Bidder can provide executed Performance Bond and Labor and Material Bond meeting requirements given in the Requirements for Prequalification.
10. By submitting notarized statement, the Prospective Bidder certifies that the Bidder can provide Certificates of Insurance in the amounts indicated in the Requirements for Prequalification.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 00213

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

PART 1 - GENERAL

1.01 INSTRUCTIONS TO BIDDERS

A. Instructions to Bidders for Project consist of the following:

1. Bidders are bound by all requirements of the Prime Contractors specifications and plans and the prime contractors by the subcontractor specifications, plans and contract requirements with Orlando Utilities Commission. Bidders shall obtain a copy of the specifications and contract requirements in their entirety. No exceptions will be allowed.
2. Each bidder shall provide a notarized statement indicating that they have obtained, read and accept the conditions, in full, of the following:
 - a. The specifications manual and contract documents in their full text for the Prime Contractor, including but not limited to:
 - 1) Insurance.
 - a) Workers Comp
 - b) Employers Liability
 - c) Commercial General and Contractual Liability
 - d) Automobile Liability
 - e) Umbrella Liability
 - 2) Safety and security.
 - 3) Environmental/Pollution liability.
 - b. The specifications manual and contract documents in their full text for the subcontractors.
 - c. The terms and conditions in the Prime Contractor's contract with Orlando Utilities Commission, in their full text
3. Prior to signing of contract, Contractor and subs shall provide Owner with certificates of insurance evidencing the required insurance and including the additional insured and waiver of subrogation requirements. Such certificates must be issued by an insurance carrier(s) acceptable to the Owner and endorsed to include thirty (30) days prior to written notice of cancellation or material change in any of the coverages. Owner's failure to insist upon an requirement in this Article shall not relieve Contractor of its obligation to fully comply with the requirements herein
4. Contractors and Subs shall permit the representatives of the Owner to inspect and observe the services at all reasonable times and to make final inspection within

reasonable time after performance. All services shall be subject to acceptance and approval of Owner. Such acceptance and/or approval does not relieve contractor of any obligations under this Contract, including warranties. The failure of the Owner to insist upon strict performance of any of the terms of this Contract or to exercise any rights conferred by this Contract shall not be construed as a waiver of its right to assert or rely on any such terms or rights on any future occasion, or as a waiver of any other terms or rights.

5. For any work element (e.g., compacted soil liner that lies below the HPDE liner, electrical conduits that are encased in concrete) that will be covered, buried, or concealed, whether entirely or partially, by subsequent work elements, the Contractor must receive written approval from the Owner indicating acceptance of that work element before proceeding to subsequent work elements. Any work element that has been covered, buried, or concealed by the Contractor without written approval from the Owner shall be uncovered for inspection, testing, and approval, as necessary. The costs associated with uncovering work and performing subsequent repairs shall be borne by the Contractor.
6. Contractor and subcontractors shall provide a representative with binding authority at each weekly meeting during the term of this project
7. Approval by Owner of the work performed hereunder shall not in any way relieve the Contractor and subcontractors of the responsibility for technical adequacy of the work. Neither approval or acceptance of, nor payment for services performed shall be construed as a waiver of any rights under this contract or any subcontract. And the contractor and subcontractor shall remain liable in accordance with applicable law for damages to Owner caused by the contractor and subcontractor negligent performance or omission of the services furnished under this contract. Contractor and subcontractors are responsible jointly and severally for the correct and total location of all underground utilities
8. Owner may at any time by written directive or order, make changes within the general scope of this contract. Prime Contractor and subcontractors shall proceed immediately to perform the work as charged. Unless otherwise required, within ten (10) calendar days following receipt of such written changes, Contractors shall submit in writing to Owner a proposal for accomplishing such changes. This proposal will reflect the increase or decrease in cost, if any, to the contract as well as any delivery schedule impact. The basis for this equitable adjustment shall, at Owners sole option, be a mutually agreed upon firm fixed price; a price determined by unit measure or formula; time and materials; or a cost reimbursement basis for actual reasonable/allowable/allocable direct costs plus a reasonable overhead and profit allowance. Contractor's failure to report changes within ten (10) calendar days shall release the Owner of all liability for additional costs or changes associated with the alleged change. Following submission of the written directive or order referenced above, the prime contractor and subcontractor shall diligently continue performance of work.
9. As a condition of payment hereunder, the Prime Contractor and Subcontractors shall, upon request from Owner, furnish lien releases satisfactory to Owner. At any time, Owner may pay and discharge liens, claims, and encumbrances filed by any contractor

or subcontractor or supplier and deduct the amount paid, together with costs and attorney's fees, from compensation due to Prime Contractor. The acceptance by Prime Contractor of final payment under this contract shall operate as a release to Owner for all claims and liability to Prime Contractor, its representatives, Subcontractors, suppliers and assigns of any additional compensation or payment relating to any and all things done or furnished relating to the services rendered by Prime Contractor or any Subcontractor in performance of the work. Final payment shall in no way relieve Prime Contractor, Subcontractors or suppliers for their obligations or for faulty or defective work discovered after final payment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 00260

PROCUREMENT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SUBSTITUTIONS

- A. Procurement Substitutions will not be allowed unless a specific product is no longer manufactured and only with ENGINEER of RECORD approval.

1.02 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Product substitution must be from the same manufacturer of the originally specified product.

1.03 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Engineer of Record; otherwise requests will be returned without action:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed alternative is due to manufacturer discontinuation of specified product.
 - 3. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
 - 4. The request is fully documented and properly submitted.

1.04 SUBMITTALS

- A. Procurement Substitution Request: Submit to **Construction Manager** and Engineer of Record simultaneously. Procurement Substitution Request must be made in writing **by prime contract Bidder only** in compliance with the following requirements:
 - 1. Requests for substitution of materials and equipment will be considered if received no later than **10** days prior to date of bid opening.
 - 2. Submittal Format: Submit **three** copies of each written Procurement Substitution Request, using **CSI Substitution Request Form 1.5C**.

3. Submittal Format: Submit Procurement Substitution Request.

- a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
- b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:
- c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
- d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.

B. Engineer of Record Action:

1. Engineer may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Engineer will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

C. Engineer of Record's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 00319

EXISTING CONDITION INFORMATION

PART 1 - GENERAL

1.01 EXISTING CONDITION INFORMATION

- A. Modifications to existing panels and PLC's are the sole responsibility of this contractor. Contractor will have to interface to Allen Bradley PLC's and EZ Automation PLC's when replacing the Underdrain, CWSA and Leachate SCADA system network and the SCADA operator workstation and replacing the HMI's of ten (10) EZ Automation underdrain pump control panels at the north and south coal ponds, and two recycle basins. It is the contractor's responsibility to field investigate complete pump control panels and SCADA systems, fully understand the scope of hardware and software changes, and make all modifications necessary.
- B. Contractor shall photograph work areas and, prior to beginning modifications, bring to the OUC Project Managers attention any damage of existing systems. Failure to properly document damages prior to beginning work may result in the contractor being accessed with the cost to repair.
- C. The contractor is responsible for coordinating with the OUC Project Manager access to the plant control room. All access requests shall be made 14 days in advance.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 00437

PROPOSED SCHEDULE OF VALUES FORM

PART 1 - GENERAL

1.01 BID FORM SUPPLEMENT

- A. A completed Proposed Schedule of Values form is required to be attached to the Bid Form.

1.02 PROPOSED SCHEDULE OF VALUES FORM

- A. Proposed Schedule of Values Form: Provide a breakdown of the bid amount in enough detail to facilitate continued evaluation of bid. Coordinate with the Project Manual table of contents. Provide multiple line items for principal material and subcontract amounts in excess of five percent of the Subcontractor Bid Sum.
- B. Arrange schedule of values using **AIA Document G703-1992**
 - 1. Copies of AIA standard forms may be obtained from the American Institute of Architects; <https://www.aiacontracts.org/library>; (800) 942-7732.
- C. The following minimum breakouts must be included. Values must be broken down by area, contractor, equipment, materials and labor.
 - 1. Cell #1:
 - a. Pumps
 - 1) New Pumps
 - 2) Refurbishment of old pumps for spares
 - b. Control Panels
 - c. Instrumentation
 - 1) Flow Meters
 - 2) Level Sensors
 - 3) Pressure Transmitters
 - d. Network Panel
 - e. Fiber Termination Panel
 - f. Power Distribution
 - 1) New Service
 - 2) Duct Bank
 - 3) Concrete
 - 4) Conductors, termination, testing
 - g. Fiber Distribution
 - 1) Duct Bank
 - 2) Concrete
 - 3) Fiber, termination, testing
 - h. Temporary Diesel Pumping duration of installation
 - i. System Testing and Startup

2. Cell #2:
 - a. Pumps
 - 1) New Pumps
 - 2) Refurbishment of old pumps for spares
 - b. Mechanical Installation:
 - 1) Valves, Backflow Preventers, Air Relief Valves
 - 2) Stations and supports
 - 3) Pipe, welds and fittings
 - 4) Pump Discharge Riser and Fittings
 - c. Control Panels
 - d. Instrumentation
 - 1) Flow Meters
 - 2) Level Sensors
 - 3) Pressure transmitters
 - e. Power Distribution
 - 1) New Service
 - 2) Duct Bank
 - 3) Concrete
 - 4) Conductors, termination, testing
 - f. Fiber Distribution
 - 1) Duct Bank
 - 2) Concrete
 - 3) Fiber, termination, testing
 - g. Temporary Diesel Pumping duration of installation
 - h. System Testing and Startup
3. CWSA Ponds:
 - a. Control Panels
 - b. Instrumentation
 - 1) Flow Meters
 - 2) Level Sensors
 - 3) Pressure transmitters
 - c. Network Panel
 - d. Fiber Termination Panel
 - e. Power Distribution
 - 1) Duct Bank
 - 2) Concrete
 - 3) Conductors, termination, testing
 - f. Fiber Distribution
 - 1) Duct Bank
 - 2) Concrete
 - 3) Fiber, termination, testing
 - g. Temporary Diesel Pumping duration of installation
 - h. System Testing and Startup

4. North Coal Pond Control Panel Upgrades
5. PLC Sunshade and installation North Coal Pond
6. South Coal Pond Control Panel Upgrades
7. Recycle Basin Expansion (RBE) Control Panel Upgrades
8. Primary Recycle Basin Control Panel Upgrades
9. SCADA System Replacement
 - a. Software
 - b. Software licensing, break down by year for the term of construction and follow-on 5-year service duration.
 - c. Wireless Service Provider monthly rates and charges for duration of construction and follow-on 5-year service duration.
 - d. Hardware and computer systems
 - e. System Screen Development
 - f. System installation, configuration and testing.
 - g. Network Administration for duration of construction and follow-on 5 year service duration.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

Application and Certificate for Payment

TO CONTRACTOR:

PROJECT:

FROM SUBCONTRACTOR:

APPLICATION NO:

PERIOD TO:

SUBCONTRACT FOR:

SUBCONTRACT DATE:

PROJECT NOS:

Distribution to:

OWNER

ARCHITECT

CONTRACTOR

FIELD

SUBCONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Subcontract. AIA Document G703™, Continuation Sheet, is attached.

1. ORIGINAL SUBCONTRACT SUM \$
2. NET CHANGE BY CHANGE ORDERS \$
3. SUBCONTRACT SUM TO DATE (Line 1 ± 2) \$
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703) \$

5. RETAINAGE:

- a. % of Completed Work (Columns D + E on G703) \$
- b. % of Stored Material (Column F on G703) \$

Total Retainage (Lines 5a + 5b, or Total in Column I of G703) \$

6. TOTAL EARNED LESS RETAINAGE (Line 4 minus Line 5 Total) \$
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate) \$

8. CURRENT PAYMENT DUE \$
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 minus Line 6) \$

CHANGE ORDER SUMMARY		ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	\$		\$
Total approved this month		\$	\$
TOTAL		\$	\$
NET CHANGES by Change Order		\$	

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

SUBCONTRACTOR:

By: Date:

State of:

County of:

Subscribed and sworn to before me this day of

Notary Public:

My commission expires:



Document G703™ – 1992

Continuation Sheet

AIA Document G702™-1992, Application and Certificate for Payment, or G732™-2009, Application and Certificate for Payment, Construction Manager as Adviser Edition, containing Contractor's signed certification is attached.
In tabulations below, amounts are in US dollars.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:
APPLICATION DATE:
PERIOD TO:
ARCHITECT'S PROJECT NO:

[illegible]

CAUTION: You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.

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DIVISION 1

GENERAL **REQUIREMENTS**

SECTION 01100

SUMMARY OF WORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Prime Contractors Specifications by reference and other Division 01 Specification Sections, apply to this Section.
- B. All subcontractors shall obtain a copy of the Prime Contractors specifications and comply with them in whole.

1.02 SUMMARY

- A. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Phased construction.
 - 4. Work by Owner.
 - 5. Work under separate contracts.
 - 6. Owner-furnished products.
 - 7. Contractor-furnished, Owner-installed products.
 - 8. Access to site.
 - 9. Coordination with occupants.
 - 10. Work restrictions.
 - 11. Specification and Drawing conventions.
 - 12. Miscellaneous provisions.

1.03 PROJECT INFORMATION

- A. Project Identification: Horizontal Expansion of Combustion Waste Storage Area Cell #2
 - 1. Project Location: OUC Stanton Energy Center, 5100 S. Alafaya Trail, Orlando, FL 32831.
- B. Owner: Orlando Utilities Commission
 - 1. Owner's Representative: Charlie Doud.
- C. Engineering Firm: Tetra Tech.

1.04 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and generally consists of the following abbreviated scope of work:
1. Provide four new control panels, all instrumentation and appurtenances at new waste ash storage Cell #2.
 2. Provide electric service panel, surge protection, distribution and duct banks for Cell #2 pump control panels.
 3. Connect Cell #2 pump control panels to network and add to new pump control panel SCADA system operator console in plant control room.
 4. Provide new remote network switch panel (see plans for proposed panel construction) and installation at Cell 1 to connect to OUC provided single mode fiber for access to Underdrain SCADA panel in plant control room.
 5. Replace four existing pump control panels, all instrumentation, flow meters, pressure sensors, and appurtenances at existing waste ash storage Cell #1.
 6. Replace four 5 horsepower leachate pumps and four 1/2 horsepower leak detection pumps at cell 1. Clean and refurbish old pumps to like new condition. Provide test reports on repaired pumps and return to OUC for spares.
 7. Connect Cell #1 pump control panels to network and add to new SCADA system operator console in plant control room.
 8. Relocate existing Cell #1 power panel, increase it to 60 amp service, provide surge suppression, install new duct banks and distribution to control panels.
 9. Provide ground rings around four existing Cell #1 concrete pads and bond to control panel, flow meters and duct bank ground.
 10. Modify ten existing underdrain control panels, 2 each on north and south coal ponds, 2 on recycle pond expansion and 4 on the recycle pond to include:
 - a. New 10.4" high output HMI.
 - b. New HMI screens and programming. Replace interior dead-front HMI mounting panel with matching panel and raise the HMI up to within 3 inches of top of panel. Provide balance of panel cutouts to support existing appurtenances and reuse such appurtenances. Contractor is responsible for field documenting all devices and requirements.
 - c. Increased power supplies, breakers and fuses to support HMI modification.

- d. New Underdrain panel PLC programming. Replace programming in its entirety.
 - e. Add new flashing fault LED light and fault light reset pushbutton on exterior front panel.
 - f. New internal panel temperature sensor with local LCD display and remote SCADA display. Provide new 2C/#16 twisted and shielded wet location conductor to PLC's for transmission to plant control room underdrain workstation. Utilize existing duct bank. Contractor will have to remove H2O rated concrete pullbox lids to perform cable installation.
- 11. Replace four CWSA Pond simplex pump control panels, flow meters, sensors, instrumentation.
 - 12. Connect CWSA pump control panels to network and add to new SCADA system operator console in plant control room.
 - 13. Provide new remote network switch panel (see plans for proposed panel construction) and installation at CWSA Ponds to connect to OUC provided single mode fiber for access to Underdrain SCADA panel in plant control room.
 - 14. Provide all LAN/WAN hardware, software, firewalls, and service provider accounts for VPN access. Setup and configure access list, passwords, and system administration during all phases of construction and for an additional 5 years after Prime Contractor's Notice of Substantial Completion is executed by OUC.
 - 15. Provide new network switch and installation at Plant control room, including 120 volt power circuit to new switch panel, in order to combine CWSA, Cells 1 and 2 and the underdrain panels at coal and recycle ponds to new operator workstation being provided in this contract scope of work.
 - 16. Provide fiber optic network cables, jumpers, connections and hardened Cisco network switches, switch configuration, testing, training and switch panels.
 - 17. Provide new pump SCADA operator/development station, software, hardware, configuration, security validations, SCADA software, VPN access, etc., for complete new pump SCADA operator station and historian, display screens, historical trending, alarms, status, etc., for the pumps on this Project including Cell 1, Cell 2, CWSA, North and South Coal Ponds, and both Recycle Ponds. Provide capability to add up to 16 future pump panels. Include up to ten reports developed from historical data.
 - 18. Setup, configure and maintain pump SCADA system during all phases of construction and for an additional 1 year after Prime Contractor's Notice of Substantial Completion is approved by OUC.
 - 19. Provide network administration of the SCADA system for the pumping systems furnished and installed under this contract until owner approval of substantial

completion and then through the contract warranty period and subsequent 5 year service period.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.05 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.06 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

1.07 OWNER-FURNISHED CONTRACTOR INSTALLED PRODUCTS

- A. Owner will furnish products indicated for contractor to install. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.
- B. Owner Furnished Products:
1. Two fiber pull boxes for single mode fiber transition and OUC pole bases.
- C. Owner-Furnished Products:
1. Owner will provide two (2) fiber optic pullboxes for installation by contractor at the base of existing OUC aerial fiber poles.

1.08 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.09 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
- B. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than **72** hours' notice to Owner of activities that will affect Owner's operations.
- C. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1.10 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of internal plant roads and with other requirements of OUC.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 8 a.m. to 5 p.m., Monday through Friday, unless otherwise indicated.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
1. Notify Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Restricted Substances: Use of tobacco products and other controlled substances Project site on is not permitted.
- F. Employee Identification: Owner will provide Visitor identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
1. Maintain list of approved screened personnel with Owner's representative.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01310

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Each contractor shall participate in all weekly coordination meetings for the period of construction.

1.03 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Engineer or Contractor seeking information required by or clarifications of the Contract Documents.

1.04 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within **15** days of Notice to Proceed, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and

telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office. Keep list current at all times.

1.05 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Coordination: Each contractor shall cooperate with Prime Contractor who shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.
 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other

contractors and direction of Prime Contractors Project coordinator to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

- E. Owner shall have free communication with subcontractors and subcontractors with owner regardless of Prime contractor's directions or exceptions, however, owner will not direct any subs verbally to perform out of scope work. All direction will come through the prime contractor.

1.06 INSTALLATION AND COORDINATION DRAWINGS

- A. Installation and Coordination Drawings, General: Prepare installation and coordination drawings in plan view and elevation of all piping, conduit control panels, etc., showing where and how all items will be installed.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of installation and coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Engineer of

Record indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Review: Engineer of Record will review installation and coordination drawings to confirm that in general the Work will be installed in an acceptable manner and if it is coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer of Record determines that installation and coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make suitable modifications and resubmit.
 3. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Prime Contractors "Submittal Procedures."
- B. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Preparation Format: DWG files.
 3. File Submittal Format: Submit or post coordination drawing files using DWG and PDF formats.
 4. Engineer of Record will furnish Contractor one set of digital data files of Drawings that are available for use in preparing coordination digital data files. Contractor will have to supplement these files for a complete installation and coordination package.
 - a. Engineer of Record makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Autocad 14 for Microsoft operating system.

1.07 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Engineer of Record will return without response those RFIs submitted to Engineer of Record by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Engineer of Record and Construction Manager.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716
1. Attachments shall be electronic files in PDF format.
- D. Engineer of Record's and Construction Manager's Action: Engineer of Record and Construction Manager will review each RFI, determine action required, and respond. Allow 14 working days for Engineer of Record's response for each RFI. RFIs received by Engineer of Record after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.

- b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Engineer of Record's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 - 2. Engineer of Record's action may include a request for additional information, in which case Engineer of Record's time for response will date from time of receipt by Engineer of Record or Construction Manager of additional information.
 - 3. Engineer of Record's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Prime Contractors requirements.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
- 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Engineer of Record.
 - 4. RFI number including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Engineer of Record's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Engineer of Record's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer of Record and Construction Manager within 7 days if Contractor disagrees with response.

1.08 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Engineer of Record's Digital Data Files: Digital data files of Engineer of Record's Autocad drawings will be provided by Engineer of Record for Contractor's use during construction.
 - 1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 - 2. Engineer of Record makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 - 3. Digital Drawing Software Program: Contract Drawings are available in DWG format for Microsoft operating system.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Engineer of Record, prepare as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.09 PROJECT MEETINGS

- A. General: Prime contractor will schedule weekly meetings and conferences at Project site.
- B. Attendees: All contractors, subcontractors and major equipment providers are to have one representative attend in person who has authority for the commitment of funds for their organization.
- C. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer of Record, but no later than 15 days after execution of the Agreement.
 - 1. Attendees: Authorized representatives of Owner, Engineer of Record, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:

- a. Responsibilities and personnel assignments.
- b. Tentative construction schedule.
- c. Phasing.
- d. Critical work sequencing and long lead items.
- e. Designation of key personnel and their duties.
- f. Lines of communications.
- g. Procedures for processing field decisions.
- h. Procedures for RFIs.
- i. Procedures for testing and inspecting.
- j. Procedures for processing Applications for Payment.
- k. Distribution of the Contract Documents.
- l. Submittal procedures.
- m. Preparation of Record Documents.
- n. Use of the premises.
- o. Work restrictions.
- p. Working hours.
- q. Responsibility for temporary facilities and controls.
- r. Procedures for disruptions and shutdowns.
- s. Construction waste management and recycling.
- t. Parking availability.
- u. Office, work, and storage areas.
- v. Equipment deliveries and priorities.
- w. First aid.
- x. Security.
- y. Progress cleaning.

3. Minutes: Prime contractor is responsible for conducting meeting will record and distribute meeting minutes.
- D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each major construction activity including duct bank installations, control panel installations, operator SCADA workstation installation.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer of Record and Construction Manager of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.

- r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- E. Project Closeout Conference: Schedule and conduct with Prime contractor a project closeout conference, at a time convenient to Owner and Engineer of Record, but no later than 90 days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Construction Manager, Engineer of Record, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work. All contractors, subcontractors and major equipment providers are to have one representative attend in person who has authority for the commitment of funds for their organization.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.

- b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for completing sustainable design documentation.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. Coordination of separate contracts.
 - l. Owner's final acceptance requirements.
 - m. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- F. Progress Meetings: All contractors; subcontractors; major equipment suppliers, ie., control panels, network and SCADA; shall personally attend weekly on-site progress meetings.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of and Owner, Construction Manager, Engineer of Record, each contractor, subcontractor, supplier of major equipment, ie., control panels, network administrator and SCADA Integrator, shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work. All contractors, subcontractors and major equipment providers are to have one representative attend in person who has authority for the commitment of funds for their organization.
 - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction

schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- 1) Review schedule for next period.
- b. Review present and future needs of each entity present, including the following:
- 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site use.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of Proposal Requests.
 - 15) Pending changes.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

PREBID SUBMITTALS

SB00115-001	1.01(B)	Certification of Receipt of Plans and Specifications
SB00153-001	1.04(A)(1)	AIA Document A305, "Contractor's Qualification Statement,"
SB00153-002	1.04(D)	Status of Prospective Bidders
SB00153-003	1.06(A)(1)	Proper Licensing
SB00153-004	1.06(A)(2)	Capacity for Performance Bond, Labor and Material Payment Bond, and Insurance
SB00153-005	1.06(A)(3)	Applicable experience of firm as described in the Contractor's Qualification Statement
SB00153-006	1.06(A)(4)	Financial Resources
SB00153-007	1.06(A)(5)	Work-in-hand Capacity
SB00153-008	1.06(A)(6)	Organization Chart of Anticipated Resources
SB00153-009	1.06(A)(7)	Firm's References
SB00153-010	1.06(A)(8)	Documentation of firm's employee screening practices
SB00153-011	1.06(A)(9)	CISCO, Allen Bradley, Square D Certification
SB00213-001	1.01(A)(2)	Certification of Receipt and Acceptance of Prime Contractors Plans, Specifications and Contract
SB00260-001	1.04(A)(1)	Procurement Substitutions
SB00437-001	1.02	Proposed Schedule of Values (Submit with Bid Proposal)
SB01310-001	1.04(A)	Sucontractor List
SB01310-002	1.04(B)	Key Personnel

Post Bid Submittals

SB01310-003	1.06(A)	Coordination Drawings
SB01310-004	1.07(E)	RFI Log Weekly
SB01330-001	1.03(A)	Submittals Schedule
SB01330-002	1.07(B)	Delegated Design Services Certification
SB01600-001	1.07(A)	Warranties
SB01600-002	1.07(B)	Special Warranties
SB01730-001	1.05(A)	Construction Layouts
SB01730-002	1.05(B)	Panel Modifications
SB01730-003	1.05(C)	Proposed Survey Points

SB01730-004	1.05(D)	Cutting and Patching Plan
SB01730-005	1.05(E)	Certified Survey
SB01730-006	1.05(F)	Final Property Survey
SB01730-007	3.02(A)	Exisitng Utiltiy Information
SB01770-001	1.04(B)	Closeout Submittals
SB01770-002	1.05	Final Application for Payment
SB01770-003	1.06	List of Incomplete Items (Punch List)
SB01770-004	3.02(B)(1)	Repair Work Procedures and Plans
SB01783-001	1.01(A)	Record Drawings
SB01783-002	1.01(B)	Record Specifications
SB01783-003	1.01(C)	Record Product Data
SB01913-001	1.03(B)	Startup Commissioning Plan
SB01913-002	1.03(C)	Startup Commissioning Schedule
SB01913-003	1.03(D)	Two-week Look-ahead Schedules
SB01913-004	1.03(E)	Pre-startup Test Reports
SB01913-005	3.05(E)	Pre-startup Audit
SB01913-006	3.05(F)	Test Procedures and Test Data Forms
SB01913-007	3.08	Startup Commissioning Reports
SB11214-001	1.01(C)(1)	Pitless Adapter
SB11214-002	1.01(C)(2)	Fittings and pump discharge column
SB11214-003	1.01(C)(3)	Safety cable
SB11214-004	1.01(C)(4)	Cam locks
SB11214-005	1.01(C)(5)	Flex Pipe
SB11214-006	1.01(C)(6)	Column check-valve
SB11214-007	1.02(B)	Test and Inspection Reports
SB11214-008	1.02(D)	Equipment Data Sheets
SB11214-009	1.02(E)	Warranty Data
SB11214-010	2.01(A)(1)	Submersible Pump
SB13410-001	1.03(A)(1)	Product Data Sheets
SB13310-002	1.03(A)(2)	Wiring Diagrams
SB13410-002	1.03(A)(3)	Digital Equiment Layouta and Schematics
SB13310-003	1.03(A)(4)	Software Programming
SB13410-003	1.03(A)(5)	Programmable Logic Controller Data
SB13310-004	1.03(A)(6)	Operator Interface Screen Dumps
SB13410-004	1.03(A)(7)	Detailed Data Dumps
SB13310-005	1.03(B)	Record Drawings
SB13410-005	1.03(C)	Operation and Maintenance Manuals
SB13310-006	1.03(D)	Warranty Information
SB13410-006	3.03	Training Materials
SB13413-001	1.03(E)	Fiber Optic Experinece Documentation
SB13413-002	1.04	Fiber Test Reports

SB13413-003	2.01(A)(1)	Fiber Optic Cables
SB13413-004	2.01(A)(2)	Fiber Optic Connectors
SB13413-005	2.01(A)(3)	Iber Optic Patch Panels
SB13413-006	2.01(A)(4)	Fiber Optic Converters
SB13413-007	3.05(A)	Testing Contractor Resumes
SB13421-001	2.02	Flow Meter
SB13423-001	2.02	Level Transmitter
SB13424-001	2.02	Pressure Transmitter
SB13430-001	2.01(A)(1)	Sunlight Readable Touchscreen
SB13430-002	2.01(A)(2)	Switches, Pushbuttons, Lights
SB13430-003	2.01(A)(3)	Relays
SB13430-004	2.01(A)(4)	Signal Switching Relay
SB13430-005	2.01(A)(5)	Terminal Blocks Touch Safe
SB13430-006	2.01(A)(6)	Terminal Blocks Open Construction
SB13430-007	2.01(A)(7)	Fusible Terminal Block
SB13430-008	2.01(A)(8)	Control Power Transformers
SB13430-009	2.01(A)(9)	Transient Voltage Surge Suppression
SB13430-010	2.01(A)(10)	Starter and Overloads
SB13430-011	2.01(A)(11)	Motor Protection Relays
SB13430-012	2.01(A)(12)	Circuit Breakers
SB13430-013	2.01(A)(13)	Enclosures
SB13430-014	2.01(A)(14)	Wire Markers
SB13430-015	2.01(A)(15)	Elapsed Timemeter
SB13430-016	2.01(A)(16)	Cabinet Air Conditioner
SB13430-017	2.01(A)(17)	Uninterruptable Power Supplies
SB13441-001	2.02	Pressure Gauges
SB13450-001	2.01(1)	Programmable Logic Controller Documentation
SB13450-002	2.01(2)	Program Developement Software
SB13460-001	1.05(A)(1)	Computer System Diagram and Description
SB13460-002	1.05(A)(2)	Bill of Materials
SB13460-003	1.05(A)(3)	Power Connection Diagram
SB13460-004	1.05(A)(4)	Interconnect Diagrams
SB13460-005	1.05(A)(5)	Component Submittals
SB13460-006	1.05(A)(6)	Shop Drawings
SB13460-007	1.05(A)(7)	Power Consumptiona and Heat Dissipation
SB13460-008	1.05(B)(1)	Software Documentation
SB13460-009	1.05(C)(1)	Test Submittals
SB13460-010	1.05(C)(2)	O&M Manuals Hardware
SB13460-011	1.05(C)(3)	O&M Manuals Software

SB13491-001	1.02(A)(1)	Spare Parts List
SB13498-001	1.02(A)(1)	Draft Service Contract
SB13498-002	1.02(A)(2)	Rates and Trip Costs
SB13600-001	1.03(B)	Test Procedures and Schedule
SB13600-002	1.03(C)	Post Testing Sign-off Sheets
SB13600-003	1.03(D)	Documented Loop Checks
SB13600-004	1.03(E)	Loop Tuning Documentation
SB13600-005	1.03(F)	Strategy Test Procedures and Results
SB13600-006	1.03(G)	Fuctional Test Procedures and Results
SB15050-001	1.02(A)(1)	Schedules
SB15050-002	1.02(A)(2)	Layout Drawings
SB15050-003	1.02(C)	Record Drawings
SB15060-001	1.02(A)(1)	Shop Drawings Supports and Anchors
SB15060-002	1.02(A)(2)	Product Data and Instructions
SB15100-001	1.02(A)(1)	Layout Drawings
SB15100-002	1.02(A)(3)	Product Data
SB15100-003	1.02(B)	Record Drawings
SB15100-004	1.04(A)	Vendor Pipe Storage Requirements
SB15110-001	1.03(A)	Ball Valves
SB15110-002	1.03(B)	Valve Warranty
SB16060-001	1.03(B)	Layout Plans
SB16060-003	1.03(C)	Qualifications of Testing Agency
SB16060-004	1.04(A)	Periodic Testing Instructions
SB16060-005	2.01	Conductors
SB16060-006	2.02	Connectors
SB16060-007	2.03	Ground Electrodes
SB16060-008	2.04	Test Wells
SB16060-009	3.06(B)	Test and Inspection Reports
SB16070-001	1.02(A)	Product Data
SB16075-001	1.03(A)	Product Data
SB16075-002	1.03(B)	Samples of Products
SB16075-003	1.03(C)	Identification Schedule
SB16082-001	1.02(A)(1)(a)	Schedule of Test and Inspections
SB16082-002	1.02(A)(1)(b)	Inspection Form Sample
SB16082-003	1.02(A)(1)(c)	Device Test Form Sample
SB16082-004	1.02(A)(2)	Test and Inspection Reports and Certifications

SB16110-001	1.04(A)	Product Data
SB16110-002	1.04(B)	Conduit Routing Plan
SB16120-001	1.03(A)	Product Data
SB16120-002	3.07(A)	Cable megger test results
SB16125-001	1.04(B)(1)	Conduit Layout Diagram
SB16125-002	1.04(B)(2)	Cable Schedule
SB16125-003	1.04(B)(3)	Component Data
SB16125-004	1.04(C)(1)	Manufacturer Certification Statement for Installer
SB16125-005	1.04(C)(2)	Subcontractor Qualifications
SB16125-006	1.04(C)(3)	Manufacturer's Certificate of Compliance
SB16125-007	1.04(C)(4)	Manufacturer's suggested installation practice
SB16125-008	1.04(C)(5)	Testing Related Submittals
SB16125-009	3.02(D)	Fiber test results
SB16280-001	1.03(A)	Shop Drawings
SB16280-002	1.03(B)	Product Data
SB16280-003	1.03(C)	Installation Instructions
SB16280-004	1.03(D)	Operating and Maintenance Data
SB16280-005	1.03(E)	Warranties
SB16442-001	1.04(A)	Product Data
SB16442-002	1.04(B)	Shop Drawings
SB16442-003	1.04(C)	Panelboard Schedules
SB16442-004	1.05(A)	operation and Maintenance Data

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

1.03 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as a submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include 14 calendar days for review, and appropriate days for ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer of Record and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Prime Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 - 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Name of subcontractor.

- d. Description of the Work covered.
- e. Scheduled date for Engineer of Record's and Construction Managers final release or approval.
- f. Scheduled dates for purchasing.
- g. Scheduled date of fabrication.
- h. Scheduled dates for installation.
- i. Activity or event number.

1.04 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

- 1. Project name.
- 2. Date.
- 3. Name of Engineer of Record.
- 4. Name of Construction Manager.
- 5. Name of Contractor.
- 6. Name of firm or entity that prepared submittal.
- 7. Names of subcontractor, manufacturer, and supplier.
- 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
- 9. Submittal purpose and description.
- 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
- 11. Drawing number and detail references, as appropriate.
- 12. Indication of full or partial submittal.
- 13. Location(s) where product is to be installed, as appropriate.
- 14. Other necessary identification.
- 15. Remarks.
- 16. Signature of transmitter.

B. Options: Identify options requiring selection by Engineer of Record.

- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer of Record and Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Paper Submittals:
 - 1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
 - 2. Provide a space on label or beside title block to record Contractor's review and approval markings and action taken by Engineer of Record and Construction Manager.
 - 3. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using AIA Document G810 transmittal form.
- E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.05 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package, and transmit to Construction Manager, Engineer of Record and Owner by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer of Record.
 - a. Engineer of Record and Construction Manager will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer of record's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 14 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Engineer of Record's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Engineer of Record's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

1.06 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:

- a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
- 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 5. Submit Product Data before Shop Drawings.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data
- C. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - 1. Identification of products.
 - 2. Schedules.
 - 3. Compliance with specified standards.
 - 4. Notation of coordination requirements.
 - 5. Notation of dimensions established by field measurement.
 - 6. Relationship and attachment to adjoining construction clearly indicated.
 - 7. Seal and signature of professional engineer for structural elements.
 - 8. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 22 by 34 inches.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineer of Records and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of

compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.07 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer of Record.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product

and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.08 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer of Record and Construction Manager.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Engineer of Record and Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.

1.09 ENGINEER OF RECORD'S REVIEW

- A. Engineer of Record will review each submittal, indicate corrections or revisions required, and return it.
 1. PDF Submittals: Engineer of Record will indicate, via markup on each submittal, the appropriate action.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer of Record.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Engineer of Record will discard submittals received from sources other than Contractor.
- E. Submittals not required by the Contract Documents will be returned by Engineer of Record without action.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.03 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Products that have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Named Product Specification: A product specification in which a single manufacturer's product is named and no substitutions are acceptable.
- C. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.04 SUBMITTALS

- A. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01330 "Submittal Procedures." Show compliance with requirements.

1.05 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer of Record will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project area.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.07 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01770 "Closeout Procedures."

PART 2 - PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Engineer of Record will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed.
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed.

2.02 COMPARABLE PRODUCTS

- A. Not Allowed.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01730

EXECUTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.

1.03 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.04 PREINSTALLATION MEETINGS

- A. Conduct conference at Project Site.
 - 1. Prior to submitting construction layouts, panel modification plans, and cutting and patching plan review extent of work anticipated and examine procedures for ensuring satisfactory result from work. Require representatives of each entity directly concerned with the work to attend, including the following:

- a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affecting by cutting and patching operations.
- 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.05 SUBMITTALS

- A. Construction Layout.
 - 1. Prior to beginning work in an area, provide complete construction layouts of the intended final installation of panels, conduit, pipe, and appurtenances. Include elevations of equipment and panel installations and isometric layouts of pip runs in double line format.
- B. Panel modification plans.
 - 1. Prior to beginning modifications to the ten (10) existing underdrain panels at the north and south coal ponds and the two recycle basins, submit plans for review on the modifications, changes to PLC ladder logic, proposed HMI screens, and complete list of required parts.
- C. Provide propose survey points for locations of pump control panels, electric service panel, underground conduits, OUC utility poles, pullboxes and duct banks.
- D. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results and final finishes.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

- a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- E. Certified Surveys: Submit 2 copies signed by Land Surveyor.
- F. Final Property Survey: Submit 5 copies showing the Work performed and record survey data. Locate all pull-boxes, duct banks, installed pipe and conduits and pump panel locations.

1.06 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer of Record for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of Pipes and pump risers; underground electrical services; control and instrumentation conduits; and other utilities.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer present, for

compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for piping, mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Provide survey documenting conditions to be relocated or affected.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Engineer of Record according to requirements in Section 01310 "Project Management and Coordination."

3.03 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer of Record and Construction Manager promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

3.04 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer of Record. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer of Record before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing all installed duct banks, conduits and pipe runs.

3.05 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer of Record.
 - 2. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Deliver such items to Project site in time for installation.
- I. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 01770 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.06 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

- C. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Concrete Slabs: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 3. Proceed with patching after construction operations requiring cutting are complete.
- D. Patching: Patch construction by filling, repairing, and refinishing with products equivalent in look and durability of original surface. Insert specific installation requirements if not specified elsewhere. Specific installation requirements are better specified in individual Sections.

3.07 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- F. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period.
- G. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.08 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01913 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.09 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION

SECTION 01770

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.03 SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.

1.04 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 30 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 2. Submit closeout submittals specified in individual Sections, including specific warranties, maintenance service agreements, final certifications, and similar documents.

3. Submit maintenance material submittals, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section.
 4. Submit testing, adjusting, and balancing records.
 5. Make final software updates and patches, run security scans and repair any security deficiencies.
 6. Submit sustainable design submittals not previously submitted.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Insure all software has been registered to Orlando Utilities Commission.
 2. Complete startup and testing of systems and equipment.
 3. Perform preventive maintenance on equipment used prior to Substantial Completion.
 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01790 "Demonstration and Training."
 5. Complete final cleaning requirements.
 6. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer of Record will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for final completion.

1.05 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 1. Submit a final Application for Payment according to OUC and Prime Contractors contract documents.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer of Record will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.06 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order by work area, ie., Cell #1, CWSA, North Coal Pond, South Coal Pond, SCADA Control Rom, Etc.
 2. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer of Record
 - d. Name of Contractor.
 - e. Page number.
 3. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Engineer of Record will return annotated file.

1.07 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Engineer of Record for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranties in Paper Form:
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.01 FINAL CLEANING

- A. Cleaning: Clean each surface or unit. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

- b. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - c. Remove labels that are not permanent.
 - d. Wipe surfaces of piping, mechanical and electrical equipment, control panels interior and exterior, gauges, instrumentation and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - e. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- B. Construction Waste Disposal: Comply with waste disposal requirements in Prime Contractors contract specifications.

3.02 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Prior to making any required repairs, submit a complete repair plan for review and approval of the Engineer of Record and OUC.
 - 2. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

END OF SECTION

SECTION 01782

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- B. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Systems and equipment operation manuals.
 - 2. Systems and equipment maintenance manuals.
 - 3. Product maintenance manuals.

1.03 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.04 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Engineer of Record will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit by email to Engineer of Record. Enable reviewer comments on draft submittals.

- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Engineer of Record will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer of Record will return copy with comments.
 - 1. Correct or revise each manual to comply with Engineer of Record's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer of Record's and prior to commencing demonstration and training.
- E. Comply with Section 01770 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.05 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations. Consider other special requirements, such as using photographs instead of drawings to demonstrate unusual installations.

1.06 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.

4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.

8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed.

1.07 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.08 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01783

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Requirements:
 - 1. Section 01730 "Execution" for final property survey.
 - 2. Section 01782 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.02 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit three set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and one of file prints.
 - 3) Submit record digital data files and one set of plots.
 - 4) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit three paper-copy set(s) of marked-up record prints.

- 2) Submit PDF electronic files of scanned record prints and three set(s) of prints.
 - 3) Print each drawing, whether or not changes and additional information were recorded.
- c. Final Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit record digital data files and one set of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy and annotated pdf files on thumb drive of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and annotated pdf files on thumb drive of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

1.03 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Changes made by Change Order or Construction Change Directive.
 - i. Changes made following Engineer of record's written orders.
 - j. Details not on the original Contract Drawings.
 - k. Field records for variable and concealed conditions.
 - l. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer of Record. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 2. Format: DWG, Version 14, Microsoft Windows operating system.

3. Format: Annotated PDF electronic file.
 4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 5. Refer instances of uncertainty to Engineer of Record for resolution.
 6. Engineer of Record will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Engineer of Record's digital data files.
 - b. Engineer of Record will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Engineer of Record.
 - e. Name of Contractor.

1.04 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders and record Drawings where applicable.
- B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

1.05 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders and record Drawings where applicable.
- C. Format: Submit record Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.
1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.06 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer of Record's and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01913

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of test equipment, instrumentation, and tools for commissioning.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

1. Section 01330 "Submittal Procedures" for submittal procedures requirements for commissioning.
2. Section 01770 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.
3. Section 01782 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal.

1.02 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.
- B. Basis-of-Design Document: A document prepared by Engineer of Record that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

- C. Commissioning Plan: A document, prepared by Contractor, that outlines the organization, schedule, allocation of resources, and documentation requirements of commissioning.
- D. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities.
- E. Construction Phase Commissioning Completion: The stage of completion and acceptance of commissioning when resolution of deficient conditions and issues discovered during commissioning and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date Construction Phase Commissioning Completion is achieved. See Section 01770 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.
 - 1. Commissioning is complete when the work specified in this Section and related Sections has been completed and accepted, including, but not limited to, the following:
 - a. Completion of tests and acceptance of test results.
 - b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
 - c. Comply with requirements in Section 01790 "Demonstration and Training."
 - d. Completion and acceptance of submittals and reports.
- F. Owner's Project Requirements: A document written by Engineer of Record details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- G. Owner's Witness: Owner's Project Manager, or Engineer of Record-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.
- H. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.
- I. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

1.03 SUBMITTALS

- A. Comply with requirements in Section 01330 "Submittal Procedures" for submittal procedures general requirements for commissioning.
- B. Commissioning Plan Information:
 - 1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors to the performance of the various commissioning requirements.
 - 2. Schedule of commissioning activities, integrated with the construction schedule.
 - 3. Contractor personnel and subcontractors to participate in each test.
 - 4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.
- C. Commissioning schedule.
- D. Two-week look-ahead schedules.
- E. Test Reports:
 - 1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
 - 2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
 - 3. Commissioning Issues Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
 - 4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
 - 5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
 - 6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit print-out of log of alarms that occurred since the last log was printed.
- F. Construction Checklists:
 - 1. Material checks.
 - 2. Installation checks.

3. Startup procedures, where required.

1.04 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction Phase Commissioning Completion, include the following:
 - a. Pre-startup reports.
 - b. Approved test procedures
 - c. Test data forms, completed and signed.
 - d. Progress reports.
 - e. Commissioning issues report log.
 - f. Commissioning issues reports showing resolution of issues.
 - g. Correspondence or other documents related to resolution of issues.
 - h. Other reports required by commissioning.
 - i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction Phase Commissioning Completion.
 - j. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction Phase Commissioning Completion.

C. Operation and maintenance data.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Test equipment and instrumentation required to perform the commissioning shall remain the property of Contractor unless otherwise indicated.
- B. Test equipment and instrumentation required to perform commissioning shall comply with the following criteria:
 1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
 2. Calibrated and certified.

- a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags permanently affixed.
 - b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.
3. Maintain test equipment and instrumentation.
4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.02 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Bind report in three-ring binders.
2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
3. Record report on compact disk.
4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:
 - a. Test specification.
 - b. Pre-startup reports.
 - c. Approved test procedures.
 - d. Test data forms, completed and signed.

- e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.01 PREPARATION

- A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.02 CONSTRUCTION CHECKLISTS

- A. Construction checklists cannot modify or conflict with the Contract Documents.
- B. Create construction checklists based on actual systems and equipment to be included in Project.
- C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment, if applicable.
 - 1. Services connection requirements, including configuration, size, location, and other pertinent characteristics.
 - 2. Included optional features.
 - 3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness and lack of damage.
 - 4. Installation Checks:
 - a. Location according to Drawings and approved Shop Drawings.
 - b. Configuration.
 - c. Compliance with manufacturers' written installation instructions.
 - d. Attachment to structure.
 - e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall

access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.

- f. Utility connections are of the correct characteristics, as applicable.
 - g. Correct labeling and identification.
 - h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.
- D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, minimum.
- E. Performance Tests:
 - 1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
 - 2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
 - 3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
 - 4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
 - 5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.
- F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction Phase Commissioning Completion. When approved, deferred construction checklists may be completed after date of Construction Phase Commissioning Completion. Include the following in request for Certificate of Construction Phase Commissioning Completion:
 - 1. Identify deferred construction checklists by number and title.
 - 2. Provide a target schedule for completion of deferred construction checklists.
 - 3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.
- G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction Phase Commissioning Completion. When approved, delayed construction checklists may be

completed after date of Construction Phase Commissioning Completion. Include the following in request for Certificate of Construction Phase Commissioning Completion:

1. Identify delayed construction checklist by construction checklist number and title.
2. Provide a target schedule for completion of delayed construction checklists.
3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.03 GENERAL EXECUTION REQUIREMENTS

- A. Schedule and coordinate commissioning with the construction schedule.
- B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.
- C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies.
- D. Report test data and commissioning issue resolutions.
- E. Schedule personnel to perform Commissioning-Process Work.
- F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:
 1. Operating the equipment and systems they install during tests.

3.04 CONTRACTOR'S RESPONSIBILITIES

- A. Management and Coordination: Manage, schedule, and coordinate commissioning, including, but not limited to, the following:
 1. Coordinate with subcontractors on their commissioning responsibilities and activities.
 2. Write, obtain, assemble, and submit commissioning documentation.
 3. Conduct periodic on-site commissioning meetings. Comply with requirements in Section 01310 "Project Management and Coordination."
 4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the construction schedule. Update schedule at specified intervals.
 5. Create test procedures and data forms for approval by Engineer of Record.
 6. Report inconsistencies and issues in system operations.

7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
8. Direct and coordinate test demonstrations.
9. Coordinate witnessing of test demonstrations by Owner's witness.
10. Coordinate and manage training. Be present during training sessions to direct video recording, present training and direct the training presentations of others. Comply with requirements in Section 01790 "Demonstration and Training."
11. Prepare and submit specified commissioning reports.
12. Track commissioning issues until resolution and retesting is successfully completed.
13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide access by Owner to these records on request.
14. Assemble and submit commissioning report.

3.05 COMMISSIONING TESTING

- A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.
- B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published commissioning schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning.
- C. Construction Checklists:
 1. Complete construction checklists as Work is completed.
 2. Distribute construction checklists to installing contractors before they start work.
 3. Installers:
 - a. Verify installation using approved construction checklists as Work proceeds.

- b. Complete and sign construction checklists weekly for work performed during the preceding week.
- 4. Provide Engineer of Record access to construction checklists.
- D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.
- E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.
- F. Test Procedures and Test Data Forms:
 - 1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
 - 2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
 - 3. Completed test data forms are the official records of the results of tests.
 - 4. Contractor shall create test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
- G. Engineer of Record will review preliminary test procedures and test data forms and provide comments within 14 days of receipt from Contractor. Review shall address the following:
 - 1. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
 - 2. Applicability of the procedure to the specific software, equipment, and systems approved for installation.
 - 3. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.
- H. Performance of Tests:
 - 1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.

2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

I. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.
2. Notify Owner's witness at least three days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.
 - a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness and shall note the absence of Owner's witness at the scheduled time and place.

J. Deferred Tests:

1. Deferred Tests List: Identify, in the request for Certificate of Construction Phase Commissioning Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction Phase Commissioning Completion as follows:
 - a. Identify deferred tests by number and title.
 - b. Provide a target schedule for completion of deferred tests.
2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Architect and Engineer of Record at least three working days (minimum) in advance of tests.
3. Where deferred tests are specified, coordinate participation of necessary personnel and of Architect, Engineer of Record, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

K. Delayed Tests:

1. Delayed Tests List: Identify, in the request for Certificate of Construction Phase Commissioning Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction Phase Commissioning Completion. Include the following in the request for Certificate of Construction Phase Commissioning Completion:
 - a. Identify delayed tests by test number and title.
 - b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.
2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Architect and Engineer of Record at least three working days (minimum) in advance of tests.
3. Where delayed tests are approved, coordinate participation of necessary personnel and of Architect, Engineer of Record, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

L. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:
 - a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
 - b. Submit commissioning compliance issue report form within 24 hours of the test.
 - c. Determine the cause of the failure.
 - d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.
5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.
 - a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
 - b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
 - c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.

- d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.
- 6. Diagnose and correct failed test demonstrations as follows:
 - a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
 - b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
 - c. Record the results of each step of the diagnostic procedure.
 - d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
 - e. Determine and record corrective measures.
 - f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.
- 7. Retest:
 - a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
 - b. For each repeated test demonstration, submit a new test data form, marked "Retest."
- 8. Do not correct commissioning compliance issues during test demonstrations.
 - a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than 15 minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.06 SEQUENCING

- A. Sequencing of Commissioning Verification Activities: For an item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:
 - 1. Construction Checklists:
 - a. Material checks.
 - b. Installation checks.
 - c. Start up, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
 - d. Performance Tests:
 - 1) Static tests, as appropriate.
 - 2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
 - 3) Equipment and assembly performance tests.
 - 4) System performance tests.
 - 5) Intersystem performance tests.
 - 2. Commissioning tests.
- B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.
- C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.
- D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.07 SCHEDULING

- A. Commence commissioning as early in the construction period as possible.

- B. Commissioning Schedule: Integrate commissioning into Contractor's construction schedule.
1. Include detailed commissioning activities in monthly updated Contractor's construction schedule and short interval schedule submittals.
 2. Schedule the start date and duration for the following commissioning activities:
 - a. Submittals.
 - b. Preliminary operation and maintenance manual submittals.
 - c. Installation checks.
 - d. Startup, where required.
 - e. Performance tests.
 - f. Performance test demonstrations.
 - g. Commissioning tests.
 - h. Commissioning test demonstrations.
 3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
 4. Determine milestones and prerequisites for commissioning. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short interval schedule submittals.
- C. Two-Week Look-Ahead Commissioning Schedule:
1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning.
 2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
 3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.
- D. Owner's Witness Coordination:
1. Coordinate Owner's witness participation via Architect.

2. Notify Architect of commissioning schedule changes at least two work days in advance for activities requiring the participation of Owner's witness.

3.08 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:
 - a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
 - b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
 - c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
 - d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
 - e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.
2. Test data reports include the following:
 - a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
 - b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
 - c. Signatures of individuals performing and witnessing tests.
 - d. Data trend logs accumulated overnight from the previous day of testing.

3. Commissioning Compliance Issues Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:
 - a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
 - b. Action distribution list.
 - c. Report date.
 - d. Test number and description.
 - e. Equipment identification and location.
 - f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
 - g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
 - h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
 - i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
 - j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
 - k. Schedule for retesting.
4. Weekly progress reports include information for tests conducted since the preceding report and the following:
 - a. Completed data forms.
 - b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.

- c. Activities scheduled but not conducted per schedule.
 - d. Commissioning compliance issue report log.
 - e. Schedule changes for remaining Commissioning-Process Work, if any.
5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.
- a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
 - b. Attach to the data form printed trend log data collected during the test or test demonstration.
 - c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.

3.09 CERTIFICATE OF CONSTRUCTION COMMISSIONING COMPLETION

- A. At the time of substantial completion, Contractor shall prepare and submit to Owner and Engineer of Record a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning.
- B. On receipt of Contractor's list, Engineer of Record will make an inspection to determine whether the construction is complete. If Engineer of Record's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction Commissioning Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction Phase Completion, complete or correct such items on notification by Engineer of Record. In such case, Contractor shall then submit a request for another inspection by Engineer of Record to determine construction phase commissioning completion.
- C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Engineer of Record's services and expenses made necessary thereby, shall be at Contractor's expense.
- D. When construction phase commissioning or designated portion is complete, Engineer of Record will prepare a Certificate of Construction Phase Commissioning that shall

establish the date of completion of construction phase commissioning. Certificate of Construction Phase Commissioning Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION



DIVISION 11

EQUIPMENT

SECTION 11214

SUBMERSIBLE VERTICAL TURBINE PUMPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Labor, materials, and equipment necessary for fabrication, production, installation, and erection of the items specified in this Section as shown on Drawings or listed on Schedule.
- B. Related Sections: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to Work of this Section.
- C. Additional furnished and installed products under this section:
 - 1. Pitless/Sewage adapter.
 - 2. Fittings and pump discharge column from pump to pitless adapter.
 - 3. 316 stainless steel safety cable.
 - 4. Cam locks.
 - 5. Flexible pipe.
 - 6. Column check-valve.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01, Shop Drawings covering the items included under this Section.
- B. Test and Inspection Report: A written report shall be submitted to ENGINEER OF RECORD documenting testing and/or inspection results, including manufacturer test reports.
- C. Operation and Maintenance Data: Submit in accordance with requirements of Section 01330, operation and maintenance manuals for items included under this Section.
- D. Equipment Data Sheet: Prior to taking of Bids for this Contract, as noted on Data Sheet included in this Section, manufacturer of the equipment furnished under this Section shall furnish ENGINEER OF RECORD the information listed on Equipment Data Sheet. The purpose of the Data Sheet is to furnish OWNER necessary information so that an evaluation of the equipment can be accomplished prior to selecting a contractor. Products that, in the opinion of the plant or ENGINEER OF RECORD, are general purpose and not of sufficient quality for a power plant application can result in dismissal of bid.
- E. Warranty: Submit in accordance with requirements of Section 01, warranties covering the items included under this Section.

1.03 SYSTEM RESPONSIBILITY

- A. Pump manufacturer may rely upon information on the mechanical plan sets pertaining to steady-state operating conditions (flow, TDH, NPSHA, etc.). However, pump manufacturer shall be responsible to review this Specification Section, Section 01330, relevant pipework Drawings, schematics, and Electrical and Instrumentation Drawings to ensure that equipment offered is suitable for the purposes intended by the Contract Documents. Refer questions and clarifications to ENGINEER OF RECORD prior to submitting a quote.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
 - 1. Equipment:
 - a. QED Torpedo Pump
 - 2. Column Check Valves:
 - a. [GA Industries](#), Model [290](#).
 - 3. Discharge Pipe Adapters
 - a. EPG
 - 1) NW Series
 - 2) 316 Stainless Steel
 - b. Merrill MFG
 - 1) SSMB Series
 - 2) 316 Stainless Steel
 - c. MAASS
 - 1) JD Series
 - 2) 316 Stainless Steel

2.02 EQUIPMENT

- A. Pumps: Pumps shall be turbine type all 316 stainless steel construction. The submersible pump stage of the unit shall be of the multi-stage submersible type with 316 stainless steel impellers, bowls, nuts, bolts, screws, motor housing, and overall construction. The bowl shall be capable of withstanding a hydrostatic pressure equal to twice the pressure of the rated

capacity or 1-1/2 times shutoff head, whichever is greater. Bowls may be threaded or bolted.

1. The impeller shall be of the enclosed type, 316 stainless steel accurately machined and balanced, and secured to a 316 stainless steel shaft with a 316 stainless steel taper lock collar.
2. The turbine pump outlet adapter shall be of 316 stainless steel.
3. The suction end of the pump shall be fitted with a perforated 316 stainless steel screen.

2.03 COMPONENTS

- A. Power Cable: The power cable from the pump motor to motor starter shall be furnished by pump manufacturer. The motor starter shall be within 15 feet of the point where cable exits the pump riser adapter. The cable shall be 4 individual conductors twisted. The insulation shall be a double covering, the inner covering of a special water-resistant Buna-N synthetic rubber insulation and the outer a tough abrasion-resistant rubber material.
- B. Pump Column: The pump column shall be of adequate size to furnish the quantity of water specified. The pump column shall be assembled in lengths not exceeding 10 feet and shall have 316 stainless steel quick connect couplings. The pipe shall be HDPE having watertight joints.
- C. Column Check Valve: Submersible pumps shall be provided with a 316 stainless steel check valve in the vertical discharge column. The valve shall be of the same nominal diameter as pump discharge column. The valve shall be spring-loaded with a fluorocarbon seat so that it will close fully when the pump stops before flow reversal occurs in the pipe. The valve body shall be 316 stainless steel, the spring shall be 316 stainless steel, and the seat shall be fluorocarbon.
- D. Level Sensor: The pump shall be equipped with a pressure sensor to provide 4-20mA calibrated level in feet of water below the pitless adapter flange to 12 inches above top of screen. Refer to Section 13423.
- E. Turbine Submersible Motor: The submersible motor shall be integral to the turbine pump and be completely enclosed type for continuous duty underwater operation on 460 volts, 60-cycle, 3-phase, AC. This motor must be sufficient size to operate the specified pump from shutoff to open discharge without overloading the motor. The stator core and windings shall be surrounded by a 316 stainless steel casing on the outside of the core. This casing shall be secured to the end rings by heliarc or seam welding techniques if the stator is hermetically sealed and surrounded by a 316 stainless steel casing. This stator shall be equipped with sleeve type radial bearings and a multiple pad type thrust bearing. The thrust bearing shall be capable of carrying the weight of all rotating parts and the hydraulic thrust of the pump. All components shall be capable of operating in water if the initial pre-fill solution is lost.

1. Pump motors shall be sized such that the maximum brake horsepower of the pump selected at any point on the performance curve does not exceed 85 percent of the nameplate horsepower multiplied by the motor service factor.

2.04 ACCESSORIES

- A. Special Tools and Accessories: Pumps shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. A steel toolbox shall be furnished. To contain the tools.
- B. Pipe Discharge Adapter. Provide an adapter for each pump for field installation.
- C. Provide all adapters, pipe, cables, etc., necessary for complete installation from pump to pitless adapter.

2.05 SOURCE QUALITY CONTROL

A. Tests:

1. Shop Tests: Each pump shall be fully tested on water at manufacturer's plant. The purpose of the shop tests shall be to demonstrate that the pumps to be furnished are fully operable and will meet the requirements of the Specifications.
 - a. Head requirements noted on Well Pump Schedule do not include entrance, column, and discharge head losses. Losses from the pump suction to discharge must be added to the heads noted on Pump Schedule and submitted to ENGINEER OF RECORD.
 - b. Test shall consist of running the pumps with furnished impeller at their rated capacity, head, and speed, and at such other conditions of head and capacity to properly establish a performance curve. Performance data including efficiency and horsepower shall be collected and noted as part of the performance curve.
 - c. All pumps shall be tested in accordance with the standards of the Hydraulic Institute. Certified copies of the test results and the performance curves, for each of the pumps to be furnished, shall be submitted to ENGINEER OF RECORD and approved prior to shipment of the pumps to the Site. These test curves shall also include minimum submergence curves for the pump.
 - d. Generally, pumps shall be tested as a complete assembly including drive and motor. If the pumps are tested separately from the motors, CONTRACTOR shall submit to ENGINEER OF RECORD characteristic curves of the motors to be furnished as guaranteed by motor manufacturer. These characteristic curves shall be obtained either from actual tests of the motors to be furnished or from test of motors of the same size and construction. The motor manufacturer's curves shall supply all the necessary information concerning the motor as indicated for the complete shop tests. The characteristic curve shall be certified by motor

manufacturer. If the pumps are tested separately from the drive, CONTRACTOR shall submit to ENGINEER OF RECORD performance data on the drive.

PART 3 - EXECUTION

3.01 ERECTION

- A. Equipment furnished and installed under this Section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with detail Drawings, Specifications, ENGINEER OF RECORD data, instructions, and recommendations of equipment manufacturer as approved by ENGINEER OF RECORD.

3.02 FIELD QUALITY CONTROL

- A. Tests: After the pumping units have been erected, performance tests shall be conducted. The purpose of these performance tests shall be to demonstrate that the units have been properly erected, and that they and their appurtenant equipment will operate satisfactorily and meet the specified conditions and the guarantees of CONTRACTOR. The measurement of the quantity of water pumped shall be included in the performance test.
 - 1. The performance tests shall be conducted under the supervision of ENGINEER OF RECORD with the cooperation of manufacturer's factory representative.

SUBMERSIBLE PUMP DATA SHEET

The manufacturer of this equipment shall submit to ENGINEER OF RECORD, two weeks prior to the time of receipt of Bids, the following specific data on the equipment being offered. The purpose of this information is to provide OWNER the information necessary to evaluate the equipment. Failure by a manufacturer to furnish all the information requested may be cause for rejection of the equipment. Any exception to the specifications must be noted and included in the information submitted below.

PUMPS

Manufacturer and Model No.: _____

Material of Construction _____

Shaft: _____

Impellers: _____

Bowls: _____

Intake Screen: _____

Discharge Column: _____

Number of Stages: _____

Capacity of 75% of Specified Duty Point TDH: _____

Capacity of 110% of Specified Duty Point TDH: _____

MOTORS

Manufacturer and Model No.: _____

Horsepower: _____

Speed: _____

Type of Seals: _____

Efficiency (%): _____

/ Power factor at full load: _____

/ Power factor at 3/4 load: _____

/ Power factor at 1/2 load: _____

COLUMN CHECK VALVE

Manufacturer and Model No.: _____

Head Loss at Design Pump Capacity: _____

SUBMERSIBLE PUMP DATA SHEET (continued)

WEIGHT

Pump: _____

Motor: _____

Guaranteed Impeller Efficiency at Duty Point: _____

Guaranteed Wire to Water Efficiency at Duty Point: _____

Attach to this form a list of submersible well pump installation with motors 25 horsepower or less, including date of initial operation. Attach standard pump curves for duty point specified. Attached details and/or cut sheet of bowls, impellers, motor, the coupling between motor and pump, column check valve, and pitless adapter.

By: _____

Telephone No.: _____

Date: _____

WELL PUMP SCHEDULE

No. of Units:

Type:

Service:

Location:

Capacity (gpm):

Head (feet):

Type Speed Variation:

Pump Setting*:

Motor Description:

Remarks:

* The probable maximum flow and head conditions are listed above for the expected pump equipment. These values may be revised. Revised flow and head conditions will be provided within 30 days of the Contract Award.

END OF SECTION



DIVISION 13

SPECIAL CONSTRUCTION

SECTION 13410

BASIC INSTRUMENTATION AND CONTROL PANEL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: General administrative and procedural requirements for instrumentation installations and abbreviated scope of expected services. Contractors shall review all specification sections and plans for complete intent of expected work. Administrative and procedural requirements are included in this Section to expand on requirements specified in Division 1.
- B. The panel integrator shall be responsible for 100% of the coordination and integration of pump control panels, network, network devices, VPN access, security, setup, configuration and SCADA display and monitoring.
- C. Contractor shall perform all instrument setup and configuration.
- D. All repairs, modifications and corrective actions must be approved by the owner prior to implementation.
- E. Subcontractors must adhere to all contract requirements of prime contractor and prime must adhere to all contract requirements of subcontractors. Subcontractors and Prime contractor agree to "include the full text" of each other's contracts including but not limited to:
 - 1. Insurance.
 - 2. Safety and security.
 - 3. Environmental liability.
 - 4. Meeting attendance.
 - 5. Repairs and corrective actions.
 - 6. Submittals.
 - 7. Dispute resolution.
- F. Work included in this contract consists of:
 - 1. Provide complete systems and duplex control panels for existing Cell 1 and new Cell 2 combustion ash storage leachate and leak detection control panels. Each panel will include controls for one leachate pump and one leak detection pump. Four panels are required for cell 2 installation and four panels for existing cell 1 replacement. All programming of HMI's and PLC's shall be turned over to OUC uncompiled for OUC internal use, modification and re-use within the company at no charge, fee, royalty or other cost to OUC. HMI screens shall use high-performance programming techniques referenced in *The High Performance HMI Handbook*. Off the shelf pre-engineered spciality leachate panels are not acceptable.

2. Provide complete cellular modems, firewalls, switches, configuration, setup of client remote access on various browsers, training, SIM cards, cellular service setup under owner's name, 4GLTE service for 2 years under base bid including base fees and usage fee's. Refer to Section 13710
3. Replace four existing Cell 1 control panels with new duplex control panel design. Replace the eight Cell 1 flow meters, eight Cell 1 pressure sensors, and eight Cell 1 level sensors. Replace wire from the existing Cell 1 termination junction boxes into the new control panels. Re-use conduit.
4. Provide and install new network switch panel at Cell 1, refer to plans for fabrication of panel. Provide switch, switch configuration and testing.
5. Install fiber optic communication network between cells 1 and 2 and all control panels from new cell 1 and cell 2 coal ash storage leachate control panels to new network switch panel. Provide all underground cables and duct banks. Make all terminations and testing to confirm reliable system. Contractor shall provide a technician for 24 hours of on-site coordination (not including travel to and from job site) with plant personnel to determine final fiber routing of existing fiber runs, test assigned fibers, make any required terminations and establish a complete communication system. See plans for general routing.
6. Provide and install new network switch panel at CWSA ponds, refer to plans for fabrication of panel. Provide switch, switch configuration and testing.
7. Install new fiber optic communication network at existing CWSA pond pump control panels and provide new network switch panel, refer to plans. Make all terminations and testing to confirm reliable system.
8. Replace four CWSA simplex pump control panels. PLC's to provide status of pumps and systems to control room via fiber network.
9. OUC will provide aerial fiber to the CWSA and Cell 1/2 ash storage. Contractor will install OUC provided pullbox and duct bank at each location, refer to plans. Only one OUC point of connection (POC) will be provided at Cell 1/2, contractor will provide all fiber and switches to interface to OUC POC.
10. Replace ten (10) touch screen HMI's on existing pump control panels, two each at two coal ponds and recycle expansion pond and four (4) on existing recycle pond. Replace with high output 10.4" screens, refer to Section 13430 for allowable screens. Provide new internal hinged deadfront mounting cover and raise screen up to 3 inches below top of mounting panel. Provide cutouts for balance of existing devices. Field install new HMI, mounting panel and devices. Make all modifications to provide a fully functioning control panel. The existing screens are wholly unuseable, with confusing color schemes, poor contrasts, and fonts that are too small. Contractor shall provide a technician to document system logic and PLC memory mapping and develop new screens that use high-performance programming techniques referenced in *The High-Performance HMI Handbook*.

11. HMI screens shall NOT include any reference whatsoever to the contractor, programmer, integration company, etc. and all files shall be turned over uncompiled for OUC internal use, modification and re-use within the OUC at no charge, fee, royalty or other cost to OUC.
12. Add 30mm red, push to test style, LED fault lamp on exterior enclosure covers of the ten (10) control panels in item six above and a reset pushbutton to clear lamp after faults are cleared.
13. Add temperature sensors inside each of the ten (10) control panels in item ten (10) above, display temperature on main HMI screen, add trending for temperature, and send temperature to two SCADA PLC panel at coal and recycle ponds for display at control room. Update programming in SCADA PLC panels and at control terminal in control room. Run necessary conductors and 2/C#16 set location shielded cable in existing duct banks to SCADA control panels for temperature transmitter and UPS status. Contractor will need to provide lift equipment to pull off concrete pullbox covers.
14. Provide 4 spare Microsoft Surface Pros 12.3" each to include: adobe professional, Microsoft 365 office, 16GB RAM;, 1TB HD, docking station (w/ external keyboard and mouse), Wireless Display adapters, Surface Pen, carrying case, 2-year Accidental Damage coverage.
15. Replace underdrain control room operator computer terminal, software, programming and screens in their entirety, refer to Section 13460 Digital Process Control Computers. Provide 5 years of software upgrades and patches from the HMI software vendor. Include time for contractor representative (System Integrator) to install patches and updates and provide routine maintenance checks on workstation on a quarterly basis for 5 years from date of final acceptance. Routine maintenance shall include: computer diagnostic check to verify and document proper system operation, memory management/usage and running security scan with latest version of Nexus security scan software. Any abnormalities shall be reported immediately to the Owner and repaired by the integrator. System integrator shall also provide on-call/on-site support for 5 years with a maximum of 4-hours response time.
16. During screen development, provide for 6 on site meetings between the Contractor, System Integrator, Owner and Engineer to review process graphic layout and displays, database/IO tagging development, and/or PLC logic as the project software is developed. These meetings shall be scheduled to show progress of the on regular intervals during software development up to and including the Factory Acceptance Test (FAT). All materials to be reviewed at each meeting shall be distributed at least 1-week prior to meeting.
17. Following system acceptance and final owner acceptance, provide 5 year follow-on of network administration as per Section 01100.

1.02 REFERENCES

A. Section 00153 Request for Qualifications

Section 00437 Schedule of Values
Section 01100 Summary of Work
Section 01310 Project Management
Section 01330 Submittals
Section 01730 Execution
Section 01770 Closeout Procedures
Section 01913 General Commissioning Requirements

1.03 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Sections 01, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
1. Product data for each product specified.
 2. Wiring diagrams, both elementary and schematic, differentiating between manufacturer installed and field-installed wiring.
 3. Digital Systems: Provide the following:
 - a. Digital equipment layouts of input and output racks showing complete module model number and addressing assignment. Layouts of port pin assignment, connection schematic indicating cable types and port addresses.
 4. Software Programs: One fully annotated printed copy of program prior to factory test. In addition, provide required number of copies of latest revisions of program at time of acceptance by OWNER. Submittal of printouts, listings, and screen images shall be supplied on paper (hard copy). With concurrence of OWNER and ENGINEER, machine readable magnetic copies may be supplied in addition to printed copies as a matter of convenience. Format of magnetic media shall be as mutually agreed with OWNER.
 5. Programmable Logic Controllers: Submits lists of input and output assignments, data file structures used, and internal data points. Show points used to communicate with between PLCs and the operator interface and data collection segments. Include complete, fully annotated ladder logic diagrams complete with cross-reference listings.
 6. Operator Interface and Supervisory Control: Submit "screen dump" images of each proposed operator interface screen. Describe color schema, mouse button use, function key controls and communication protocol with PLCs. Provide a flow diagram showing screen navigation. Show sample event and alarm log outputs.
 7. Data Collection: Submit details of data structures, communications protocols, data exchange formats, sampling intervals, and file storage space management. Provide "screen dump" images of historical trending.
 8. Data Management and Reporting: Includes process data management, laboratory management, and reporting. Submit data definitions, customization of base software, data entry screens, menus, and report formats. Describe data entry, collection, and

reporting scenarios. Describe data file storage management including backup and archive operations.

- B. Record Drawings: At Project closeout, submit record drawings of installed products, in accordance with requirements of Section 01.
 - 1. Where Drawings are drafted by computer equipment, CONTRACTOR shall furnish files on a flashdrive. These Drawings shall include changes made by Field Orders, Change Orders, Addenda, and errors discovered during start-up and acceptance.
 - 2. Drawings shall include terminal numbers at each wiring termination and piping termination. A complete system diagram shall be included.
- C. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01, operation and maintenance manuals for items included under this Section.
 - 1. Instructions shall be short, easy-to-understand directions specifically written for this Project describing various possible methods of operating equipment. Instructions shall include procedures for tests required, adjustments to be made, and safety precautions to be taken with equipment. These documents are to be submitted to ENGINEER's office.
 - 2. Provide 1 complete set of manufacturer documentation covering programmable equipment supplied. Include hardware manuals and prints as manufacturer normally ships with programmable equipment.
 - a. Include complete software manuals for operating system, as well as manuals for any other software. Written instructions for the operations and maintenance of software shall be provided. The instructions shall be short, easy-to-understand directions specifically written for this Project describing various possible methods of operating software.
 - b. Include program listings, point/address lists, cross-reference listings, images of screens, data entry forms, and sample reports.
 - c. Manuals shall include instructions for program users and instructions for maintenance programmers.
- D. Warranty: Submit in accordance with requirements of Section 01, warranties covering the items included under this Section.

1.04 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. National Electric Code.
 - 2. Applicable State and local requirements.

3. UL listing and labeling shall be adhered to.
-
- B. Items covered by this Section are designated as undelivered specifically manufactured equipment for which associated progress payments will be made in accordance with this Specification.
 - C. Equipment that does not have a UL, FM, CSA, or other listed testing laboratory label shall be furnished with a notarized letter signed by the supplier stating that equipment furnished has been manufactured in accordance with National Electric Code and OSHA requirements.
 - D. CONTRACTOR shall provide permits and licenses, observe and abide by applicable laws, regulations, ordinances, and rules of State, territory or political subdivision thereof, wherein the Work is done. CONTRACTOR shall pay fees for permits, inspections, licenses, and certifications when such fees are required.
 - E. To ensure timely performance and conformance with Specifications, Project meetings shall be held at OWNER's facility weekly during course of Project. Refer to Section 01310 Project Management for complete details and requirements of meetings. Cost of such meetings shall be included in bid.
 - F. Calibration Equipment and Testing Apparatus: Equipment supplier shall have available test and calibration equipment for factory panel tests, installation, start-up, service contract, and maintenance or troubleshooting purposes.
1. The equipment required for these tests is as follows:
 - a. One - Digital Multimeter with an accuracy of plus or minus 0.1 percent.
 - b. One - Signal calibrator for analog signals.
 - c. One - 0 to 100 psi, 6-inch-diameter pressure gauge with 1 psi graduations and plus or minus 1 percent accuracy. Include "Tee" fittings and fittings for 0.25 inch through 1-inch threaded taps to connect gauge.
 - d. One - Air tank pressurized to 150 psi with 2 regulators. One regulator for the 0 to 30 psi range, and one regulator for the 30 to 100 psi range. Include accessories of fittings for 0.25 inch through 1-inch threaded taps to connect air tank.
 - e. One - 30-foot supply of 0.375-inch PVC clear plastic tubing with fittings for 0.25 inch and 0.375-inch threaded taps to make manometers for Venturi tubes, orifice plates, etc., for calibration checks.
 - f. One - Decibel meter for telemetry work capable of reading minus 40 db to plus 10 db over frequency range of 300 to 2,500 hertz with a selective narrow band filter.
 - g. One - High-impedance earplug speaker with alligator clips for telemetry monitoring of transmitter keying.

- h. One - Signal generator for telemetry adjustable over 300 to 2,500 hertz with 1 milliwatt output into 600-ohm line.
 - i. One - Set of portable radios capable of operating within buildings at one location and 5 miles outside of buildings in hilly terrain.
 - j. One - Programming terminal with software to configure programmable equipment.
- G. Component Requirements: For the purposes of uniformity and conformance to industry standards, signal transmission modes shall be either electronic 4-20 mA DC or pneumatic 3-15 psi only. No other signal characteristics are acceptable, except for remote temperature detector (RTD) and thermocouple (TC) sensing circuits; 4-20 mA DC signals shall be such that devices may be wired in parallel for 1-5 volt DC as required. 1-5 volt DC mode shall be employed only within control panel enclosures.
- H. Responsibility and Coordination: Drawings and Specifications are intended to include details of a complete equipment installation for purposes specified. CONTRACTOR shall be responsible for details which may be necessary to properly install, adjust, and place in operation complete installation. Any error on Drawings or in Specifications which prevents proper operation of supplied system shall be shown correct at time of Shop Drawing submittal for approval or brought to attention of ENGINEER with or prior to submittal and error must be presented to the Engineer of Record in a submittal with a request to revise the design documents.
- I. CONTRACTOR shall be responsible for costs incurred to correct aforementioned errors brought to ENGINEER's attention. CONTRACTOR shall assume full responsibility for additional costs which may result from unauthorized deviations from Specifications and make all corrections to be in compliance with design specifications and contract documents

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Manufactured material shall be adequately packed to prevent damage during shipping, handling, storage, and erection. Material shipped to Site shall be packed in a container properly marked for identification. Blocks and padding shall be used to prevent movement.
- B. CONTRACTOR shall inspect the material prior to removing it from carrier. If damage is observed, CONTRACTOR shall immediately notify carrier so that a claim can be made. If no such notice is given, material shall be assumed to be in undamaged condition; any subsequent damage that occurs to the equipment shall be the responsibility of CONTRACTOR. Repair and replacement of damaged parts will be done at no expense to OWNER.
- C. CONTRACTOR shall be responsible for any damage charges resulting from handling of materials.

PART 2 - PRODUCTS

2.01 EQUIPMENT SUPPLIERS

- A. Subject to compliance with specified requirements, equipment suppliers shall be the following (no "or equals"):
 - 1. Revere Control Systems, Birmingham, AL (205) 824.0004
 - 2. MR Systems, Norcross, GA (888) 564.5688)
 - 3. Control Instruments Inc., Smyrna, GA (404) 351.1085
- B. References made in these Specifications to specific manufacturer's products are intended to serve as a guide to type, construction, and materials. Listing of a manufacturer does not imply acceptance by ENGINEER of a manufacturer's particular product, product line, or latest product revision if it does not meet Specifications.
- C. Equipment Supplier: Equipment specified under additional specification sections and shown on Drawings shall be designed as a system, fabricated or purchased, shipped to Site, and started up by one of the qualified and approved equipment suppliers listed under this Section. Intent is for unit responsibility.
 - 1. Equipment supplier shall not assign any of its rights or delegate any of its obligations under these Sections without prior written acceptance by ENGINEER.
 - 2. Direct purchase of any items in these Sections by CONTRACTOR is not in compliance with this Specification and will not be permitted.
 - 3. When a Service Contract is included, it shall be performed by factory-trained personnel employed by equipment supplier. Equipment supplier shall assign a qualified Professional Engineer employed by the supplier as Project Engineer/Project Manager.
 - a. Project Engineer/Project Manager's name and resume shall be forwarded to CONTRACTOR and ENGINEER within 30 days after receipt of a purchase order by equipment supplier for review and approval.
 - b. Project Engineer/Project Manager shall be focal point for design, fabrication, Contract communications, and shall be responsible for start-up and acceptance. Project Engineer/Project Manager shall be at factory test at Site for start-up and at the Site during entire acceptance procedure. Only qualified and approved equipment suppliers shall be accepted as meeting this Specification.

2.02 EQUIPMENT

- A. Transmitted electronic signals to equipment of other vendors and between control panels shall be a separate isolated-floating output for each item of equipment and shall conform to ISA Standard S50.1.

- B. All outdoor enclosures shall be NEMA 4X white powder coated 316 stainless steel with sunshields and air conditioning unit.
- C. No external power connections shall be allowed unless specifically called for in Specification. Where an external power source is called for, unit shall accept 120 VAC, plus or minus 10 percent power.
- D. Current-to-current converters shall be used as power boosters to provide sufficient signal power as required. It is equipment supplier's responsibility to determine under what circumstances and locations power boosters are required, provide them, and integrate them into the instrumentation system to make system function properly.
- E. Separate power supplies shall be totally enclosed with solderless terminals for connections. They shall be short circuit current limiting type that will automatically resume regulation after removal of short circuit. They shall operate from 120-volt AC, plus or minus 10 percent power. Regulated voltage shall be fixed. Units with internal trim potentiometers will be accepted.
- F. Size and style of instruments are defined in Specifications.
- G. Charts and scales are shown on Drawings. Standard scales shall not be accepted without ENGINEER's approval if it differs from those shown. Ratio station scales and other scales shall be graduated such that major graduations fall on whole numbers (i.e., 1, 2, 3, or 5, 10, 15, etc.) and minor graduations fall on 0.1 or 0.2 intervals (i.e., 1.1, 1.2 or 11, 12, etc.). If two scales are called for on ratio stations, each scale shall be indexed to meet Specification. Drawing of each scale for ratio stations shall be submitted with Shop Drawings for approval.
- H. Solid-state output switches, where used, shall be overvoltage transient protected and not be damaged by di/dt or dv/dt for their design application under this Contract.
- I. Instruments shall be equipped with permanently attached identification tag. Tag shall be included on field- and panel-mounted devices. Tags shall include ENGINEER's tag identification and manufacturer's tag identification if different from ENGINEER's.
 - 1. Tags shall be either stamped metal or laminated phenolic with black letters engraved on a white background. Field-mounted devices shall have tags fastened with screws. Devices mounted in panels will be tagged inside panel on subplates or on device itself where it can be easily read.
- J. Finish on instruments and accessories shall provide protection against corrosion by elements in environment in which they are to be installed. Both the interior and exterior of enclosures shall be finished. Extra paint of each color used on material shall be provided by manufacturer for touch-up purposes.
- K. Provide equipment identification nameplates complying with Section 16075. Nameplates shall contain ENGINEER's item designation and, for indicators and transmitters, design range and units of device shown.

2.03 SOURCE QUALITY CONTROL

- A. Control and monitoring system control panels and computer equipment, if any, shall be tested at the factory prior to shipment to Site. The Engineer and/or Owner reserve the right to witness the testing. Contractor shall give a minimum of 4 weeks notice to Owner and/or Engineer before factory test date. Factory test shall include checking for conformity to Specifications, fabrication, and nomenclature. Control and monitoring system logic and terminals shall be checked line by line and function by function in total for conformity of Drawings.
- B. Conduct preliminary testing prior to factory checkout by executing programs supplied for this Project. Exercise inputs to test logic for correct function and proper response of outputs. Verify correct interface with programs. Verify correct communications.
- C. Factory testing shall be used to validate fieldbus and plant LAN/WAN interconnections. Proper communication between devices and software components shall be demonstrated. Data Collection and Data Management Reporting shall be demonstrated.
- D. Equipment supplier shall have test equipment available at the factory. A full set of annotated logic programs and wiring diagrams with the latest revisions shall be made available to Engineer of Record at factory for checking purposes. Drawings shall include wire numbers and terminal numbers.
- E. Control panels and programmable equipment shall not be shipped to Site until logic conforms to Contract requirements, physical changes required by testing are made, and tags conform to factory test corrections. Equipment delivered to Site without factory test or corrections will be returned to factory at CONTRACTOR's expense.

2.04 SOURCE QUALITY CONTROL

- A. The equipment supplier shall make available 2 qualified person for entire duration of the factory test. This includes equipment supplier factory testing witnessed by ENGINEER, and during the software checkout phase of the factory test listed below.
- B. Once the PLCs, SLC's, etc., are connected at the equipment supplier's factory, and it has been demonstrated that the equipment properly communicates, the Engineer may require that the panels shall remain at the supplier's facility for 4 additional weeks to allow Engineer of Record to check out the PLC/SLC software and operator interface software.
- C. Test Procedures:
 - 1. Hardware testing to verify system wiring, layout, workmanship, and appearance. Demonstrate correct function of inputs and outputs using a switch and lamp "mimic board." Perform a PLC/SLC load test to verify that outputs can be driven at full load simultaneously.
 - 2. Communications tests to verify inter-processor messaging via data highway, serial links, data management computer, and modems.
- D. Provide services of PLC/SLC manufacturer's application engineer at factory test for 1 day.
- E. CONTRACTOR shall include in his Bid an amount, when the system factory test facility is more than 80 miles from ENGINEER's Orlando, Florida office, all cost of hotels and transportation for weekly trips and lodging for 2 members of ENGINEER's staff over entire factory test.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Equipment provided under this Section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of equipment manufacturer as approved by Engineer of Record.
- B. Install equipment as indicated, in accordance with manufacturer's written instruction, and in compliance with recognized industry practices to ensure that products fulfill requirements.
- C. Control panels shall be installed in accordance with Division 16 Sections.
- D. Drawings are not intended to show every detail of construction or location of piping, or equipment. Where proper operation or construction makes it necessary or advisable to change location of piping, instrumentation equipment, or other equipment, CONTRACTOR shall so inform Engineer of Record for his approval and permission.

3.02 FIELD QUALITY CONTROL

- A. Calibrate equipment in accordance with manufacturer's instructions to ranges or set points indicated on Drawings.
- B. Installation and Start-up: Equipment supplier shall have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than 12 hours travel time from Site.

- 1. For purposes of new Cell 2 control panels, Equipment supplier shall provide an experienced, factory-trained, competent, and authorized service representative for a minimum of 6 times at Site, including once during installation and start-up and once during acceptance to inspect, check, and calibrate any part of system. Supplier's service representative shall revisit Site for 8 hours per day as often as necessary after installation until trouble is corrected and equipment has passed acceptance test and is operating satisfactorily to the Engineer of Record.

Sixth trip shall be after equipment has been accepted and shall be used to instruct OWNER's personnel in aspects of operation and maintenance, such as fuse locations, use of controls, instruction manuals, etc. Sixth trip shall be for duration one 8-hour day at OWNER's facility. Equipment supplier shall create a power point presentation and provide 3 hard copies of the presentation and O&M documentation used as reference during training in the clients Site training room. Presentation shall be polished and professional to fully cover all maintenance and training aspects.

- 2. For replacement of existing control panels of Cell 1, the CWSA panels and the installation of the two new network switch panels, Equipment supplier shall provide an experienced, factory-trained, competent, and authorized service representative for a minimum of 9 times at Site, including once during installation and start-up and once

during acceptance to inspect, check, and calibrate any part of system. Supplier's service representative shall revisit Site for 8 hours per day as often as necessary after installation until trouble is corrected and equipment has passed acceptance test and is operating satisfactorily to the Engineer of Record.

Ninth trip shall be after equipment has been accepted and shall be used to instruct OWNER's personnel in aspects of operation and maintenance, such as fuse locations, use of controls, instruction manuals, etc. Sixth trip shall be for duration one 8-hour day at OWNER's facility. Equipment supplier shall create a power point presentation and provide 12 hard copies of the presentation and O&M documentation used as reference during training in the clients Site training room. Presentation shall be polished and professional to fully cover all maintenance and training aspects.

3. For modifications to the existing coal runoff ponds and two recycle basins, equipment supplier shall provide sufficient experienced, trained, competent field personnel to modify the existing underdrain and leak detection control panels in the field and insure complete and full functionality of the modified panels, programs and equipment. Following successful completion of all panel modifications, programming, network setup and control room operator station integration, Equipment supplier shall create a power point presentation and provide 12 hard copies of the presentation and O&M documentation used as reference during training in the clients Site training room. Presentation shall be polished and professional to fully cover all maintenance and training aspects.
4. Training requirements in 1, 2 and 3 above are to be separate presentations conducted within 30 days of the completion of work for the given area and not to be combined.

3.03 TRAINING

- A. Digital Equipment: Equipment supplier shall provide comprehensive instruction for the programmable controller, operator interface, computers, and software packages supplied. This instruction shall be performed by manufacturer of the products at the OUC plant conference room. Equipment supplier shall submit to ENGINEER an outline of the proposed training courses to meet the requirements set forth below. Equipment supplier shall also provide to ENGINEER a list of additional courses available from manufacturer. Upon review, ENGINEER may request that a substitution be made of a course content that better fits the needs of OWNER. Such substitution shall only be requested for courses of equal length, cost, and availability. The content of these courses and proposed lengths shall be as follows:

1. Programmable Logic Controller Training:

- a. Courses:

1) PLC/SLC Maintenance and Troubleshooting	0.5 days
2) Maintenance and Troubleshooting	0.5 days

2. Operator Interface Computer-Network File Server:

1) Supporting Windows NT Server	0.5 days
2) Supporting Windows NT Workstation	0.5 days

3. SCADA Software:

a. Training Courses:

1) Maintenance	1 day

- B. CONTRACTOR shall bear costs for the specified training. CONTRACTOR shall arrange for training for OWNER with a minimum of 4-week notification of the training schedule prior to the actual course being provided. Scheduling of the courses and their contents shall be approved by ENGINEER and provided at a time and location agreeable to OWNER. The course shall be conducted at the OUC plant conference room.

3.04 DEMONSTRATION

- A. Upon completion of installation and calibration, demonstrate functioning of equipment in accordance with requirements, where possible, correct malfunctioning units at Site, then retest to demonstrate compliance; otherwise, remove and replace with new or repaired units, and retest to demonstrate compliance.

END OF SECTION

SECTION 13413

OPTICAL FIBER CABLING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Product and installation requirements for the following:

1. Fiber-optic (FO) Cables.
2. Fiber-optic Connectors, Couplers, and Patch Panels.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

1. Product data for each type of product specified.
2. Product certificates, signed by the communication system manufacturers, certifying that the cables are suitable for the connected equipment as described in "Quality Assurance" Article below.

1.03 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Firms regularly engaged in manufacture of equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Connected Equipment Manufacturer Certifications: Where cables specified in this Section are used to provide signal paths for systems specified in other sections of these Specifications, or for systems furnished under other contracts, obtain review of the cable characteristics and certification for use with the connected system equipment by the connected equipment manufacturers.
- C. UL Compliance: For cables that may be run in plenum ceilings or other air-handling spaces, provide cables tested for compliance with applicable requirements of UL Standard 910, "Test Method for Fire and Smoke Characteristics of Electrical and Optical Fiber Cables Used in Air-Handling Spaces." In addition, provide FO cables that have passed the UL VW-1 flame test.
- D. EIA/TIA Compliance: Comply with applicable requirements of EIA Standards, EIA-440, -455, -458, -475, -509, -568-b.3, and 598-a pertaining to optical fiber cable and system component construction and installation. EIA/TIA-455-61, FOTP-61, Measurement of Fiber or Cable Attenuation Using an OTDR.

- E. Fiber Optics Experience: CONTRACTOR must be able to prove to the satisfaction of OWNER that it has significant experience in the installation of fiber-optics cable systems. Installation must include installation of fiber-optics cable, fiber termination, knowledge of interconnect equipment, and a thorough knowledge of testing procedures.
- F. Labeling: Handwritten labels are not acceptable. All labels shall be machine printed on clear or opaque tape, stenciled onto adhesive labels, or type written onto adhesive labels. The font shall be at least 1/8 inch in height, block characters, and legible. The text shall be of a color contrasting with the label such that it may be easily read. If labeling tape is utilized, the font color shall contrast with the background. Patch panels shall exhibit workstation numbers or some type of location identifier, in sequential order, for all workstations or devices attached. Each fiber-optics cable segment shall be labeled at each end with its respective identifier.
- G. Fiber-Optics Interconnect Equipment (Patch Panels): Interconnect equipment shall be used in all fiber cable installations. Patch panels shall be mounted in the equipment racks or panel mounted. Interconnect equipment mounted in racks shall be affixed to the rack by at least 4 screws. All fiber-optics interconnect devices shall be assembled and installed in accordance with the manufacturer's instructions and recommendations.
- H. Patch Cords: Patch cords shall be provided for each fiber-optic port on the patch panel. Patch cords shall meet or exceed technical specifications of all installed fiber-optic cable. Patch cord connectors shall be matched with patch panel connector type and network fiber module connector type as required.

1.04 COMMISSIONING

- A. Subsequent to hook-ups of FO system to signal sources and destination equipment, operate systems to demonstrate proper functioning. Replace malfunctioning FO cabling system items with new materials, and then retest until satisfactory performance is achieved.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
 - 1. FO Cables:
 - a. Corning Altos Lite Gel Free 50um multimode
 - b. Corning FreeDM LST singlemode
 - 2. FO Connectors and Couplers:
 - a. AMP Netcon.

- b. AT&T Network Systems.
 - c. Corning.
 - d. ITT Corp.
- 3. FO Patch Panels:
 - a. Panduit.
 - b. Volition.
- 4. FO Converters
 - a. Black Box LBH100A-HD-ST-24 multimode.
 - b. Black Box LBH100A-HD-SSC-24 single mode.

2.02 OPTICAL FIBER CABLING SYSTEMS

- A. Fabricate system using manufacturer's standard materials as indicated by published product information and in sizes, types, and performance characteristics as indicated.
- B. FO Cables: Factory fabricated, single channel, all dielectric, low loss glass type, fiber-optic multimode graded-index cables with the following operational and construction features:
 - 1. Multi-mode Fibers:
 - a. Cable Type shall be Corning ALTOS One Indoor/Outdoor Tight-Buffered Cable.
 - b. Number of Fibers: 6 minimum or as listed on Drawings.
 - c. Core Diameter: 50 microns or as listed on Drawings.
 - d. Cladding Diameter: 125 microns or as listed on Drawings.
 - e. Fiber Category: style OM2 or OM3.
 - f. Subunit Size: 2.0 mm or as listed on Drawings.
 - g. Maximum Attenuation: Less than 2.5 dB/km at 850 nm and less than 1 dB/km at 1300 nm.
 - h. Minimum Bandwidth: Greater than 1000 MHz-km.
 - i. Minimum Bend Radius (Unloaded): 10 cm (3.1 in).
 - j. Operating Temperature Range: -20 to +70 degrees C.

2. Single-mode Fibers Below Grade:

- a. Cable Type shall be Corning FREEDM LST Single-Tube Indoor/Outdoor Tight-Buffered Cable.
 - b. Gel-free.
 - c. Number of Fibers: 6 minimum or as listed on Drawings.
 - d. Core Diameter: 9 microns or as listed on Drawings.
 - e. Cladding Diameter: 125 microns or as listed on Drawings.
 - f. Subunit Size: 2.0 mm or as listed on Drawings.
 - g. Maximum Attenuation: Less than 0.5 dB/1,350 nm.
 - h. Minimum Bandwidth: Greater than 1000 MHz-km.
 - i. Minimum Bend Radius (Unloaded): 10 cm (3.1 in).
 - j. Operating Temperature range: -20 to +70 degrees C.
- C. FO Connectors: 316 Stainless steel, fiber-optic cable connectors, capable of terminating FO glass cables with diameters from 8 through 1,000 microns. Fabricate connectors with optical fiber, self-centering, axial alignment mechanisms. Select ST or SC style connectors as required or shown on Drawings. Connectors shall have an insertion loss of 0.5dB or better.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions with the Installer present for compliance with requirements, and other conditions affecting the performance of optical fiber cabling system. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION

- A. Install fiber-optic cables and associated equipment and devices in accordance with industry standards, OUC standards and manufacturer's written instructions.
- B. Install fiber-optic cable without damage to fibers, cladding, or jacket. Ensure that media manufacturer's recommended pulling tensions are not exceeded. Do not, at any time, bend cables to smaller radii than minimums recommended by manufacturer.

- C. Install FO cables simultaneously where more than one cable is being installed in same raceway. Use pulling lubricant where necessary; compound used must not deteriorate cable materials. Do not use soap. Use a pulling means, including fish tape, rope, and basket-weave grips, that will not damage media or raceway.
- D. No splices are allowed, except at indicated splice points on drawings.
- E. All strands in a cable shall be tested, terminated and installed on a termination box mount. All cable runs shall incorporate service loops in every handhole, manhole, termination cabinet, pullpoint. In duct banks, provide 6 foot service loop in each pull box immediately ahead of a termination point.
- F. To insure the cable tensile-load rating is not exceeded, a breakaway swivel, winch line dynamometer or tension-limiting winch must be used for cable pulls.
- G. Observe minimum bend radius of cable vendor but in no case shall bends be less than 30 x OD of cable.

3.03 GROUNDING

- A. Provide grounding connections for other system components as required by manufacturer's written instructions.

3.04 APPLICATIONS

- A. Install optical fiber cabling for project applications.
- B. Install OUC provided pullbox and 3" conduits with pull cords for OUC installation of aerial plant fiber.

3.05 FIELD QUALITY CONTROL

- A. Testing: Testing shall be done by CONTRACTOR with at least 5 years of experience in testing fiber-optic cabling systems. CONTRACTOR shall test each fiber strand. **OWNER reserves the right to have representation present during all or a portion of the testing process. CONTRACTOR must notify OWNER 5 days prior to commencement of testing.** If OWNER elects to be present during testing, test results will only be acceptable when conducted in the presence of OWNER. Any fiber-optic cable left non-terminated at the discretion of OWNER, shall be tested using an adequate light source to determine that all installed strands are not damaged.
- B. Fiber-Optics Cable: Each fiber strand shall undergo bi-directional testing for signal attenuation losses using power meter and light source prior to removing from cable reels and after installation. Testing shall also include Optical Time Domain Reflectometer (OTDR) at both 850 and 1,300 nanometers for all installed fiber strands.

1. Recommended Test Equipment:

- a. Siecor OM-100F and OS-100D or equivalent power meter and light source.
 - b. Siecor OTDRPlus with appropriate modules for testing.
- 2. Tests:
 - a. Multi-mode: Bi-directional signal attenuation at 850 and 1,300 nm.
 - b. Single-mode: Bi-directional signal attenuation at 1310 and 1,550 nm.
- 3. Test Criteria: Signal loss of less than 10 dB through entire fiber path, including cable, couplers and jumpers.
- C. Documentation (Fiber Optic): CONTRACTOR shall provide documentation to include test results and as-built Drawings. Fiber Test Results: The results of the fiber testing shall be entered into the form "Fiber Attenuation Tests Results." Handwritten results are acceptable provided the test is neat and legible. Copies of test results are not acceptable. Only original signed copies will be acceptable.
 - 1. Each cable installed shall undergo complete testing in accordance with TIA/EIA TSB-67 to guarantee performance to this standard.
 - 2. All required documentation shall be submitted within 30 days at conclusion of the project to OWNER.
 - 3. Test Criteria: Pass rate to conform to latest TIA/EIA Standards that incorporate link performance testing through entire path, including cable, couplers, and jumpers.
- D. Acceptance: Acceptance of the Data Communications System, by OWNER, shall be based on the results of testing, functionality, and the receipt of documentation.

3.06 CLEANING

- A. Clean optical fiber cabling and components of dirt and construction debris upon completion of installation.

END OF SECTION

SECTION 13421

FLOW MEASUREMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Inline Electromagnetic flow meter and indicating transmitter, insertion external pipe mount meters not acceptable.

1.02 SUBMITTALS

- ###### A. Shop Drawings: Submit in accordance with Sections 01, Shop Drawings covering the items included under this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- ###### A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work included.

1. Inline Magnetic Flow Meter:

- a. Rosemount.
- b. Johnson Yokogawa Corp.

2.02 INLINE ELECTROMAGNETIC FLOW METER

- ###### A. Magnetic flow meters shall be flanged type.
- ###### B. Meter body shall be Schedule 10, 316 stainless steel.
1. Meter shall have a ceramic, Teflon, or Tefzel liner and Hastelloy "C" electrodes.
- ###### C. Liner material shall be suitable for Leachate.
1. Meters 4 inches or smaller shall be furnished with a Teflon or Tefzel liner.
- ###### D. Electrodes shall be suitable for Leachate and shall be bullet nosed style made of Hastelloy "C".

- E. Start-up and acceptance check for flow meters shall be performed by a qualified employee of flow meter manufacturer. Service personnel of sales representative or of equipment supplier of this Section will not be accepted.
- F. Meter shall be capable of withstanding accidental submergence in 30 feet of water for up to 48 hours. Field coil design shall be such that they shall not overheat or otherwise be damaged if flow tube is not totally filled with fluid. Magmeters shall be provided with 2 grounding rings.
- G. The sensing element shall be constructed of suitable materials to withstand submergence to 30 feet to IP 68 rating indefinitely. The tube shall be designed so that it may be buried to a depth of 15 feet where applicable. Provide evidence of ability to be buried. Directions for installation of conduit and wiring connections shall be clearly written and graphically shown for Installer's use.
- H. Magnetic flow meter signal converter shall consist of solid-state, feedback-type microprocessor circuitry. Operational parameters shall be user configurable locally via an integral push-button arrangement or via a remote intelligent terminal. Appurtenances, including hand-held programmer and/or programming software, shall be provided for local configuration of operational parameters. Converter shall change a low-level flow signal from sensor electrodes into a proportional isolated 4-20 mA DC signal. The converter shall have an extremely high input impedance and not be affected by quadrature noise. The unit shall be capable of accommodating uni-directional or bi-directional flow. Sensing of meter failure shall activate a user-configurable zero or 130 percent output signal and a failure alarm contact closure.
- I. A high-frequency digital proportional output shall be provided for use with high-accuracy totalizers. To eliminate errors, the converter shall incorporate an integral zero return circuit to provide a constant zero output signal in response to an external dry contact closure. An automatic empty pipe detector and low-flow cutoff shall be provided as standard.
- J. Magmeter shall be electronically isolated for grounding. Where insulated or nonconductive pipe is used, only orifice plate-type grounding rings will be acceptable. Grounding electrodes which penetrate the liner will not be acceptable.
- K. Unit shall be supplied with an integral or local conduit-mounted flow indicator calibrated in engineering units. Indicator shall be tagged showing design range in units being measured and shall be capable of simultaneously displaying flow rate and totalization with an alphanumeric display.
- L. Zero stability shall be achieved by pulsing the sensing head magnetic field coils with a regulated direct current, first in one direction and then in opposite direction.
- M. Continuous zero stability shall be obtained by signal sampling during the quiescent coil states. There shall be no zero offset or zero adjustments required. The converter shall not require calibration over its expected life under normal use.

- N. Flow meter shall operate within Specifications on 120 volt AC plus 10 percent and 60 hertz plus 5 percent. Power consumption shall not exceed 25 VA for meters 24 inches and smaller, and 50 VA for meters 30 inches or greater.
- O. Input span shall be adjustable between 0-1 and 0-30 feet per second and range adjustment shall be digital. Converter shall include adjustable damping circuitry. Unit shall not be affected by power line aberrations such as those produced by SCR-type motor controllers or other voltage transients.
- P. System accuracy, including primary magnetic flow meter, shall be plus 0.5 percent of rate for maximum flow velocities from 1.33 to 33.33 feet per second, and plus 1 percent of rate for maximum flow velocities from 0.7 to 1.32 feet per second. Repeatability shall be plus 0.1 percent of span. Rangeability shall meet or exceed 30:1 turndown.
- Q. The signal converter portion of the magnetic flow meter shall include both a magnetic driver to power the magnetic coils and the signal converter electronics. The converter shall have the ability to be either integrally mounted. It shall be housed in a NEMA 4X 316 stainless steel case.
- R. Magmeter manufacturer shall comply with ISO9000 Standards and the meter shall be FM approved. Signal converters shall be interchangeable without effect of meter accuracy or the need for recalibration for all meter sizes.

PART 3 - EXECUTION

3.01 GENERAL

- A. Examination, Installation, Field Quality Control, Demonstration: In accordance with Section 13410.
- B. Contractor to coordinate setup and configuration of unit with vendor service personnel.

END OF SECTION

SECTION 13423

LEVEL MEASUREMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:

1. Submersible level (pressure) sensor/transmitter.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Sections 01, Shop Drawings covering the items included under this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Submersible Level Sensor:

- a. Endress Hauser
- b. Rosemount

2.02 SUBMERSIBLE LEVEL TRANSMITTER

A. Submersible level transmitter shall measure liquid depths using a fully submerged differential pressure transmitter suspended in measured medium by electrical cable. Transmitter shall be supplied with cable required to reach control unit from sensor location. Transmitter shall have internal surge protection and provide a 4-20mA output to the control panel.

B. Sensor shall be loop powered 2-wire.

C. Sensor shall be intrinsically safe.

D. Provide bellows termination of air tube with inline desiccant ahead of the bellow.

PART 3 - EXECUTION

3.01 GENERAL

- A. Examination, Installation, Field Quality Control, Demonstration: In accordance with Section 13410.

END OF SECTION

SECTION 13424

PRESSURE MEASUREMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:

1. Pressure to current (P/I).

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Sections 01, Shop Drawings covering the items included under this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Pressure to Current:
 - a. Endress Hauser
 - b. Rosemount.

2.02 PRESSURE TO CURRENT (P/I)

- A. Pressure to current signal converter shall be 2-wire, solid-state electronic, temperature-compensated, strain gauge or capacitive type. Process pressure shall be applied to sealing diaphragm in measuring section. This pressure shall be transmitted to a measuring element connected to the electronics of the transmitter. Transmitter shall output an isolated 4-20 mA signal proportional to pressure measurement.
- B. Positive overage protection shall be provided to 2,000 psig. Diaphragms and wetted parts shall be 316 stainless steel, except where other special alloys are required to prevent corrosion.
- C. Accuracy shall be within plus or minus 0.1 percent of calibrated span for spans from 1:1 to 15:1 of URL. Stability shall be plus or minus 0.1 percent of URL for 6 months. Zero suppression and elevation shall be at least 500 percent of range.

- D. In applications where pressure transients may occur (i.e., level for elevated and ground storage tanks, pumping pressure, etc.), CONTRACTOR shall include snubbers in pressure tap line and an electronic signal time constant which will reduce pressure transients to plus or minus 1 percent of calibrated span. Time constant is to be achieved by placing it in panel providing power to pressure transmitter.

PART 3 - EXECUTION

3.01 GENERAL

- A. Examination, Installation, Field Quality Control, Demonstration: In accordance with Section 13410.

END OF SECTION

SECTION 13430

CONTROL PANELS AND CONSOLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Control panels and consoles.
2. Touchscreens
3. Switches, push-buttons, lights.
4. Relays.
5. Terminal blocks.
6. Fuse blocks.
7. Control power transformers.
8. Transient Voltage Surge Suppression
9. Starters and overloads
10. Motor Protection Relays
11. Circuit breakers
12. Enclosures
13. Wire Markers
14. Elapsed Timemeter
15. Cabinet Air Conditioner

1.02 SUBMITTALS

- ###### A. Shop Drawings: Submit in accordance with Sections 01, Shop Drawings covering the items included under this Section.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Codes, Ordinances, and Industrial Standards: Design, testing, assembly, and methods of installation for materials, electrical equipment, and accessories proposed under this Section shall conform to National Electric Code and to applicable State and local requirements.
2. UL listing and labeling of custom-built panels (UL 508) shall be adhered to under this Contract.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Sunlight readable touchscreen HMI Displays
 - a. AbraxSys Corporation
 - b. AIS
 - c. Advantech
 - d. Maple
2. Switches, Push-Buttons, Lights:
 - a. Eaton (Cutler-Hammer) (Type 10250T).
 - b. IDEC (Type TWTD)
 - c. Schneider Electric (Square D). (Type 9001K).
 - d. Rockwell Automation (Type 800T/H).
3. Relays:
 - a. Eaton (Type D2PF2).
 - b. Potter-Brumfield (Type KUP).
 - c. Rockwell Automation (Type 700HB).
 - d. Schneider Electric (Square D). (Type KU).
 - e. Phoenix Contact
4. Signal Switching Relay:
 - a. Potter-Brumfield (Type R10-E1 or PT5).
 - b. Schneider Electric (Square D). (RXM4GB2F7).
 - c. Phoenix Contact

5. Terminal Blocks; finger safe construction:
 - a. Phoenix Contact
 - b. Altech (Type CTS4U-N).
 - c. Eaton (type XBUT4 series)
 - d. Rockwell Automation (Type 1492WM4 or Type 1492W4).
 - e. Schneider Electric (Square D). (Type 9080GM6).
 - f. Weidmueller (SAK TS35 or WDU 2.5).
6. Terminal Blocks; Open construction:
 - a. Phoenix Contact
 - b. Altech (Type CTS4U-N).
 - c. Rockwell Automation (Type 1492F1 or Type 1492CA1).
 - d. Schneider Electric (Square D). (Class 9080, Type KCA-1).
 - e. Thomas & Betts (100 series or 200 series).
 - f. Weidmueller (SAKD2.5N or SAK2.5).
7. Fusible Terminal Blocks:
 - a. Altech (Type CAFL4U).
 - b. Eaton (Type XBUT6FBN).
 - c. Rockwell Automation (Type 1492-CE6H5 or 1492-H6).
 - d. Schneider Electric (Square D). (TeSys Type DFCC).
 - e. Weidmueller (SAKS1 or ASK1).
 - f. Phoenix Contact
8. Control Power Transformers:
 - a. Phoenix Contact
 - b. Acme.
 - c. Sola.
9. Transient Voltage Surge Suppression:
 - a. Eaton
 - b. Phoenix Contact
 - c. Emerson.
 - d. Sola.
 - e. Schneider Electric (Square D)
10. Starter and overloads:
 - a. Allen Bradley
 - b. Square D
 - c. Siemens

11. Motor Protection Relays:
 - a. Symcom Motor Saver Model 601
12. Circuit Breakers
 - a. Allen Bradley
 - b. Square D
 - c. Phoenix Contact
13. Enclosures:
 - a. Saginaw
 - b. Hoffmann
 - c. Hammond Manufacturing
 - d. Rittal
14. Wire Markers:
 - a. Brady.
 - b. T&B.
 - c. Westline.
15. Elapsed Timemeter
 - a. Simpson
16. Cabinet Air Conditioner
 - a. Stratus
 - b. Thermal Edge
 - c. Ice Qube
 - d. Hoffman
17. Uninterruptable Power Supplyw/ external bypass switch
 - a. APC
 - b. SOLA
 - c. Eaton

2.02 CONTROL PANELS AND CONSOLES

A. Sheet Metal Construction:

1. Panels and consoles shall be fabricated from 316 stainless steel welded and bolted into a rigid self-supporting structure a maximum of 90 inches high and a minimum of 20 inches deep. Panel face layouts shown on Drawings are intended to indicate relative position of all components. Supplier shall fix exact locations and overall dimensions to

meet requirements of its equipment. Panels and consoles shall be factory primed and powder coated white. Outdoor units shall be provided with both an A/C unit and factory sunshades mounted to the the sides and top of primary enclosure with equivalent finishes. HMI displays shall be provided with a sun shade to aid in protecting and reading the display.

2. Interior of panel shall have hinged deadfront with main power disconnect switch with bypass mechanism, HMI display, HOA switches for each pump, and elapsed time meters.
3. Behind panel deadfront, panel shall have subplate for mounting of all control deveices.
4. Panel, subplates, deadfronts and console bodies shall be 12-gauge minimum 316 stainless steel for panels up to 42 inches in width, and 10-gauge minimum 316 stainless steel for panels exceeding 42-inches in width. Panel subplates shall be same gauge as enclosure. Stiffening members shall be provided for strength and stiffness as required.
5. A minimum of 3 inches shall be provided between edge of panel subplate and outside walls of panel body to ensure adequate wire-way space for external wires entering panel. Panel subplate shall be mounted on collar studs for easy removal. Print pockets shall be provided on each panel. Brackets welded to inside of panel, complete with lights, shall be provided on panels where indicated by Drawings.
6. Identification plates shall be laminated phenolic with black letters engraved on a white background and mounted with screws or double-back adhesive foam tape.
7. All components inside panel shall have identification plates. This includes instruments, relays, switches, circuit boards in plug-in racks, etc. Identification plates shall include engineering symbols (FBQ-1, SW-3, FIC-4, CR-1, etc.). Switches and circuit breakers inside panel shall have names (Horn, Audio Tone, Panel Power, etc.) on identification plates as well as engineering symbol.
8. Identification plates shall be located on or adjacent to device they are identifying and shall be readable without looking around, under, or on top of device to find identification plate.

B. Access:

1. Wall- and/or floor-mounted control panels shall have continuous 316 stainless-steel piano-hinged doors for ease of access. Door openings shall expose a minimum of 80 percent of panel interior. Door openings shall be sealed with a 0.125-inch thick minimum cellular neoprene gasket cemented with oil-resistant adhesive and held in place with a retaining strip. A rain shield shall extend 1 inch past top of door. Print pockets shall be provided on each door. Two door enclosures shall have a removable center post. Panel doors less than 40 inches high shall be equipped with quarter turn latches with at least one padlockable quarter turn latch.

2. Panels shall have an interior deadfront panel to mount control switches, displays and indicator lights. The only externally mounted switches and lights shall be the power available light and fault light.
3. Components and terminals shall be accessible without removing another component except covers. Swing out sections shall be used if mounting space is required that is not normally accessible.
4. No components shall be cut-in or mounted to the top of panel enclosures providing an access point for water to migrate into panel.

C. Finish:

1. Panel face openings for mounting equipment shall be smoothly finished cut with counterboring and trim strips provided as required to give a neat finished appearance. Bezels shall be used on all front panel-mounted devices to cover panel cutouts. A chrome-plated or 316 stainless-steel bezel shall be used at parting line of panels that have shipping splits or at parting line of panels placed end to end.
2. Graphic plates, when used, shall be fastened to panel frame with fasteners not visible from front of graphic.
3. After fabrication, panel surfaces shall be given a phosphatizing treatment inside and out, and then finished with 2 coats of textured polyurethane enamel. Panel interior shall be powder coated white, ANSI No. 51.
4. Panels shall have identical exterior finishes as selected by ENGINEER. Panel finishes on matching colored panels shall be identical. It is supplier's responsibility to achieve this result, especially for panels fabricated in different shops.

D. Sunlight readable HMI touchscreen displays:

1. 10.4" minimum display size with 1024 x 768 pixels, 1300 nits, long life industrial grade active matrix TFT LCD LED backlight and 700:1 contrast ratio.
2. Industrial rated, NEMA 4 IP65.
3. 120 VAC power.
4. High ambient light readability technology.
5. Operating temperature range -22°F to 150°F.
6. Humidity: 5%-95% noncondensing.
7. Touchscreen technology: Resistive, infrared or surface capacitive.

E. Electrical:

1. Internal panel wiring shall be 19 strand No. 16 AWG, 90°C MTW, Class C stranded, or THHN/THWN approved as 90°C MTW. All panel wiring not run in wire ducts shall be bundled and tied. Each wire shall be identified at both ends with same exclusive number. Number shall be same number shown on control schematic. Number shall not be used again for any other purpose. Wires marked differently on each end will not be accepted. Wire markers shall be provided on end of each wire at termination point.
2. Control wiring associated with control circuits de-energized when main disconnect is opened shall be color-coded red. Control wiring associated with control circuits which remains "hot" when main disconnect is opened shall be color-coded yellow. DC control wiring shall be color-coded blue. Ground wires shall be color-coded green. Terminal blocks shall be numbered in numerical order. Yellow wiring leaving panel shall be brought to an isolated set of terminal blocks.
3. Provide an instrument common bus 0.1 by 0.5 by 6-inch minimum in enclosure and isolated from enclosure. A separate instrument common wire shall be run from each common terminal on an instrument to instrument common bus. Instrument common wires looped from one terminal to another and then to instrument common bus will not be accepted.
4. Instrument common bus shall be connected to power supply common with a wire or wire braid strap as short as practical and of sufficient capacity to prevent troublesome voltage drop. Common terminals and common bus for instrument common shall be tagged "Instrument Common." Instrument signal wires of 4-20 mA or 1-5V shall be shielded wire. Telephone wires and telemetry equipment interconnection wires shall be shielded wires.
5. Provide a copper ground bus 0.1 by 0.5 by 6-inch minimum in enclosure to which all instrument grounds and panel enclosure are tied. Separate ground wire shall be run from instrument enclosure ground terminal directly to ground bus. Instrument ground wires looped from one instrument to another will not be accepted. Under no circumstances shall neutral side of power source or any other terminals used for grounding power circuits be used as an instrument common.
6. Wires to internal components shall be connected to inside of terminal strip. Wires to external components shall be connected to outside of terminal strip. No more than 2 wires shall be connected to one terminal point.
7. Panel wire duct shall be provided between each row of components and adjacent to each terminal strip. Wire ducts shall be a minimum of 1-inch wide and 3 inches deep with removable snap-on covers and perforated walls for easy wire entrance. Wire ducts shall be constructed of nonmetallic materials with a voltage insulation in excess of maximum voltage carried therein.
8. Floor-standing panels and consoles shall be equipped with a flange mounted 600V rated main non-automatic trip circuit breaker or disconnect switch. Single phase, 60 hertz

power at voltage shown on Drawings shall be supplied to main disconnect. Panel fabricator shall provide any additional voltages and power requirements at control panel to meet requirements of equipment contained therein.

9. Disconnect and transformer shall have enclosed protected terminations to prevent accidental shock.
10. Within each control panel a Transient Voltage Surge Suppression (TVSS) device shall be installed at the main disconnect and shall be sized for the control panel feeder size.
11. Relays, devices, etc., installed on panel subplate shall be provided with a minimum spacing between component and wire duct of 1.5 inches above and 1 inch below. Minimum spacing between adjacent components shall be 0.25 inch. Relays, timers, etc., shown in schematics are intended to show function. Additional relays may be required in conjunction with items shown to provide total number of contacts required. Where limit, pressure, float switches, etc., are used and more than SPDT contacts are indicated by schematics, provide additional contacts required by using auxiliary relays. However, if a DPDT switch is called for, using a SPDT with a relay will not be accepted. All control and pilot devices such as relays, timers, etc., shall be 120V, 3 amp rated except where noted with coil voltage as required. One N.O. spare contact shall be provided on each relay.

F. Panel/Subplate Layout:

1. Panel face-mounted equipment shall consist of pilot lights, push-buttons, selector switches, meters, indicating timer, etc. Spacing between horizontal rows of components shall be 1.5 inches minimum; spacing between vertical columns of components shall be 1.875 inches minimum. Components shall be grouped and/or located as indicated on Drawings. Distance from bottom row of components to floor shall be not less than 36 inches. Top row of recording and indicating instruments shall be centered approximately 60 inches above floor. Maximum height for annunciator windows shall be 85 inches above finished grade or slab. In general, indicating lights, push-buttons, etc., shall be mounted in accordance with sequence of operation from left to right and top to bottom.
2. A minimum of 2 inches shall be provided between terminal strips and wire ducts or terminal strips and terminal strips. In general, terminal strips shall be mounted on vertical edges of subplate. Where terminal strips are mounted side-by-side, terminals shall be elevated 1.5 inches above subplate to allow wires to pass underneath.
3. Subplates shall have a minimum of 15 percent spare mounting space, and terminal strips shall have a minimum of 20 percent spare terminal blocks.

2.03 SWITCH, PUSH BUTTONS, LIGHTS

- A. Selector switches shall be 120 VAC rated, oil-tight construction with standard operator knob.

- B. Start push buttons shall be 120 VAC rated, oil-tight construction with extended guard and black color insert.
- C. Stop push-buttons shall have a half-guard with red color insert. Contacts shall be rated NEMA B-150 and P-150.
- D. Pilot lights shall be push-to-test oil-tight construction with cap colors and voltages as required. Pilot light shall be supplied with Light Emitting Diode (LED) type light module.
- E. Nameplates for each switch and light shall conform to manufacturer's series and type with engraving as called for on Drawings.
- F. Lights shall be LED.
- G. Lights shall have a common push to test button or each light shall be a push to test style.
- H. Switches, lights and pushbuttons shall be 30mm.

2.04 RELAYS

- A. Control Relays: Switching and output relays shall be plug-in type with contacts rated 120 VAC, 3 amp with 120 VAC or 24 VDC coil, indicating light, manual operator, and plastic transparent cover. Relays shall have a retainer mechanism to prevent loosening from vibration. Relays shall not be used for switching 1-5 VDC or 4-20 mA signals associated with instruments.
- B. Latching Relays: Latching relays shall be transparent enclosed plug-in type with mechanical or magnetic latching, mechanical holding device, contacts rated 120V at 3 amps, and continuous duty coils. These relays shall not be used for switching 1-5 VDC or 4-20 mA signals associated with instruments.
- C. Signal Switching Relays: Instrument relays shall be those relays switching a 1-5 VDC or 4-20 mA signal. Instrument relays shall be transparent enclosed plug-in type with indicating LED and mechanical holding mechanism. Relay contacts shall be dry circuit type rated 250 mA maximum. Contact material shall be a gold-platinum-silver alloy.

2.05 TERMINAL BLOCKS

- A. Terminal blocks shall be 300 or 600 volt rated, channel-mounted box lug with pressure plate type or binding head screw type with pressure plate, and shall have a white marking strip. Terminal blocks shall be color-coded according to the following coloring scheme:

Black	120V power circuits de-energized when main disconnect is opened.
White	120V neutral conductors.
Red	120V control circuits de-energized when main disconnect is opened.
Yellow	120V control circuits which remain hot when main disconnect is opened.
Blue	Terminal blocks for DC wiring.

Gray	Terminal blocks for shields in DC wiring.
Green	Ground terminal blocks.

- B. For terminals associated with 120V nonisolated input cards, individually fused terminal blocks shall be used for 120V power to field devices.
- C. Provide a minimum of 20 percent spare terminals for each type and color of terminal used. All terminals of a given color shall be grouped with other terminals of the same color.

2.06 CONTROL POWER TRANSFORMERS

- A. Control power transformers shall be sized to handle in-rush currents and to accommodate continuous load of circuits plus 25 percent future load with 5 percent or less voltage drop. Transformer primary voltage shall be as indicated on Drawings. Transformers shall be shipped loose for field installation next to enclosure. Transformer shall be encapsulated and rated for direct sun light exposure in Florida environment. Derate for summer heating affect. Provide derating calculations with submittals. Provide in white powder coated 316 stainless steel enclosure. Primary and secondary fusing shall be provided in either the transformer or control panel enclosure and properly labeled and sized terminal blocks shall be provided in control panel.

2.07 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

- A. Transient Voltage Surge Suppression (TVSS) device shall be installed at the main disconnect or main power distribution block. TVSS shall be sized for the control panel feeder size and shall protect equipment from a peak surge of 45kA per mode and minimum 80kA peak surge per phase. Protection modes shall include phase to phase, and phase to ground for three phase panels, and shall include phase to neutral, phase to ground and neutral to ground for single phase panels. TVSS shall have a status LED indicating that it is operating properly.

2.08 ELAPSED TIME METERS

- A. Simpson model 55ET/Round, 120 VAC, analog, hours, totalizer, 3.5" face.

2.09 CABINET AIR CONDITIONERS

- A. Size cooling to maintain 78 Degree F based on ASHRAE hottest month 0.4% Cooling DB/MCWB conditions for Orlando International Airport.
- B. Provide NEMA 4X 316 Stainless steel enclosure.
- C. Corrosion protection with coated condenser and evaporator coils and coated refrigeration tubing.
- D. Provide local and remote alarm capabilities with dry contact outputs.
- E. Provide internal control cabinet temperature local display on control panel deadfront.

- F. Provide low ambient package.

2.10 UNINTERRUPTABLE POWER SUPPLY

- A. DIN rail mount
- B. High heat battery, internally mounted.
- C. RS-232 DB-9 Serial Port
- D. Dry contacts for On-Battery, Low Battery, Fault.
- E. Automatic self-test.
- F. Automatic switch to normal power on UPS failure.
- G. Manual Bypass switch

PART 3 - EXECUTION

3.01 GENERAL

- A. Examination, Installation, Field Quality Control, Demonstration: In accordance with Section 13410.

END OF SECTION

SECTION 13441

INDICATORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes"

1. Pressure gauge.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Sections 01, Shop Drawings covering the items included under this Section.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Pressure Gauge:
 - a. Ametek.
 - b. Ashcroft.
 - c. Helicoid Division, Bristol-Babcock, Inc.

2.02 PRESSURE GAUGES

- A. Pressure gauges shall be oil filled and shall act directly from line pressure. Gauges shall be a nominal 2.5-inch diameter for front panel or field mounting and be direct reading. Accuracy shall be 1 percent or better with 0.5-digit graduations minimum.
- B. Housing shall be all-welded 316 stainless steel, no brass or brass solder joints.
- C. Wetted parts shall be suitable for direct exposure to Leachate.

PART 3 - EXECUTION

3.01 GENERAL

- A. Examination, Installation, Field Quality Control, Demonstration: In accordance with Section 13410.

END OF SECTION

SECTION 13450

PROGRAMMABLE LOGIC CONTROLLERS, SCADA AND HMIs

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Programmable Logic Controller (PLC):
 - a. Central processing unit.
 - b. Process input/output.
2. Small Programmable Logic Controller (SLC):
 - a. Central processing unit.
 - b. Process input/output.
 - c. Programming device.
 - d. Memory module.
3. Data Highways:
 - a. Serial network interface modems.
 - b. SCADA Network Requirements.
4. Program Development Software:
 - a. HMI screens.
 - b. PLC/SLC programming.

1.02 SUBMITTALS

- ###### A. Shop Drawings: Submit shop drawings covering the items included under this Section.

1.03 RELATED SECTIONS

Section 00153 Request for Qualifications
Section 00437 Schedule of Values
Section 01100 Summary of Work
Section 01310 Project Management
Section 01330 Submittals
Section 01730 Execution
Section 01770 Closeout Procedures
Section 01913 General Commissioning Requirements

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be regularly engaged in manufacturing equipment complying with requirements of these Specifications.

1.05 WARRANTY

- A. Special Warranty: CONTRACTOR shall purchase **5-year** upgrade and technical support warranties for all software purchased under this Section. As part of these services, there shall be no intermediaries. They shall be between OWNER and OEM. Warranty begins after acceptance of substantial completion by OUC.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
 - 1. Small Programmable Logic Controller (SLC):
 - a. Allen-Bradley. (CompactLogix).
 - b. Square D Co. (M34X).
 - 2. Program Development Software:
 - a. Rockwell Software Co. - RSLogix/Studio 5000 – CompactLogix Only (3 user)
 - b. Schneider - Unity Pro (3 user)

2.02 ADDITIONAL SCOPE ITEMS

- A. Beyond the primary scope of developing and installing four (4) new cell 2 pumping systems, the contractor will perform the additional scope:
 - 1. Contractor shall replace the existing underdrain work station in plant control room, software, operating system, network switch, ancillary software and ancillary devices with a new system fully configured with new screens incorporating existing underdrain pumps at the north and south coal ponds (4 pump control panels and 1 PLC), both recycle basins (6 pumps control panels and 1 PLC), add coal ash storage cell 1, cell 2, cell 3, and new CWSA north and south pond pump controllers (4 simplex pump controllers).
 - 2. Prior to completing control room computer setup, and everytime a software update or service pac is installed, contractor shall, at their cost, run Nessus scans to determine vulnerabilities. Vulnerabilities shall be repaired/removed prior to installing the computer on site to the satisfaction of the Engineer of Record. Prior to turning bringing the computer on site, the contractor shall

submit a clean scan report indicating no vulnerabilities to the Engineer of Record. Subsequent to any software upgrades or patches, the contractor shall run a Nessus vulnerability scan and repair all vulnerabilities. Within 30 days of final turn over of the system, contractor shall run a final Nessus scan, repair any vulnerabilities and turn over as part of the O&M documents a clean scan report.

3. Contractor shall incorporate the new temperature sensors and alarms for the two (2) coal ponds, recycle basin expansion, recycle basin and CWSA north and south ponds into the SCADA system, remote pond PLC's and control room underdrain monitoring operator display computer.
4. The control room computer will not have internet access due to business network restrictions at OUC. Contractor will need to make all software changes and upgrades utilizing portable hard drives. Contractor shall work with OUC IT department to establish and meet requirements, including Nessus security scans, to allow connection to the OUC network for internet access.
5. Contractor shall include eight (8) all day meetings with OUC IT department to coordinate the requirements for connection to the business network and providing VPN access to the workstation. Contractor is responsible for all software, software configuration and setup for access. Contractor shall coordinate the IT meetings, run them and provide complete meeting minutes of all discussions and directions.

2.03 SMALL PROGRAMMABLE LOGIC CONTROLLER (SLC)

- A. Modular small programmable logic controllers (SLC) shall be general-purpose process data acquisition and control devices. The SLC shall be microprocessor-based, driven by a stored program, and shall be compatible with and work in harmony with remote devices specified herein.
- B. SLCs shall be capable of sensing, monitoring, and reporting all external signals connected to them.
- C. Central Processing Unit:
 1. Each central processing unit shall consist of a 16-bit parallel processor with scan, not to exceed 150 ms for all program steps and input/output time servicing.
 2. The system shall contain a general-purpose set of instructions. Watchdog timer protection shall be provided. The processor shall have self-diagnostic capabilities. Each processor shall be supplied with adequate random access memory to support all tasks covered in these Specifications. Further, memory shall be semiconductor with on-board lithium battery backup power for at least 4 months prime source outage. The processor(s) shall have memory capacity as shown on Drawings.

3. The modular programmable logic controller shall be supplied complete with manufacturer's standard CPU, power supplies, battery, chassis, and discrete and analog input/output modules.
4. PLCs shall have permanently installed system software for process input/output servicing, PLC intercommunications, LAN communication, diagnostics, and process control. The basic model for PLC operations shall be "ladder diagram."
5. Data elements shall be grouped according to type or function into registers or files. Provide a consistent addressing structure for PLC and external machines to reference data elements. The following basic data types shall be provided:
 - a. Input.
 - b. Output.
 - c. Bit.
 - d. Integer (16-bit).
 - e. Real Number
 - f. Timer.
 - g. Counter.
 - h. Character (ASCII).
6. Process Control: Program elements shall be provided to execute the following kinds of actions:
 - a. Basic relay logic.
 - b. Timers: On-delay, Off-delay, Retentive.
 - c. Counters: Count-up, Count-down.
 - d. Arithmetic: Add, Subtract, Multiply, Divide, Square Root.
 - e. Logic: Negate, And, Or, Exclusive Or.
 - f. Conditionals.
 - g. Data transition.
 - h. One-shot.
 - i. Stepper switches (sequencers).
 - j. Branching Instructions.
 - k. Subroutines.
7. Analog PID Control:
 - a. ISA Algorithm.
 - b. Independent Gain Algorithm.
 - c. Ratio Control.
8. Process Input/Output: Complete process input/output assemblies shall be provided. Process input/output shall consist of modules of each major function to be monitored or controlled. Each input/output module shall plug into processor frame assembly and be interconnected to input/output terminal strip cable connections.

- a. Remote input/output modules shall be separately housed as shown on Drawings. Where remote modules are used, they shall communicate with SLC via SLC manufacturer's standard data highway.
9. Analog Input: Analog inputs to system shall be in form of differential (non-grounded) direct current voltages. Input circuitry shall be high-impedance such that external sensing circuits will not be adulterated by the presence of this equipment. In all cases, this equipment shall be passive with respect to analog sensing circuits. External power supplies shall be provided as necessary.
- a. Milliampere loops shall be sensed in concert with precision resistors appropriately sized. Such resistors shall be applied at termination point in a way that input card removal does not affect loop continuity. Each analog signal shall be connected to system via a removable, barrier-type terminal strip.
 - b. Input impedance shall be a minimum of 10 megohms and common mode rejection shall be 120 dB or better. Accuracy shall be plus or minus 0.1 percent full scale and resolution shall be 25 percent. Analog to digital conversion shall yield a signed 12-bit integer. Provide 4 inputs per card.
10. Analog Outputs: Control signals in form of 4-20 mA analog signals into 500 ohms shall be provided. Each analog output shall be provided on a removable, barrier-type terminal strip.
- a. Analog output modules shall be provided to interface each output to appropriate terminal strip. Each output shall be continually maintained by a sample and hold circuit with a drift rate no greater than 1 percent in 12 hours. Digital to analog conversion shall accept signed 12-bit integers. Provide 4 outputs per card.
11. Discrete Inputs: Discrete inputs to be monitored shall consist of isolated dry contact closures and 120 VAC inputs as shown. Removable, barrier-type terminal strips capable of terminating inputs shall be provided.
- a. A discrete input circuit board shall be equipped with a photo isolation for each discrete input. Noise and contact bounce less than 20 milliseconds shall be rejected. Provide 8 inputs per card.
12. Discrete Outputs: Control signals in form of discrete outputs shall be provided. Each discrete control signal shall be provided on a removable, barrier-type terminal strip. They shall make use of relays or zero-angle fired triacs having a capability of at least 2 amps. They shall include any necessary arc suppression or other conditioning circuitry to ensure their proper operation in conjunction with field elements specified.

- a. Each output shall be fused and shall be equipped with a status indicator. A blown fuse indicator shall also be provided.
 - b. Outputs used to control devices external to enclosure in which module is located shall be isolated type allowing use of a different external 120 VAC power source for each output. Outputs used to control devices within enclosure in which module is located need not be isolated. Provide 8 outputs per card.
 - c. Outputs used to control devices external to enclosure in which module is located shall be relay type. Outputs used to control devices within enclosure in which module is located may be zero-angle fired triacs where compatible with devices.
- 13. Rack Configuration. Provide I/O to meet requirements shown on Drawings, plus 20 percent spare I/O of each type used. Equipment rack layout must allow for addition of 20 percent more cards per rack; minimum space 2 slots. This requirement is totaled for each rack; it is not based on overall network.
 - a. Unused Slots. Provide blank filler cover for all unused slots.
- 14. Memory Module: Provide manufacturer's standard EEPROM memory module for each PLC, unless otherwise shown on Drawings.
 - a. Memory module shall be provided complete with ancillary components required to save and read a processor program to/from a non-volatile memory source of modular form.

2.04 DATA HIGHWAYS

- A. Link the PLC/SLC's, Operator Interface Computers and associated equipment into an integrated network. Small Logic Controllers (SLCs) shall be equipped with communication as depicted on Drawings. PLC/SLCs shall include an Ethernet Adapter port and USB for local programming and troubleshooting.
- B. Plant-wide Networks:
 - 1. PLC/SLCs shall include an Ethernet Adapter port. The selected messaging protocol for this port shall be TCP/IP and shall provide high throughput with error detection and correction. Reliability shall be achieved through use of appropriate check sums, parity checking, redundant messages, and acknowledgment/rejection of messages. Networking software shall be open systems interconnect compliant.
 - 2. The network shall operate at a speed of 10M bits per second or faster. Network protocol shall be carrier sense multiple access/collision detection (CSMA/CD) in compliance with IEEE 802.3. Alternate protocols conforming to IEEE 802 may be used only upon written permission granted by ENGINEER.

3. Contractor to provide, configure and install Cisco IE-3000 series switches with power supply option and fiber expansion ports, refer to plans for additional information.
- C. PLC Networks:
1. Data highways shall be used to interconnect SLC with their remote input/output racks. Highway topology shall be multi-drop. Provide termination resistors if required. Protocol passing per manufacturer's standard. Minimum effective speed to be 19.2 Kbps for SLCs.
- D. Logic Controller Network Interface:
1. Provide networking interfaces as shown on Drawings. Where an operator interface computer is shown as a node on network, preferred interconnection shall be via high-speed backplane bussing. "T"-type connectors shall be used to provide maximum network (trunkline) integrity. Daisy-chain connections are not acceptable for node (drop-line) connections.
- E. Fiber-Optic Converters:
1. Provide fiber-optic communication compatible with logic controller hardware and communication protocols. Converters shall be stand-alone or rack-mounted as shown on Drawings. Converters shall use multi-mode fiber and Type SMA-905 mating connectors. Transmit launch power shall be -15 dbm and receive sensitivity shall be -32 dbm. Single-mode converters shall have typew SC-connectors.
- F. Serial Networks:
1. Small Logic Controllers shall include a 0-25 pin D-shell serial port, support standard EIA RS-232C and RS-423, and be RS-422 compatible. The port shall support ASCII or DFI full-duplex, half-duplex master, and half-duplex slave protocols.
- G. Serial Network Interface Modems shall be used for communication with remote Logic Controllers and shall be point-to-point or multi-drop as shown on Drawings. They shall be designed for fiber communication.
- H. Provide cables as required to interconnect each network component. Provide all cables and connectors for programmable products. Cables shall be installed in conduit and/or underground duct under Division 16. Cables shall be shipped to Site in bulk with connectors not attached.

2.05 PROGRAM DEVELOPMENT SOFTWARE

- A. Provide program development software for SCADA, HMIs and SLCs. Each copy shall be fully licensed and supported by software manufacturer and license shall be converted

over to OUC at the end of this project. Provide media and complete documentation with each copy of the software.

- B. All software shall be updated within 30 days of project completion and turned over to owner with latest revision at no additional cost to owner. All associated programming shall be accomplished to fully integrate final software and drivers at no charge to the owner.
- C. All software development files shall be turned over to OUC for their in-house use and modification without charge, fee's or royalties of any type. Vendor is free to use the developed program for other clients at their own risk and no approvals or acceptance of programming by OUC or Tetra Tech will imply it is reliable for use outside of OUC plant property or on other projects or for other vendor clients.
- D. Program development software shall have the following features as a minimum:
 - 1. Perform on-line configuration of all processors.
 - 2. Modify programs off-line.
 - 3. Store programs on hard disk and be able to upload/download programs of a processor on data highway.
 - 4. Fully document and cross-reference programs including printed copies.
 - 5. Support all logic functions of processors.
 - 6. Show ladder diagrams on-screen.
 - 7. Be mouse-driven and compatible with Microsoft Windows.
- E. Graphic Screen Displays
 - 8. The CONTRACTOR shall be responsible for developing and configuring the custom HMI and SCADA graphic displays. Each pump control panel and PLC (new and existing, including Cell 1, Cell 2, Cell 3 (add future cell 3 to screens but make inactive), CWSA north and south ponds, north and south coal ponds and two recycle basins) shall be monitored by the Central control system workstation computer to be located in the Plant Control Room. Each pump control panel, pump and ancillary devices shall be displayed on one or more graphics at the local pump control panel HMI and at the SCADA Central pond display computer. Graphic screens shall be representations of the equipment. The screens must accurately show devices and equipment that are part of the control loops. The requirement for alarm and/or event displays shall also be provided and proven functional prior to acceptance of the system.
 - 9. Graphic screens for each pump shall display a minimum of 20 parameters each from each of the following; motor protective device status; Logic Controller status; ground water and leachate levels, flows and pressures; control panel

temperatures, UPS status, alarm status, faults, pump on/off status, HVAC unit status, panel temperatures, see plan sets for additional points.

- F. Alarms – Provide specific details for points that have alarming parameters. Alarm classification (level), display requirements, and alarm messaging are to be included. The CONTRACTOR shall submit a list of Critical alarms for approval by the Owner. The time required for the operator interface to display an alarm shall not exceed 15 seconds.
- G. The contractor shall replace the existing display screens on the operator pond pump SCADA computer during this upgrade that currently display the North and South Coal Pond underdrain pumps, recycle expansion basin underdrain pumps and the existing recycle basin underdrain pumps. In addition, the replacement of 4 CWSA north and south panels and 4 Cell 1 Ash Storage Leachate panels shall be added to the SCADA central control computer display for status and alarming. The new Cells 2 and 3 Ash Storage Leachate control panels are to be added to the Central SCADA control panel display. Cell 3 will be non-functional until such time the control panels are added under a future contract.
- H. SCADA screens shall be displayed using high performance HMI graphics as defined in *The High Performance HMI Handbook-2018*, co-authored by Bill Hollifield and as modified by OUC plant direction. The extended use of color may be used at outdoor sunlight readable displays where it enhances the quick recognition of pump status. On outdoor displays, graphics must be extremely bright, large, and readable in direct Florida sunlight. Contractor shall insure this is met by the hardware and screen designs they submit on without use of sunscreens. Contractor shall provide a one day active display at the plant of one screen on an HMI touch screen they intend to use for pump control panels prior to ordering all displays or programming all screens for approval by the plant and engineer of record. Contractor shall provide any power supplies, wiring and a 50 foot industrial extension cord for the display unit to plug into plant exterior receptacles.
- I. Contractor shall hold (6) six half day meetings at the OUC plant to show examples of screen displays, retrieve plant input for changes and review progress of displays. Each pump control panel shall have a dedicated popup when initiated by an operator that provides complete status of the selected unit. Sublevel displays shall be available showing an image of the plant and the control panel names and locations. The primary opening screen shall be displayed at all times and not have a sleep or power saving mode enabled. This primary screen shall display basic status and alarm status of every pump and have sufficient space for up to 8 future pumps beyond the cell 3 buildout.
- J. Pump control panel HMI font sizes shall not be smaller than #18. SCADA workstation fonts shall not be smaller than #14.

PART 3 - EXECUTION

- 3.01 Examination, Installation, Field Quality Control, Demonstration: In accordance with Section 13410.

END OF SECTION

SECTION 13460

DIGITAL PROCESS CONTROL COMPUTERS

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers requirements for the Computer Subsystem (CS) and is in addition to requirements in Section 13430, 13450.
- B. Computer Subsystem (CS) functions include successful communication with control equipment to allow the Owner to provide data acquisition, historical data storage, text and graphic data display, alarming, process control, data analysis, report generation, and program development. Requirements listed below identify minimum acceptable system performance. Provide all hardware and software packages required to make system totally operational. Provide turnkey startup, configuration, hardware testing and software testing.
- C. Partial system acceptance is not acceptable, contractor is responsible for all hardware maintenance and software updates until final contract completion by prime contractor. After final owner acceptance, the warranties and support contracts shall commence.

1.02 RELATED SECTIONS

Section 00153 Request for Qualifications
Section 00437 Schedule of Values
Section 01100 Summary of Work
Section 01310 Project Management
Section 01330 Submittals
Section 01730 Execution
Section 01770 Closeout Procedures
Section 01913 General Commissioning Requirements

1.03 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Institute of Electrical and Electronics Engineers (IEEE): 802.3, Local Area Networks: Carrier Sense Multiple Access with Collision Detection
 - 2. International Organization for Standardization (ISO): 7185, Programming Languages - PASCAL (Endorsement of British Standard BS 6192).

1.04 DEFINITIONS

A. Abbreviations:

1. CPU: Central Processing Unit.
2. CS: Computer Subsystem.
4. DCU: Distributed Control Unit.
5. PLC: Programmable Logic Controller.
6. PMCS: Process Monitoring and Control Software.
7. RTU: Remote Terminal Unit.
8. TS: Telemetry Subsystem.

B. Terms:

1. Circular Files: Files that are updated such that each record written to file replaces oldest record in file.
2. Log a Message: Print a message on an alarm/status printer.
3. Field Interface Units: PLCs. If PLCs are used as RTUs, then requirements for PLCs also apply to RTUs.

C. Types of Variables:

1. Field Interface Unit Variables: Analog inputs, discrete inputs, analog outputs, discrete outputs, pulse inputs, calculated variables, and internal register values.
2. Calculated Analog Points (CA): Analog variables computed from inputs from field interface units, manual inputs, calculated discrete points, and other calculated analog points.
3. Process Variables (PV): Analog variables from field interface units and calculated analog points.

1.05 SUBMITTALS

A. Provide Shop Drawings and Submittals in accordance with Section 01:

1. CS block diagram and overview description. Include network IP addresses. IP addresses are to be assigned by contractor.
2. Bill of Materials for CS Components: Component number, manufacturer, model number, component description, and quantity.
3. Power Connection Diagram: For CS equipment, show interconnection from power sources through uninterruptible power supplies and power distribution panels, to computer and peripherals.

4. Interconnecting Wiring and Cabling Diagrams.
5. Component Submittal: For each CS component:
 - a. General data and description.
 - b. Engineering Specifications and data sheets.
 - c. Scaled drawings and mounting arrangements.
 - d. Network equipment layouts.
 - e. Description of software installed on each workstation or server.
 - f. Equipment weights.
 - g. Power and grounding requirements.
 - h. External electrical interconnection and interface definitions.
6. Shop Drawings for Specifically Manufactured CS Equipment:
 - a. A complete connection diagram.
 - b. Data sheets on each major item: annotated as necessary to describe specific items furnished.
 - c. Scaled layout and fabrication drawings.
 - 1) Cable access areas and cable routing.
 - 2) Power termination and ground lug location.
 - 3) Data cable termination points.
 - 4) Anchor bolt size and location.
 - d. Installation and and mounting detail drawings.
 - e. Equipment weights.
7. Power Consumption and Heat Dissipation Summary for CS Equipment: Voltages, current, phase(s), and maximum heat dissipations in Btu/hr.

B. Software:

1. Standard Software Documentation:
 - a. System Software Documentation: Complete reference information for system users. Detailed descriptions including features and limitations of package, how to use package, and how package interfaces with other software packages.

- 1) Extended Documentation for Operating System and Utilities:
 - a) Base Documentation: For day-to-day users of tasks, including editing files and using command procedures.
 - b) General User Documentation:
 - (1) Index to Extended Documentation.
 - (2) Using files, directories, command language, and text editors.
 - (3) Alphabetic list of errors, warning, and informational messages, including explanation and response required.
 - c) System Manager Documentation:
 - (1) Setting up systems.
 - (2) Maintaining system and files.
 - (3) Optimizing performance.
 - (4) Networking features.
 - d) Programming Documentation:
 - (1) Linking, loading, running, and debugging tasks.
 - (2) Screen management.
 - (3) Librarian and file management.
 - (4) Device support and device drivers.
 - e) Release notes.
- 2) Programming Language: Syntax, execution, use and reference capabilities.
- 3) Online and Offline Diagnostics: How they are used, and various execution options available.
- b. PMCS: Detailed technical reference manuals and user level manuals.
 - 1) Types of Manuals:
 - a) System Manager Documentation:
 - (1) Initial system setup.
 - (2) Database and file structures.
 - (3) Communication with field interface units.
 - (4) Maintaining system and files.
 - (5) Troubleshooting system problems.
 - (6) Optimizing performance.
 - b) System Engineer Documentation: Configuring, applications software.
 - c) Operator Documentation: Using the PMCS with configured applications software.
 - 2) PMCS Functions:
 - a) Process database.
 - b) Communication with field devices.
 - c) Input processing.
 - d) Message logging.
 - e) CS diagnostic alarms.
 - f) Alarm handling.
 - g) Control processor.
 - h) Restart program.
 - i) Human-machine interface-general functions.

- j) Graphics display generator.
- k) Types of displays.
- l) Alarm/Status log history.
- m) Historical data collection.
- n) Data retrieval.
- o) Trending.
- p) Report generator.

- c. Disk and Memory Requirements: Table showing CPU and disk memory requirements for each standard software package.
- d. Changes to Standard Software: If changes to standard software packages are needed to meet Specifications, provide detailed descriptions of proposed changes and additions.
- e. Presoftware Development Submittal: Provide software system overview to include written overview description of each major software package.
- f. Disk and Memory Allocations: Tables showing breakdown of relative percentages of CPU and disk memory required, including spare.

C. Informational Submittals:

- 1. Testing related Submittals.
- 2. O&M Manuals-Hardware:
 - a. Updated version of Hardware Shop Drawings Submittals.
 - b. Component Manufacturers' O&M Manuals: Instructions for installation, operation, maintenance, troubleshooting, and calibration.
 - c. List of spare parts and expendables provided.
 - d. List of recommended additional spare parts.
- 3. O&M Manuals-Software Documentation:
 - a. Updated version of Software Shop Drawing Submittals.
 - b. Third Party Software: For system software that is not a product of the Contractor or his Subcontractors, include manufacturer's original disks and manuals with hardware shipments.

1.06 EXTRA MATERIALS

A. Spare Parts

- 1. One track ball or mouse of each type supplied.

2. One keyboard of each type used for Operator CRT units.

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE

A. Capacity:

1. Furnish CS with sufficient capacity to handle equipment required by Contract Documents and equipment listed under paragraph Future Components, and still have specified spare capacity. Except for software configuring, implementing listed future components, shall not require addition of other CS hardware or software.
2. Spare capacities are based on size of CS as required to implement equipment required by Contract Documents plus equipment listed under paragraph Future Components. For example, total storage capacity furnished for given functions:

$$(CURRENT + FUTURE) * (100 + SPARE)/100$$

Where:

CURRENT Equals: Storage capacity required to implement that function for hardware and software furnished under Contract Documents.

FUTURE Equals: Storage capacity required to implement that function for equipment listed under paragraph Future Components.

SPARE Equals: Percentage spare specified for that function.

3. Capacity refers to required physical size, storage capacity, and processing throughput of CS hardware and software. CS changes required to implement listed future components shall be limited to "configuring" database tables and system parameters to allow system to recognize the additional equipment.
4. In order to verify that system has required capacity, accelerate PLC polling rate and exception reporting rates during all tests to simulate inputs from additional devices listed under paragraph Future Components. For example, if number of future RTUs listed equals the number of RTUs required by contract document, conduct tests using a polling rate that is twice that specified.

- #### B. Future Components:
- Furnish sufficient CS capacity to implement the following future components. Assume that each future field interface unit has a number of I/O points equal to average number of I/O point provided for similar units required by Contract Documents.

1. PLCs: 3.
2. Pump Control Panels PLC's: 12
3. CS Operator CRTs: 2

2.02 SYSTEM SOFTWARE

A. Operating System:

1. Each workstation shall be provided with Microsoft's Windows 7 Professional operating system.
2. Each server shall be provided with Microsoft's Windows Server 2012 operating system.

B. Utilities:

1. File Management:

- a. General-purpose file system supporting dynamic creation, extension, and deletion of disk files from source programs, object programs, and data files.
- b. Copy individual files between devices (e.g., disk to disk, disk to tape, tape to disk, and disk to printer).

2. Network Communications: General-purpose network communications software to support local area network connection between CS and personal computer. Allows for exchange of disk files between computer systems.

3. Provide VPN cellular access to allow network connection by remote devices.

4. Disk Backup and Reload: Operator-initiated utility for maintaining backup copy on removable disk pack of all CS disk files.

C. Diagnostics:

1. Online Diagnostics:

- a. Complete system of diagnostic software to monitor, isolate, identify, tabulate, and alarm system hardware malfunctions and software failures.

- 1) Input/output addressing for all I/O devices (detection of illegal addresses).
- 2) Incorrect data transfers (e.g., parity error).
- 3) No response (or time-out) from I/O device.

- b. Central mechanism for accumulating and reporting number of soft and hard system errors. Hard errors are errors that persist after multiple retries.

- 2. Offline Diagnostics: Exercise and identify problems for all CS equipment.

2.03 PROCESS MONITORING AND CONTROL SOFTWARE (PMCS) PACKAGE

- A. General: The PMCS application software shall be Trihedral's VTScada version 11.3 with 5,000 tags. The system shall include VTScada's native historian with 5,000 tags. Provide five (5) years of Trihedral's SupportPlus. The support agreement shall begin once the installed software has been delivered to and accepted by the Owner.
- B. PMCS HMI Workstation Development Software:
 - 1. Provide Trihedral's VTScada 5,000 tag Development Runtime License.
 - 2. The software shall allow the graphic displays to be viewed from any of the workstations on the wired Ethernet network or remotely via WEB browser.
- C. PMCS HMI Workstation View Software:
 - 1. Provide Trihedral's VTScada Anywhere Client license (1 client), 5,000 tags.
 - 2. The software shall allow the graphic displays to be viewed from any of the workstations on the wired Ethernet network.
- D. PMCS Historical Data Storage and Retrieval Application Software:
 - 1. All VTScada Development Runtime licenses include the VTScada historian. The native historian for up to 5,000 tags shall be included.
 - 2. The software shall be installed to allow designated variables to be saved for trending, report generation, and historical records. In addition, the software package shall allow data to be retrieved for listing, trending, reporting, and input to other programs from disk or tape.
- F. PMCS Alarm Notification Application Software:
 - 1. Provide VTScada 5,000 tag alarm notification license.
 - 2. Provide a MultiTech external USB TAPI compliant voice modem for single voice line connection
 - 4. The software shall be capable of delivering voice, email, and mobile alerts to telephone-related or email devices for alerts generated from alarms or other specified conditions.

G. Restart Program:

1. At least every 5 minutes, save on disk, CPU memory resident data needed to completely characterize current status of CS hardware and software.
2. When system restart is required, use saved data to initialize CPU memory resident data. Use battery operated clock to set time and date. Execute "housekeeping" required to restore system to normal operation.

2.04 HARDWARE

A. CS Block Diagram: Refer to figure CS Block Diagram on Drawings. Interconnecting lines shown on block diagram imply information flow and not necessarily wiring.

B. Equipment Mounting: Unless otherwise noted, mount all CS components in freestanding metal cabinets or provide with suitable metal stands to bring them to normal operating levels.

C. Color: Color-coordinate CS components to produce an attractive installation.

D. Cables Required:

1. For interconnection between all CS components.
2. Cables Under 50 Feet Long: Prefabricated with connectors and factory tested with CS.
3. Special signal conditioning/repeating equipment as required for proper operation of CS.
4. Surge Arrestors: Provide surge strips for all equipment.

E. Power to CS Equipment:

1. Central Control Room: Contractor to provide floor mount 1500VA uninterruptible power supply with 30 minutes of backup time.

F. Power Failure Detection and AUTO Restart:

1. Prevents errors due to power failure or short-term power fluctuations that occur when UPS is not operating.
2. Power Failure: Voltage variations more than plus or minus 10 percent of normal for a duration of 0.5 second or longer. Causes CS equipment to automatically shut down as required to prevent introducing errors on disk.

3. Short-term Power Fluctuations: Voltage variations in excess of plus or minus 10 percent of normal for durations of 0.5 second to 1 millisecond). CS shuts down as above or is buffered to prevent fluctuations from causing errors.
4. CS executes Restart program and return to normal operation when power is restored. Battery backed-up real-time clock used by CS during automatic restart to set time and date.

2.05 EQUIPMENT

A. CS Component List Format:

1. Quantity: Capacities and quantities shown are minimum. Provide additional capacity or units as necessary to meet the functional requirements. Refer to Drawings where no quantity is listed here.
2. Component Identification Code: Refer to Article Supplements, Component Specifications.

B. CS Component List:

1. Operator Workstation:

a. General:

- 1) Note: Component specified herein is based on the state of the art during design. Contractor shall provide the latest state of the art hardware available during the submittal process, and shall upgrade features as necessary. The following specifications outline minimum requirements for each computer.
- 2) Function: Support LAN clients; Execute required HMI software; operator interface to LAN.
- 3) Type: 100 percent IBM Compatible.
- 4) Quantity: 1

b. Features:

- 1) Monitor: Single 23-inch LED.
- 2) Intel® Xeon® Processor E3-1225 v3 (Quad Core, 3.20GHz Turbo, 8MB)
- 3) 8GB (2x4GB) 1600MHz DDR3 Non-ECC
- 4) (2) 500GB 3.5inch Serial ATA (7200 Rpm) Hard Drive. (1) for the OS and VT SCADA; (1) for the Historical Data collection
- 5) (2) 1GB Integrated NIC's.
- 6) 16x DVD+/-RW Drive
- 7) 1 GB AMD FirePro™ V4900 (2DP & 1DVI-I) (2DP-DVI & 1DVI-VGA adapter)
- 9) Ports: 5 USB, 1 Audio, 2 Video.

- 9) Standard Windows USB Keyboard.
- 10) Standard System USB Scroll Mouse.
- 11) Integrated 7.1 Channel Audio Sound Card.
- 12) Dell USB SoundBar.

c. Software:

- 1) Microsoft Windows 7 Professional x64.
- 2) CD-RW/DVD-RW
- 3) Symantec anti-virus software, latest version.
- 4) Microsoft Office Professional, latest version.
- 5) Resource DVD
- 6) Adobe professional

d. Support Agreement:

- 1) Onsite Hardware Support: 7 day/24 hour, 8-hour response, 5 years from time of Plant final acceptance of project completion by accepting the notice of substantial completion of the Prime Contractor.

e. Manufacturer and Product:

- 1) Dell Precision Workstation.
- 2) Equivalent HP Computer.

2.06 SOURCE QUALITY CONTROL

A. Factory Demonstration Test: Test all nonloop-specific functions including, but not limited to:

- 1. Failure mode and backup procedures including power failure, AUTO restart, and disk backup and reload.
- 2. Communication with field interface units.
- 3. System Software: Operating system, programming languages, and utility functions.

PART 3 EXECUTION

3.01 QUALITY CONTROL

A. Operational Readiness Test.

B. Performance Acceptance Test: Include the same types of testing that are specified for Factory Demonstration Test.

C. Reliability Acceptance Test.

3.02 TRAINING

A. Operations:

1. Training Session Duration: 2 instructor days.
2. Number of Training Sessions: One.
3. Location: Project Site.
4. Content:
 - a. Using man-machine interface (HMI) functions from process operator's standpoint.
 - b. HMI programming and general functions.

B. Field Equipment and Hardware Maintenance Onsite Training:

1. Training Session Duration: 2 instructor days.
2. Number of Training Sessions: One.
3. Location: Project Site.
4. Content:
 - a. Standard hardware maintenance for CS equipment.
 - b. How equipment and components are connected and set up for the Project.
 - c. Test, adjustment, and calibration procedures.
 - d. Troubleshooting and diagnosis.
 - e. Component removal and replacement.
 - f. Periodic maintenance.

C. PLC Programming and Software Maintenance Onsite Training:

1. Training Session Duration: 2 instructor days.
2. Number of Training Sessions: One.
3. Location: Project Site.

4. Purpose: To provide Owner staff with sufficient training so that they can maintain CS software on a day to day basis.
5. Content:
 - a. System Overview: Basic system design, configuration, functions, maintenance, and operation.
 - b. System Hardware: Specific hardware provided.
 - c. System Software:
 - 1) Operating system, assembler, and compiler details.
 - 2) Backup, reload, restart, and failover procedures.
 - 3) Utilities, compilers, debugging aids, file management, and system generation.
 - 4) Diagnostic Software: Capabilities, usage, and interpretation of results.
 - d. PMCS:
 - 1) Communication with field devices.
 - 2) Calculated analog and discrete points.
 - 3) Restart Program.
 - 4) Human-Machine Interface-General Functions.

END OF SECTION

SECTION 13470

LOCAL AREA NETWORKS/WIDE AREA NETWORKS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Local area network (LAN) shall support 100Base-TX and 100Base-FX communication and be backward compatible with 10-Base-T Ethernet. LAN topology shall be radial from one or more central wiring hubs as shown.
2. Wide Area Network (WAN) shall support reliable, secure, Enterprise class routing and security, 3/4G LTE dual provider access through AT&T and Verizon, from one location on site with VPN access, security, management software, SNMP, HTTP/HTTPS, FTP, SFTP, SCP, SMTP, NTP/SNTP.

B. This Section includes the following:

1. Network Management software.
2. Cellular Router.
3. Switches.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Sections 01330 and 13410, Shop Drawings and product data for products provided under this Section. The following information must also be included in submittals for this Section:

1. Network Topology Diagram: Prior to ordering any parts or installing any equipment contractor shall provide complete network point to wiring and topology diagrams for OUC and Engineer of Record approval. Show and label each cable segment, network outlet, termination rack, hub, inter-network device, computer, connector type and peripheral.
2. Installation/Configuration Manual: Provide for each of the network components.
3. System Configuration Guide: Show the settings of the network hardware and network-related configuration of the software. Provide complete typed list of configuration setting, IP addresses, usernames and passwords for each device in the network to allow easy replacement and configuration in the event of a failure.
4. Network Management Guide: Show how the components are operated from the network management node. Provide 8 hours of onsite training with power point presentation and hands on examples. Power point shall address from the most basic setup and operating requirements to the more complex operation, firewall setup, switch configuration, etc. in a logical, easy to follow format.

5. Provide a portable tablet with all required software and cables necessary to plug into any network device and perform the necessary updates, configuration changes, security changes, and troubleshooting local at each device. Also install on the operator/development SCADA workstation.

1.03 WARRANTY

- A. Special Warranty: CONTRACTOR shall purchase 5-year upgrade for all software purchased under this Section from the date of OWNER final acceptance of the Prime Contractors substantial completion date.
- B. Contractor is responsible for all updates, troubleshooting, repair, replacement and management of the LAN/WAN at no charge to owner until the warranty period discussed above commences.
- C. Maintenance Contract: CONTRACTOR shall provide Network administration for 5-years of 24-hour, on-site response with 5-day-a-week, normal business day coverage for all modems, routers, switches and network hubs purchased under this Section. These support contracts shall start upon acceptance of the system by OWNER of the Prime Contractors substantial completion. The Contractor shall maintain and administer the Network for 5 years after the Owners acceptance of Prime Contractors Substantial Completion. The contractor shall access the network either remotely or by physically visiting the site monthly and run diagnostics, provide updates and insure operation. At least twice a year the contractor shall visit the site to perform this operation in person after coordinating access with the owner. Provide a written report to the owner monthly. Any system failures will require the contractor to provide onsite response for system diagnostics and repair. All costs associated with the five years of Network administration shall be included in the BASE bid with a monthly rate. Invoices shall be submitted monthly after rendering services.

PART 2 - PRODUCTS

2.01 EQUIPMENT SUPPLIERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
 1. Network Installation Equipment Suppliers:
 - a. Revere Control Systems, Birmingham, AL (205) 824.0004
 - b. MR Systems, Norcross, GA (888) 564.5688
 - c. Control Instruments Inc., Symrna, GA (404) 351.1085

2. Network Management Software:
 - a. CISCO.
3. Cellular Router:
 - a. MOXA OnCell G3150A-LTE.
 - b. DIGI TransPort WR21
4. Ethernet Switch:
 - a. CISCO (as indicated on plans)
 - b. Antairia (as indicated on plans)

2.02 NETWORK MANAGEMENT SOFTWARE

- A. Network Management software shall provide a standards-based system for managing all SNMP-compliant network components listed under this Section. Physical and MAC-layer information gathered by network modules must be displayed through an easy-to-use graphical user interface. The software must provide for managing the entire network from a single station and have the following features:
 1. Operation System: Compatible with SCADA system listed in 13450 and file server listed in Section 13460.
 2. Standards Compatibility:
 - a. RFC 1115 (Structure of Management Information).
 - b. RFC 1156 (Management Information Base).
 - c. RFC 1157 (Simple Network Management Protocol).
 - d. RFC 826 (Address Resolution Protocol).
 - e. RFC 854 (Telnet).
 - f. RFC 792 (Internet Control Message Protocol).
 - g. RFC 791 (Internet Protocol).
 - h. RFC 768 (User Datagram Protocol).
 - i. RFC 783 (Trivial File Transfer Protocol).
 - j. RFC 951 (BOOTP Protocol).
 - k. RFC 1597 (Addressing of Private Networks).

2.03 CELLULAR ROUTER

- A. Cellular Router shall be designed for remote connectivity via any major browser including Chrome, Android iOS, Firefox, Mac OS, Linux and be interoperable in multi-vendor, multi-protocol environments by supporting all major local area network and wide area network protocols. Router shall be designed for enclosure mounting with DIN rail hardware mounting and shall be manufacturer's standard configuration, factory assembled, with no locally added parts except as approved. Provide Enterprise level software packages, enterprise level routing and security. It shall have the following features and attributes:

1. Ethernet Standards Compatibility:
 - a. 3/4G LTE, 20MHz bandwidth, 100Mbps DL, 50 Mbps UL
 - b. IEEE 802.3: Version 1.0/2.0 Ethernet frame formats.
2. Power requirements: 12-48VDC at 1.0A max.
3. Dual SIM cards.
4. LAN interface: 1 port 8-pin RJ45, 10/100 Mbps.
5. Cellular Interface: 2, SMA, MIMO for LTEconnectors and 2/3/4G omni directional antenna, IP67 rated waterproof with cables and connectors. Provide with ground screw.
6. Alarm Contact: 1 realy output 1 amp @24VDC.
7. Extended Temperature Range: Operating temperature -30°C to 70°C
8. Routing/Firewall: NAT, port forwarding, IP/MAC/Port filtering.
9. VPN:
 - a. IPSec VPN:
 - 1) Encryption: DES, 3DES, AES, MD5, SHA-1, DH2, DH5
 - 2) Authentication: PSK/X.509/RSA
 - 3) GRE over IPsec
 - b. OpenVPN:
 - 1) OpenVPN (Server / Client)
 - 2) Tunnel mode (routing) and TAP mode (bridge)
 - 3) Encryption: Blowfish CBC, DES CBC, DES-EDE3 CBC, AES-128/192/256 CBC
 - c. NAT-T, PFS, DPD
 - d. Throughput:
 - 1) IPsec: 16 Mbps max.
 - 2) OpenVPN: 8 Mbps max.
 - 3) Concurrent VPN Tunnels: Max. of 5 (Responder/Initiator)

10. Management Features: Local and Remote SMS Control, SNMP, Web, Telnet, Serial Console.
11. Applications: Real COM, Reverse Real COM, TCP Server, TCP Client, UDP, RFC2217.
12. Reset pushbutton.
13. Self monitoring software with persistent cellular connectivity.
14. 1 serial port RS-232/422/485 selectable.
15. Mounting: Din rail bracket.

2.04 ETHERNET SWITCH

A. Locations as shown on plans:

1. CISCO IE3000 series.
2. CISCO C111X-8P series
3. Antaria LNX-0501-M-T
4. Antaria LNX-804GN-T

B. Ethernet Switch shall be a segment-switching hub that provides multiple 10 Mbps ports and a single 100 Mbs connection for creating Switched Fast Ethernet links to high-speed servers, hubs or routers. Ethernet Switch shall have the following features:

1. Data rates: 10 Mbps on attachment ports.
100 Mbps on expansion port.
2. Standards Compatibility: IEEE 802.3i 10Base-T.
3. IEEE 802.3u 100Base-T.
4. Ethernet Interfaces: RJ-45, 62.5/125 multimode fiber and single mode fiber with SC or SFP connectors as shown or as required by specific LAN/WAN gear.
5. Management Features: Remote installation and management capability.
6. SNMP-based management.

PART 3 - EXECUTION

3.01 GENERAL

- ### A. Examination, Installation, Field Quality Control, Demonstration: In accordance with Section 13410.

3.02 SOURCE QUALITY CONTROL

- A. Network Configuration: Field engineer shall attend the factory test specified in Division 16, Electrical, and shall configure all network components listed under this Section.

3.03 FIELD QUALITY CONTROL

- A. Network Certification: Field Engineer shall field check and certify network wiring, and installed components shall meet manufacturer's specifications and IEEE/ANSI standards.

END OF SECTION

SECTION 13491

SPARE PARTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Instrumentation system spare parts.
2. Control panel spare parts.
3. Programmable/Small Logic Controller (PLC/SLC) spare parts.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Sections 01, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

1. Spare Parts List: Submit a list of recommended spare parts for the equipment provided as part of the instrumentation system.

1.03 DELIVERY

A. Deliver spare parts to OWNER prior to final acceptance of instrumentation system and equipment.

PART 2 - PRODUCTS

2.01 SPARE PARTS

- A. Equipment spare parts as required for 1 year shall be provided and stored at Site by CONTRACTOR.
- B. Spares consumed during construction shall be replaced at no cost to OWNER until equipment is accepted as defined in Specification.
- C. Pumps provide the following:
1. Provide one spare pump for each size used on project.
- D. Provide the following:
1. One spare relay of each type used, including time-delay relays.

2. One-year supply of expendable spares such as lamps and fuses.
- E. Instruments provide the following:
1. Three (3) spare level transmitters.
 2. One spare pressure sensor.
 3. One spare electromagnetic flow meter for each size used in the field.
 4. One spare pressure gauge.
- F. Digital Systems: For digital systems, spare parts as required for a period of 1 year shall be provided and stored at Site, unless directed otherwise by OWNER.
- G. Provide the following:
1. For pump control panels provide:
 - a. Two (2) spare display touch screens. Provide copies of each control panel specific configuration and software program in electronic format to allow plant personnel to install spare display screen on any pump control panel and install the correct configuration and programming files.
 - b. Three (3) spare surge suppressor replacement modules for each type installed in the field.
- H. Provide the following:
1. On systems employing SLCs, provide 1 spare circuit card of each type used in delivered equipment. Circuit cards shall include the following (matching units in service):
 - a. Analog input card.
 - b. Analog output card.
 - c. Discrete input card.
 - d. Discrete output card.
 2. One (1) spare Ethernet card and cable.
 3. Provide 1 spare module of each type listed below:
 - a. Processor of type used in delivered equipment.
 - b. Remote I/O interface
 - c. Backup communication modules
 - d. Fiber optic interface
 4. One (1) spare Ethernet adapter card and cable.
 5. Provide a box of fuses for each size and type used.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 13498

SUPPLEMENTAL NETWORK AND CONTROLS WARRANTY

PART 1 – GENERAL

This section shall be supplemental and in addition to all other required contract warranties, including but not limited to the prime contractor's warranty requirements. Contractor shall request a copy of the prime contractors required warranty and comply with it in whole.

1.01 SUMMARY

A. Section includes the following:

1. Supplemental Warranty Information.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

1. Warranty Draft containing all of information specified.
2. Contractor shall state daily man-day rates and trip costs and office rates for systems check via Network login, in service contract.
3. Contractor shall state unit pricing for hardware and the total markup.
4. Warranty and Service Contract shall state the regular required maintenance and service checks to be provided both onsite for hardware and equipment checks and, via Network login access, for Network checks, system health checks, software patches, system updates and alarm checks.

PART 2 - PRODUCTS

2.01 SERVICE CONTRACT

- A. The Prime Contractor and Integrator are both equally responsible for the 1 year maintenance following the Owner's acceptance of the Prime Contractors substantial completion and shall include the cost of the maintenance contract in the base bid. The contractor shall include the total cost of the maintenance contract in the base bid as a separate line item and unit pricing as indicated below. The base contract will not be closed until the service contract is fulfilled in its entirety.
- B. Equipment supplier shall furnish under this Section continuing maintenance, system checks and repairs for a period of 1 year. The Contract shall become effective on date equipment

under this Specification is accepted. Acceptance shall be on the date OUC accepts and signs off the Prime Contractors substantial completion notice for construction activities.

- C. Contractor shall include the cost of the full 1 year service contract in their base bid as an allowance. The service contract shall be structured to allow periodic invoices over the life of the maintenance of documented services provided.
- D. Scope: Instrumentation, control panels, pumps, Network equipment, hardware, software, surge protectors, and equipment furnished under this construction set of plans shall be included. Additionally, contractor shall take over the maintenance of the ten existing control panels and two PLC Allen Bradley panels at the two Recycle ponds and the North and South Coal Ponds. Service Contract shall consist of weekly Network health checks, weekly alarm review and actions to resolve, monthly system onsite inspections, cleaning, lubricating, calibration, and service reports. Equipment supplier shall furnish a qualified man for 8 hours (full day) onsite (excluding travel time to site) at Owner's facility at monthly intervals of not less than 24 days and not more than 37 days between intervals (12 man-days total at one trip each man-day). Equipment supplier shall furnish at each 6-month interval 2 qualified service technicians for 2 full days at Owner's facility to completely clean, recalibrate, and tune equipment. (Eight man-days total; trips and 2 of the man-days are part of monthly interval allotment.) In addition, equipment supplier shall provide a qualified man for 2 full days at Owner's facility for emergency service for 3 separate emergency calls in a 1-year period. Emergency service shall include 24 man-days and 3 trips to Owner's facility over the 1-year period. Emergency service shall be executed during normal working hours, 7-days a week and shall commence within 24 hours from time of notification.
 - 1. Emergency trips and man-days are to be independent of regular warranty service schedule and are not to affect monthly schedule.
 - 2. Service records shall be maintained at Owner's facility and updated at conclusion of each visit by equipment supplier. Service record shall be dated and signed by equipment supplier's representative and cosigned by a representative of Owner. Equipment supplier shall forward a copy to ENGINEER.
- E. Digital Equipment: Contractor shall provide support services for the new pump SCADA central station computer, drives, Network, standard terminal equipment, and appurtenances, including operating system software service. Assignment shall be for highest normal level of service and quickest normal response time available. Cost of the total 1 years shall be included. Contractor shall supply their own copy of Nessus vulnerability scan software and all subsequent yearly licensing to check for and repair system vulnerabilities. Refer to Appendix A for existing hardware and software versions. Contractor will also include licensing fees required for existing software updates and changes, refer to Appendix A for existing software and versions.
- F. Parts: Contractor shall furnish all lubricants, inks, fuses, cleaning fluids, service tools, and instruments to keep equipment in good calibrated operation. Contractor shall furnish replacement parts as needed including:
 - 1. Pumps.

2. Level Sensors.
3. Flow meters.
4. Pressure sensors.
5. Pressure switches.
6. Pressure gauges.
7. Networks switches, managed and unmanaged.
8. Local switches, managed and unmanaged.
9. Cellular modem/router.
10. HMI display screens.
11. Surge protection devices
12. Relays.
13. Contactors.
14. UPS units.
15. UPS batteries.
16. Lamps/lights.
17. Fuses.
18. Air conditioning units and all their parts.
19. Air conditioning refrigerant.
20. SCADA Workstation components including:

- a. NIC cards
- b. Display
- c. Roller Ball/mouse
- d. Motherboard
- e. Hard drives
- f. RAM
- g. Drivers
- h. DVD
- i. Audio card
- j. Video card
- k. Keyboard
- l. Soundbar

21. Power supplies.
22. PLC parts and cards.

G. Performance: Contractor shall provide only personnel who are factory-trained full-time employees of equipment supplier. No subcontractor shall be employed without prior written approval of Owner. Tools and test equipment shall be provided in good working order for proper execution of required service. If service personnel fail to have proper equipment or equipment is not functioning, service trip will be forfeited and an additional month of service will be added to service contract.

1. Equipment supplier's service contract shall be extended one month for each day or fraction thereof following 24-hour period in which service personnel do not respond to an emergency service call.

2. Service contract will be extended one month for each emergency trip not used during period of service contract.
 3. Service contract will be extended one month for each monthly service period in which equipment supplier's service personnel do not appear at Owner's facility within time specified under "Scope" of Work.
- H. Extension of Service Contract: Owner shall have option, by written notice to equipment supplier before expiration of service contract, to renew service contract for an additional period of one year. One-year period will include all features of original contract including "Scope" of Work and "Performance."
1. Cost to Owner for renewal shall be at lesser rate specified in service contract or rates shown on Progress Payment Schedule for service contract plus an incremental adjustment based upon Engineering News Record cost index between Bid date of Contract and service contract renewal date.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Obtain Owner's signature on Service Contract following final control system monitoring and instrumentation system acceptance. The effective date of service contract shall be date system is accepted by Engineer.

END OF SECTION

SECTION 13600

FIELD TESTING

PART 1 – GENERAL

1.01 SUMMARY

- A. This section describes the requirements for field-testing equipment supplied under Division 13 and demonstrating the complete integration of the work.
- B. Furnish test equipment required to perform the testing specified herein. This test equipment may either be owned or leased and is not a part of the equipment furnished to the Owner under this Contract.
- C. Pretest equipment and wiring before beginning any formal field tests. Document pretest results. Submit documentation prior to formal field tests.

1.02 RELATED SECTIONS

Section 00153 Request for Qualifications
Section 00437 Schedule of Values
Section 01100 Summary of Work
Section 01310 Project Management
Section 01330 Submittals
Section 01730 Execution
Section 01770 Closeout Procedures
Section 01913 General Commissioning Requirements

1.03 SUBMITTALS

- A. Include test procedures, coordination/scheduling issues, and sign-off forms for each of the following tests:
 - 1. Loop Tests.
 - 2. Control Loop Tuning.
 - 3. Function Tests.
 - 4. Control Strategy Tests.
 - 5. Integrated System Tests.
- B. With initial test procedure submittal, include a proposed schedule outline which indicates how tests will be scheduled within specific subsystems or type, how coordination issues for each subsystem or type of test affect the proposed schedule, duration of tests, and any constraints between tasks or tests. Include time for mobilization of test personnel, set-up for each type of test or subsystem as applicable, and coordination meetings with construction manager. Include a written description or list of all field wiring required to be terminated and labeled for each subsystem or type of tests including whether panel end, equipment end, or both is required to be

terminated and labeled before test. No Division 13 equipment may be shipped to the job site until this submittal has been approved.

- C. After testing, submit the completed test sign-off forms within ten days.
- D. Document loop checks on the loop drawings and submit to the Engineer. Include the following:
 - 1. Type of test(s) performed.
 - 2. Date tested.
 - 3. Problem description, if any.
 - 4. Signature of tester and date.
 - 5. Signature of Engineer and date.
 - 6. Attach additional sheets to the loop drawings as needed to document resolution of issues raised during the test.
- E. Submit loop tuning documentation to the Engineer which includes:
 - 1. Loop number and description.
 - 2. Problem description, if any.
 - 3. Signature of tester and date.
 - 4. Signature of Engineer and date.
- F. Document strategy tests and submit to the Engineer. Include the following:
 - 1. Strategy identification.
 - 2. Tests performed.
 - 3. Logic which could not be tested.
 - 4. Copies of messages, displays and trends which verify operation.
 - 5. Problem description, if any.
 - 6. Signature of tester and date.
 - 7. Signature of Engineer and date.
- G. Document function tests and submit to the Engineer. Include the following:
 - 1. Description of function.
 - 2. Tests performed.
 - 3. Copies of messages, displays, reports, and trends which verify operation.
 - 4. Problem description, if any.
 - 5. Signature of tester and date.
 - 6. Signature of Engineer and date.
- H. Submit, separately, test results which indicate failure and need to be retested. Indicate reason for failure, proposed date for retesting, and overall schedule impacts if any.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. Pretest loops and wiring prior to formal field testing. Provide complete documentation describing results of pre-testing. Clearly indicate that loops have been pre-tested, along with descriptions of any problems encountered. Perform no formal field testing until pre-tests have been completed, and documentation approved.
- B. Conduct field tests in the presence of the Owner or Engineer, except when advised by the Engineer that test witness presence will not be necessary.
- C. If a test, or a portion of a test, fails to the point where it needs to be rescheduled at a later date, re-testing shall be required at no additional cost to the Owner and no extension of the Contract completion date.
- D. Perform field testing to verify the operation of the control system. Perform field testing sequentially and organize by plant area and by unit process within each area. Field tests are as follows:
 - 1. Loop tests.
 - 2. Loop tuning.
 - 3. Control strategy tests.
 - 4. Function tests.
 - 5. Integrated system test.
- E. Test each major subsystem. A subsystem is an integrated, fully operational subset of the control system and includes the following:
 - 1. Programmable Logic Controller (PLC) and associated I/O.
 - 2. Network communications equipment required for operation of the subsystem.
 - 3. Field instruments, panels, termination cabinets, control devices and related interconnections provided for the plant area.
 - 4. Operator interface and graphics added and integrated into the existing Plant Control System.
- F. Meet the following conditions prior to the start of any testing:
 - 1. Correct deficiencies noted during unwitnessed in-factory testing.
 - 2. Have documentation on-site pertinent to the part of the system being tested.
 - 3. Have on-site, labeled, and properly stored, spare parts, expendables and test equipment pertinent to the part of the system being tested.
 - 4. Have Engineer approved test schedules and test procedures.

5. Field instruments and equipment interfacing with the PLC under test shall have been calibrated and/or tested in accordance with the requirements of the individual specification sections.
- G. Schedule field testing through the Construction Manager and the Owner on a daily basis.
1. The Owner may redirect testing from one unit process to another. Make no claim for delay or additional costs for testing if the testing effort is redirected to a different unit process provided the following conditions are met:
 - a. The redirection does not cause more than one-hour interruption to the testing to move test equipment and test personnel to the new unit process.
 - b. There is no change in the amount of test equipment or personnel requirements.
 - c. The redirection is not arbitrary. Process operational constraints, personnel availability, and other's work are valid reasons for redirection.
 - d. The redirection does not occur more than once in any work day subsequent to the daily scheduling meeting.
 2. Perform no testing that may affect plant operation without Owner concurrence.
 3. Perform testing on a per site basis. Test no more than one site at any given time.
- H. Perform tests by following the operation and maintenance manuals word-for-word unless approved otherwise by the Engineer. Lack of complete, detailed manuals will be cause for declaring the test to have failed regardless of the actual test results.
- I. Begin testing by performing the following steps:
1. Check equipment against shop drawing lists.
 2. Verify that the equipment has been installed in accordance with Contract documents and manufacturer's directions.
 3. Power up the equipment and run diagnostics to verify error-free operation.
 4. Load software.
- J. Make available for Owner's use loops and control strategies that have been verified to operate properly immediately subsequent to conclusion of the respective test.
- K. The Owner may participate in testing activities at the Owner's discretion.
1. This participation will serve as a learning experience for plant operations and maintenance personnel but does not take the place of specified training.
 2. This participation does not relieve the Contractor from the specified requirements for testing.

3. Recognize and adjust for Owner involvement in developing test procedures and schedules.
4. Owner participation and use will be such that it does not adversely affect specified testing requirements. Make no claim for delay unless the following conditions are met:
 - a. The Owner and the Engineer are notified verbally that Owner actions could cause delay if continued.
 - b. The Owner persists in the delay action.
 - c. Submit written documentation within 24-hours which describes the Owner action and the impact.

3.02 LOOP TESTS

- A. Verify field wiring continuity from field device to PLC Panel termination.
- B. Check each loop from the end element to the respective control display. Include instruments, field wiring, control devices, panels, termination cabinets, input/output cards and other devices in the loop to ensure proper operation and linkage to control station displays.
- C. Test operation of the final control element through panels and through control stations. If a final control element is out of service or not released by the Owner for testing, simulate operation at the final control element location.
- D. For loops found to contain defective or inoperable equipment perform the following:
 1. Correct and recheck these loops when equipment is operable.
 2. The Engineer will assist in coordinating the correction of defective work by others.
 3. Do not perform additional checkout work unless directed by the Engineer.

3.03 CONTROL LOOP TUNING TESTS

- A. Complete loop checkout and problem correction prior to loop testing.
- B. Tune regulatory control loops to produce stable control. Use a loop tuning software program to document loop performance.
 1. For conventional control loops for PI and PID control, use minimum ITAE (Integral of Time and Absolute Error) criteria with overshoot constrained to 10 percent unless otherwise directed by the Engineer.
 2. Provide reduced gains or filtering to minimize unnecessary output activity to electric actuators as directed by the Engineer.
 3. Adjust input scan time or time intervals between controller calculations as necessary to produce stable control.

4. Tune cascaded controllers similar to the above with the inner loop tuned first while the outer loop is off or inactive.
- C. Derive initial tuning parameters from open loop tests. Make final tuning parameter adjustments based on closed loop tests.
- D. Operate tuned loops for a minimum of 24 hours prior to control strategy testing.

3.04 CONTROL STRATEGY TESTS

- A. Fully test control strategies to ensure specified operation. Include the following:
 1. Sequences.
 2. Alternate control modes.
 3. Dynamic gain adjustments.
 4. Contingency responses to device failures, where possible.
 5. Display and keyboard interaction.
 6. Messages.
- B. Prior to use on the process equipment, compare strategies with approved submittals to verify that as-built linkages and logic agree with the documentation. Note and correct discrepancies.
- C. Test as much of the logic as possible for process equipment. It may not be possible to test all logic due to operational constraints.
- D. Annotate changes made during testing on the documentation to reflect final as-built conditions.

3.05 FUNCTION TESTS

- A. Test functions of subsystems to verify that the subsystem has been installed and is operational. Test functions that apply to the subsystem being tested.
- B. Fully test operator station functions. Include the following:
 1. Process control displays and linkages.
 2. User entry functions.
 3. Alarm and event handling.
 4. Other specified functions for the stations.
- C. Test data handling and access functions. Use live data and include the following:
 1. Control System database.
 2. Historical data collection and storage, retrieval and correction at SCADA Servers.
 3. Historical trending.
 4. Report generation.
 5. Other specified data handling functions.

- D. Demonstrate the following support and maintenance functions:
 - 1. System status displays and use.
 - 2. Diagnostics.
 - 3. Power fail/restart.
 - 4. Other specified functions.
- E. Data acquisition tests shall include the following:
 - 1. Control System data acquisition via the PLC fiber optic data highway and cellular systems.
 - 2. Alarm/event handling.

3.06 INTEGRATED SYSTEM TEST

- A. The integrated system tests may only begin after other testing specified in this section has been completed and test results submitted.
- B. Perform integrated system testing to verify the operation and performance of the complete, integrated control system.
 - 1. Begin integrated system testing after other field tests have been completed.
 - 2. Conduct the test for two calendar weeks, 24 hours per day.
 - 3. Provide full-time, on-site assistance during business days and within four hours after call-in for the test duration.
 - 4. The Engineer will monitor and participate in the test.
- C. Include the following:
 - 1. Data communication, both normal and failure modes.
 - 2. Fully loaded system response times.
 - 3. Other system operations the Engineer may elect to perform.
- D. Correct deficiencies within 24 hours of notice. If deficiencies remain uncorrected at the end of the test period, the test period will be extended on a day-to-day basis until specified operation can be demonstrated.

END OF SECTION



DIVISION 15

MECHANICAL

SECTION 15050

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: General administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Submittals.
 - 2. Record documents.
 - 3. Maintenance manuals.
 - 4. Quality assurance.
 - 5. Delivery storage and handling.
 - 6. Guarantee.
 - 7. Rough-ins.
 - 8. Mechanical installations.
 - 9. Cutting and patching.
- B. The Drawings are schematic and are not intended to show every detail of construction.
 - 1. In general, piping/ductwork transitions and offsets shown on Drawings indicate approximate locations in plan and elevation where the systems are intended to be run.
 - 2. CONTRACTOR shall fully coordinate mechanical work with other trades to avoid interferences.
 - 3. In the event of interferences, CONTRACTOR shall request clarification from Engineer of Record in writing.
- C. All repairs, modifications and corrective actions must be approved by the owner prior to implementation.
- D. Subcontractors must adhere to all contract requirements of prime contractor and prime must adhere to all contract requirements of subcontractors. Subcontractors and Prime contractor agree to "include the full text" of each other's contracts including but not limited to:
 - 1. Insurance.
 - 2. Safety and security.
 - 3. Environmental liability.
 - 4. Meeting attendance.
 - 5. Repairs and corrective actions.

6. Submittals.
 7. Dispute resolution.
- E. Owner shall have free communication with subcontractors and subcontractors with owner regardless of Prime contractor's directions or exceptions.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
1. A schedule indicating the system, line size, line material, joints, fittings, valves, support type and spacing, test pressure and shop finish for each system shown on the Drawings and/or specified herein.
 2. Complete layout drawings of all pipes, Isometrics, etc., showing all sizes and controlling elevations. These drawings shall be reproducible and submitted on tracing, mylar or sepia paper.
 3. No work shall be undertaken until such drawings, specifications and schedules have been approved by Engineer of Record. Approval of this data by Engineer of Record shall not relieve CONTRACTOR of responsibility for the completeness, coordination, and dependable operation of the system as installed.
- B. Product Data: Submit in accordance with requirements of Section 01, product data covering the items included under this Division of the Work.
- C. Record Drawings: At Project closeout, submit record drawings of installed products.
- D. Operation and Maintenance Manuals: Submit operation and maintenance manuals for items included under this Section.

1.03 QUALITY ASSURANCE

- A. Inspections: CONTRACTOR shall coordinate all inspections with the Engineer of Record 10 days prior to desired date and time of inspection. If the Engineer of Record cannot honor the date and time, the contractor shall be notified, and it shall be rescheduled at no cost to the Owner or Engineer of Record and at no delay in schedule. No work shall be covered and no concrete poured until all affected installations are inspected and approved, or in the event of ion-compliance with design documents, corrected and re-inspected.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.05 PROJECT CONDITIONS

- A. All piping, pipe fittings, pipe supports and hangers, and fasteners shall be made of 316 stainless steel. Pipe may also be HDPE.
 - 1. Acceptable Manufacturers: Products shall meet the requirements of this Section and be the product of:
 - a. Liberty Plastics.
 - b. JM Eagle
 - c. Charter Plastics
 - d. Pipeline Plastics, LLC
 - e. Carpenter & Paterson, Inc.
 - f. Empire Industries
 - g. National Pipe Hanger Corporation

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.02 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of piping and instrumentation systems, materials, and equipment. Comply with the following requirements.
 - 1. Coordinate mechanical systems, equipment, and materials installation with other system components.
 - 2. Verify all dimensions by field measurements.
 - 3. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed. Furnish, set, and grout or secure in place all required sleeves.
 - 4. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to trip hazards piping

and supports may cause when pumps must be pulled from pump risers for maintenance.

5. Piping installation shall be well thought out and prepared. Contractor shall insure all piping is square, level and plumb with no odd or unnecessary angles or offsets. Piping that is not square and plumb shall be removed and replaced at no cost to Owner.
- B. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum degree of freedom for the maintenance of equipment and instruments.
- C. Install systems, materials, and equipment to conform with approved submittal data. Conform to arrangements indicated by the Contract Documents, recognizing that portions of Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to ENGINEER. The contractor is responsible for locating all underground utilities.
- D. Install systems, materials, and equipment level, plumb, perpendicular and parallel with concrete slabs in outdoor areas.
- E. Install mechanical equipment and instrumentation to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

3.03 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with the following requirements:
 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 1. Uncover Work to provide for installation of ill-timed Work.
 2. Remove and replace defective Work.
 3. Remove and replace Work not conforming to requirements of the Contract Documents.

END OF SECTION

SECTION 15060

SUPPORTS AND ANCHORS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Extent of supports and anchors required by this Section is indicated on Drawings and/or specified in other Division 15 Sections.
- B. Types of supports and anchors include the following:
 - 1. Horizontal piping supports.
 - 2. Miscellaneous materials.
 - 3. Anchors.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
 - 1. Manufacturer's assembly type Shop Drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.
 - 2. Submit manufacturer's technical product data, including installation instructions, for each type of support and anchor.
- B. Operation and Maintenance Manuals: Submit operation and maintenance manuals for items included under this Section. Include maintenance data and parts list for each type of support and anchor.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
- C. Manufacturers Standardization Society of the Valves and Fittings Industry, Inc. (MSS) Standard Compliance:

1. Provide pipe supports of which materials, design, and manufacture that comply with MSS SP-58.
2. Select and apply pipe supports complying with MSS SP-69.
3. Fabricate and install pipe supports complying with MSS SP-89.
4. Terminology used in this Section is defined in MSS SP-90.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
 1. Supports:
 - a. B-Line Systems, Inc.
 - b. Carpenter and Paterson, Inc. Empire Industries
 - c. National Pipe Hanger Corporation
 2. Saddles and Shields:
 - a. Elcen Metal Products Co.
 - b. Pipe Shields, Inc.
 - c. Empire Industries
 - d. National Pipe Hanger Corporation

2.02 MATERIALS

- A. Supports and anchors shall be 316 stainless steel.

2.03 MISCELLANEOUS MATERIALS

- A. Use 316 Stainless Steel Plates, Shapes, and Bars: Provide products complying with ANSI/ASTM A 36.
- B. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1 part cement to 3 parts sand, by volume, with minimum amount of water required for placement and hydration.
- C. Pipe Guides: Provide factory-fabricated guides, of heavy fabricated 316 stainless steel, consisting of bolted 2-section outer cylinder and base with 2-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any) and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PREPARATION

- A. Proceed with installation of supports and anchors only after required concrete pad work has been completed in areas where the Work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors, and other structural attachments.
- B. Prior to installation of supports, anchors, and associated Work, Installer shall meet at Site with Prime Contractor, Installer of each component of associated Work, Installers of other work requiring coordination with Work of this Section, and Engineer of Record for purpose of reviewing material selections and procedures to be followed in performing the Work in compliance with requirements specified.

3.03 INSTALLATION OF SUPPORTS

- A. Install supports, clamps, and attachments to support piping properly from concrete pad; comply with MSS SP-69. Install supports with maximum spacings complying with MSS SP-69. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install supports of same type and style as installed for adjacent similar piping.
- C. Provisions for Movement:
 - 1. Install supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion loops, expansion bends, and similar units.
 - 2. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31.1 Pressure Piping Codes are not exceeded.

3.04 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31.1.

- B. Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe runs between expansion loops and bends.

3.05 ADJUSTING AND CLEANING

- A. Provide grout under supports so as to bring piping to proper level and elevations.
- B. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 15100

PRESSURE PROCESS PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes the following:
 - 1. Provide all labor, materials, and equipment necessary for fabrication and production of the items specified in this Section and as shown on Drawings.
 - 2. Piping shall contain necessary unions or companion flanges to allow ease of equipment and instrumentation removal.
 - 3. Provide all necessary joint and coupling materials, including bolts, nuts and gaskets, and standard or special fittings. Furnish supports, anchors and other and special fittings.
 - 4. Provide plugs in open ends of pipe for temporary seal to complete new work.
- B. Products Installed But Not Furnished Under This Section: Install flow meters, pressure sensors and other appurtenances which are furnished under other Sections and incorporated in the piping systems as shown on Drawings and specified in this Section.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
 - 1. Shop Drawings shall be fully dimensioned Drawings showing the piping in full detail with exact locations, dimensions, and schedules of all pipe, fittings, supports, and appurtenances. They shall be made in accordance with the general information shown on Drawings. Where special fittings are required, they shall be shown in large detail with all necessary dimensions.
 - 2. Each pipe section, special fitting and appurtenance shall be identified on Drawings.
 - 3. Product Data: Submit product data covering the items included under this Section.
- B. Record Drawings: At Project closeout, submit record Drawings of installed products.

1.03 QUALITY ASSURANCE

- A. All Work under this Section shall be done in accordance with standard practices as recommended by manufacturer and ANSI B16.34

- B. Codes, Ordinances, and Standards: Manufacture, storage, and erection of equipment under this Contract shall be in accordance with current ASA (ANSI), and ASTM Standards. Standards and Specifications referenced herein shall be the current published edition. The manufacturer of the pipe and fittings shall furnish Engineer of Record a certified statement that all pipe and fittings furnished by manufacturer meet the material requirements and have been inspected and tested in accordance with the applicable Specification and Standard.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage:

1. All pipe and related items installed under this Section shall be stored as recommended by manufacturer.
2. CONTRACTOR shall take all actions necessary to protect all items installed under this Contract including furnishing all special storage areas required by equipment manufacturers.
3. Pipe shall be stored on suitable timber skids free from contact with the ground. Gaskets shall be stored in as cool, clean, and shaded a place as practical.

B. Handling:

1. All items installed under this Contract shall at all times be handled as recommended by manufacturer and in such a manner as to avoid any damage.
2. All special handling equipment and temporary supports shall be provided by CONTRACTOR.
3. Items will be subject to inspection and approval upon delivery to the Site and after storage. No cracked, broken, or damaged pipe shall be used.
4. In the event coatings are damaged, the damaged area shall be recoated with an approved coating similar to that specified for that item.
5. During handling, hauling, and storage of pipe, each piece shall be kept from contact with adjacent pieces by means of wooden blocks or timbers.

1.05 PROJECT CONDITIONS

- A. Existing Conditions: The Drawings are not intended to show every detail of construction or location of piping or equipment. Where existing conditions make it necessary or advisable to change location of piping or equipment, CONTRACTOR shall submit a formal submittal of proposed change to owner and Engineer of Redcord for approval.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
 - 1. Adapter Flange Coupling (AFC):
 - a. EBAA Iron Sales, Inc.
 - b. Smith-Blair, Inc.
 - c. Uni-Flange Corp.
 - d. Victaulic Co.
 - 2. High-Density Polyethylene Pipe (HDPE):
 - a. Performance Pipe.
 - b. KWH.
 - 3. Equipment Connections:
 - a. Garlock.
 - b. Metra Flex.
 - c. Mercer Rubber Co.
 - d. Redflex.
 - e. Atlantic Metal Hose Co. (Vibra-flexor).
 - f. Allied Metal Hose Company.
 - g. Universal Oil Products Flexonics Division.
 - 4. Utility Markers:
 - a. ScotchMark mid-range markers, Model 1258, as manufactured by 3M Company.
 - b. 3M Marker Locator Model 1265.

2.02 PIPE JOINTS

- A. All joint material and lubricants shall be furnished with the pipe, including all joint material required for connection to equipment furnished under other Sections. All joint materials shall be assembled in accordance with standard practice and manufacturer's recommendations. All equipment connections shall be flanged, union, or grooved coupling so that equipment can be removed without disassembly of the connecting piping.
- B. Bolted Flexible Couplings (BFC): Bolted flexible couplings shall consist of a 316 stainless steel sleeve, with centering bead removed, rubber gaskets, follower rings, and a full complement of nuts and bolts. Couplings shall allow a deflection of approximately 4 degrees per joint.
 - 1. Couplings shall have a minimum middle ring thickness and minimum length as follows:

<u>Pipe Size (inches)</u>	<u>Middle Ring Thickness</u>	<u>Middle Ring Length</u>
2-4	0.203-inch	5-inch

2. Couplings and accessories shall be 316 stainless steel.

C. Flanged Joints (FJ): Pipe flanges shall conform to American Standards: dimensions, ANSI B16.1 and threads, ANSI B2.1. Flange faces except 316 stainless steel shall be coated with a rust inhibitor immediately after drilling.

1. Flanges for 316 stainless steel pipe shall be fabricated from 316 stainless steel flat plate of the same composition as the pipe.
2. Flanges shall be firmly braced and bolted with machine, stud or tap bolts of the proper size and number meeting the requirements of ASTM A 307, Grade B. Joints made with bolts or bolt studs shall have a nut on each side. Bolt projection through nuts shall be equal, and where studs are used, bolt projection on each side of the flange shall be equal.
3. All nuts and bolts shall be 316 stainless steel; flanges shall be 316L stainless steel.
4. Flange joints shall not be used on ground-buried pipe.

2.03 PIPING

A. Stainless Steel Pipe (SSP): Stainless steel pipe shall be designed and fabricated in accordance with the ASTM Standards A 312 and A 409, and as shown on Drawings.

1. The pipe and fittings and all appurtenant supports specified shall be made from 316 L stainless steel with a minimum No. 1 mil finish and a maximum carbon content of 0.035 percent.
2. Pipe schedule shall be as shown on Drawings or on Pipe Schedule.
3. Fittings shall be made to ASTM A 403 standards, to MSS SP-43 dimensional tolerances, and shall be equal in wall thickness to, and meet the conditions of, the pipe.
4. Special fittings shall meet the requirements of the pipe and shall be as shown on Drawings.
5. All welding shall be performed in shop and be accomplished using inert gas shielded-arc method. Where consumable electrode or filler wire is used, they shall be the same material as the parent metal. Butt welds shall have full penetration to the interior surface and gas shielding provided to the interior and exterior of the joint.
6. All interior weld finishes shall equal the smoothness of a minimum No. 1 mil sheet finish. The weld bead shall be smooth evenly distributed with an interior projection not exceeding 1/16 inch beyond the I.D. of the pipe or fitting. All unevenness shall be finely ground to meet the above requirements. Coarse grinding shall not be permitted.

7. All exterior weld finishes shall be wire brushed with 316 stainless steel brushes used only on 316 stainless steel. The joints shall then be cleaned of all discoloration, and deposits left during welding shall be removed by pickling.
- B. High-Density Polyethylene Pipe (HDPE): High-density polyethylene pipe shall be furnished and installed as shown on Drawings or noted on Schedule.
1. Pipe shall be manufactured in accordance with ASTM F 714, Cell Classification PE345434C per ASTM D 3350, SDR 9.
 2. Fittings and specials shall be in accordance with ASTM D3350 and ASTM F2619/F2619M-13.
 3. Joints shall be thermally butt-fused according to recommendations of manufacturer or flanged as shown or noted on Drawings or on Schedule.
- C. General Pipe Selection Criteria

Table 1 - General Pipe and Tubular Selection Criteria					
			Minimum Wall Thickness		
Material	Typical Standard	Typical Temperature Range	Diameter Less Than or Equal to 2 Inches (50 mm)	Diameter Greater Than or Equal to 2 Inches (50 mm)	Notes
Stainless Steel	A312, A790	-20°F to 1,500°F (-29°C to 816°C)	Sch 10 S	Sch 10S	--
HDPE	ASTM D3350	0°F to 120°F	SDR 11	SDR 17	Air, slurry, ash, or water service (PE100 resin or heavier wall required for compressed air service*)

2.04 EQUIPMENT CONNECTIONS

- A. The connecting piping to pumps and other equipment shall be supported independently of the pump or equipment so as to avoid any strain on the pump or equipment.
- B. All equipment connections shall be flanged or have unions to facilitate removal of the equipment.

- C. Piping to vibrating equipment shall contain control-rodde, retainer ringed flanges, flexible spool-type expansion joint of duct and chlorobutyl or Buna-N material as shown or noted on Drawings.

2.05 SUPPORTS

- A. Supports shall include all supporting devices of metallic construction shown, specified, or required for piping, apparatus, and equipment installed under this Section. All supports and parts shall conform to the latest requirements of ANSI B31.1, except as supplemented or modified by the requirements of this Specification or as detailed on Drawings. Materials shall be 316 stainless steel.
- B. Supports shall be adequate to maintain the pipelines, apparatus, and equipment in proper position and alignment under all operating conditions with due allowance for expansion and contraction, and shall have springs where necessary. Supports shall be of standard design where possible and be best suited for the service required, as approved by ENGINEER. Supporting devices shall be designed in accordance with the best practice and shall not be unnecessarily heavy. Hangers shall be sling or saddle type.
- C. Saddle stands shall be of the adjustable type. Each stand shall consist of a length of 316 stainless steel pipe fitted at the base with a standard threaded flange and at the top with an adjustable saddle or roll. The base flange shall be bolted to the floor, foundation, or concrete base.
- D. Anchors shall be furnished and installed where specified, shown, or required for holding the pipelines and equipment in position or alignment. Anchors shall be designed for rigid fastening to the structures, either directly or through brackets. The design of all anchors shall be subject to approval by ENGINEER. Materials shall be 316 stainless steel. Inserts for concrete shall be 316 stainless steel and shall be installed in the concrete structures where required for fastening supporting devices.

2.06 SOURCE QUALITY CONTROL

- A. Tests, Inspections:
 - 1. All pipe and fittings delivered to the Project shall be accompanied by certification papers showing that the pipe and fittings have been tested in accordance with the applicable Specifications and that pipe and fittings meet the Specifications for this Project. All pipe and fittings will be inspected upon delivery to the Site by ENGINEER or OWNER's Representative. No cracked, broken, or damaged pipe or fittings will be allowed in this Work.

PART 3 - EXECUTION

3.01 ERECTION

- A. Equipment provided under this Section shall be fabricated, assembled, erected, and placed in proper operation condition in full conformity with detail Drawings, specifications, engineering data, instructions, and recommendations of equipment manufacturer approved by ENGINEER.

3.02 INSTALLATION

- A. Laying and Erecting Pipe: Pipe shall be installed as recommended by manufacturers and by the applicable sections of ASTM D2774.
 - 1. Pipe shall be carefully laid to line and grade. Care shall be taken to keep the interior of the pipe clean and free from dirt and other foreign materials.
 - 2. HDPE pipe with scratches exceeding 10% of the pipe wall thickness shall be removed and replaced.
- B. Field Cutting Piping: The spigot ends of all pipe lengths, which have been cut in the field, shall be ground to a smooth surface and painted with 2 coats of asphaltum metal protective paint.
- C. Bolted Flexible Couplings (BFC): All bolted flexible couplings shall be harnessed with tie bolts or studs across the joint, design based on test pressures. Provide torque schedule submittal for approval by Engineer of Record.
 - 1. Piping shall be furnished with lugs. The number and size of the bolts and studs and other details of the harnessed joint shall be submitted to ENGINEER for review.
 - 2. Tie bolts or studs shall be 316 stainless steel.
- D. Joints: All joints shall be assembled in accordance with that described in the "Pipe Joints" Article 2.02

3.03 PIPE LOCATING SYSTEMS

- A. Utility Markers: All plastic pipe pumping mains shall have an electronic marker system furnished and installed complete with marker locator.
 - 1. Markers shall be installed in a horizontal position 3 to 4 feet below the ground surface.
 - 2. A marker shall be placed over every buried tee, bend, or saddle fitting, at intervals no greater than 100 feet along pumping mains and where directed by ENGINEER.

3. Holes shall be excavated over bored or directionally drilled pumping main for placement of markers.
- B. Wire Pipe Location System: All directional bores shall be marked with copper tracer wire.
1. Copper wire shall be 6 AWG type RHW and be strung continuously along the pumping main.
 2. The wire shall be fastened to all gate valves or manholes which may serve as access points.
 3. Directional bores of less than 100 feet and bores in residential areas that will have service lateral taps on the pipe shall be marked with utility markers.
 4. CONTRACTOR shall test the locator system, before payment, for pumping main that is directionally bored.
 5. Failure of the copper wire shall result in the installation of utility markers at no additional cost to OWNER.

3.04 REPAIR

- A. Damage pipe sections shall be removed and replaced.

3.05 FIELD QUALITY CONTROL

- A. Defective Pipe: No pipe or special casting known to be defective shall be laid in Work.
1. Any piece found to be defective after it has been laid shall be removed by CONTRACTOR and replaced by a sound and perfect piece at CONTRACTORS expense.
 2. If the major part of a defective pipe is sound, the good end may be cut off and used.
 3. The cutting of pipes for this and any other purpose shall be done by skilled workers, and in such manner as will not injure the pipe. Every such cut shall be square and smooth. Cut surfaces shall be recoated as specified for the pipe.
- B. Tests:
1. After completion, each run of pipe shall be tested by CONTRACTOR in the presence of ENGINEER. All appurtenances such as service connections, corporation stops, and curb stops shall be tested with the run of pipe.
 - a. Any leaks shall be made tight.
 - b. Under this Work, CONTRACTOR shall furnish all water or air, piping, bulkheads, pumps or compressors, gauge, and other equipment required for the test.

- c. The section of pipe to be tested shall be cleaned and isolated by valves or plugs, and shall not exceed 2,000 feet for any individual test. Such valves or plugs shall be designed to hold against the test pressure. Sections of pipe shall have an opening through which air or water can be introduced. The supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the pressure. The pressure gauge shall have a minimum diameter of 3-1/2 inches and a range compatible with the test pressure. After completion of tests, all pipes shall be drained. Buried pipelines shall be pressure tested with all pipe joints exposed for visual inspection unless otherwise directed by ENGINEER.
 - d. CONTRACTOR shall furnish proposed test procedures for approval including pipe identification, test pressure and a description of the method of testing.
 - e. In the event that the leakage, the joints in the line shall be carefully inspected for leaks and repaired where necessary. Any pipes or special castings found to be cracked shall be removed and replaced with new pieces by CONTRACTOR. After this Work has been done, the test shall be repeated. Final acceptance of the lines will not be made until satisfactory tests have been passed.
2. Test Pressures: In general, pipelines shall be tested at 1-1/2 times their working pressure or at the test pressure indicated on Piping Schedule. Adjustments for hydrotest water temperature and water column elevation differences at point of test must be made. Record temperature and pressure readings at beginning of test, end of test and each 60 minutes of testing.
3. Hydrostatic Testing: The section of pipe to be tested shall be filled with water, the entrained air within the line shall be removed, and water shall be pressurized up to test pressure at the pipe low point within 5 to 10 minutes.
- a. The test period shall start immediately after initial pressurization. The line shall be maintained under the test pressure for a continuous 6-hour period.
 - b. The section of pipe to be tested shall hold the test pressure with no more than a 5 percent loss in pressure over the test period or the leakage per hour under the conditions of test shall not exceed values determined by the following equation:

$$L = \frac{SD\sqrt{P}}{148,000}$$

where

- L = allowable leakage per hour (gallons)
- S = length of pipe in test (feet)
- D = nominal diameter of pipe (inches)
- P = average test pressure (psi, gauge)

- c. Piping with flanged, grooved coupling, screwed, socket type, and welded joints shall be completely tight at the designated test pressure.

- d. The test pressure shall not vary by more than 5 psi throughout the entire test period.
4. Hydrostatic Testing of HDPE Pipe: The section of pipe to be tested shall be filled with water, the entrained air within the line shall be removed, and water shall be pressurized up to test pressure at the pipe low point within 5 to 10 minutes. To compensate for expansion after initial pressurization, sufficient make-up water shall be added into the pipe system at hourly intervals for 3 hours to raise the pressure back up to the test pressure.
- a. After completion of this initial phase, approximately 4 hours after start of the testing procedure, the actual test shall begin.
 - b. The system shall be pressurized up to the test pressure and by make-up water held continuously at the test pressure for at least 6 hours.
 - c. The make-up water used during the test shall be measured and shall not exceed the allowance given in the following table.

ALLOWANCE FOR EXPANSION OF HDPE PIPE UNDER TEST PRESSURE

Allowance for Expansion
(U.S. Gallons per 100 Feet of Pipe)

Nominal Pipe Size (In.)	1-Hour Test	2-Hour Test	3-Hour Test
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5
10	0.75	1.3	2.1
11	1.0	2.0	3.0
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	11.1	16.8
28	5.5	11.1	16.8
32	7.0	14.3	21.5
36	9.0	18.0	27.0
40	11.0	22.0	33.0
48	15.0	27.0	43.0
54	22.0	35.0	55.0

- d. If there are no visible leaks or pressure drops greater than 5 psi during the actual test period, the system passes the test. If leakage is revealed, however, the defect shall be corrected and a retest shall be made after a 24-hour minimum depressurized recuperation period.
- e. Pneumatic testing of HDPE pipe shall not be allowed.

5. Each valve assembly shall be tested by CONTRACTOR; the test shall consist of opening and closing the valve.

PIPEWORK SCHEDULE KEY

GENERAL

The following Pipe Schedule gives the designation for each pipe line, pipe size, joint, material, service, and other pertinent data. The key of symbols for the Schedule is as follows:

SCHEDULE KEY

PIPING MATERIAL

Process Piping

BSP	Black Steel Pipe
CSIP	Chrome Silicon Iron Pipe
DIP	Ductile Iron Pipe
FRP	Fiberglass Reinforced Pipe
GSP	Galvanized Steel Pipe
HDP	High Density Polyethylene
PVC	Plastic Pipe
PCCP	Prestressed Concrete Cylinder Pipe
RCPP	Reinforced Concrete Pressure Pipe
SSP	Stainless Steel Pipe
SPP	Steel Plate Pipe

Pipe Joints

BFC	Bolted Flexible Coupling
BSC	Bell and Spigot Concrete
BSL	Bell and Spigot Lead
BSS	Bell and Spigot Steel
FJ	Flanged
GC	Grooved Couplings
MJ	Mechanical Joint
SJ	Screwed Joint
STJ	Socket Type Joint
WJ	Welded Joint
FWJ	Field Welded Joint
AFC	Adapter Flange Coupling

Remarks

CL Class

PIPING SCHEDULE

THE FOLLOWING IS AN EXAMPLE FOR COMPLETING THIS FORM

No.	Location	Service	Size (inches)	Materials	Joints	Interior or Exposed	Test Pressure	Remarks
1	Raw Sewage Pump Station	RS	4	DIP	MJ	Exposed		GS for 1-1/2-inch section only.
2	Treatment Bldg. to Oxidation Ditch	RS, RAS	6	DIP	MJ	Interior		Remarks should be brief. Longer remarks should be footnotes.

END OF SECTION

SECTION 15105

BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Piping materials and installation methods common to more than one Section of Division 15 and includes pipe, fitting and joining materials, piping specialties, and basic piping installation instructions.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Sections 01330 and 15050, Shop Drawings covering the items included under this Section.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.
- D. Store pipe in a manner to prevent sagging and bending.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
 - 1. High Density Polyethylene Pipe (64.2):
 - a. Driscopipe 8000.
 - b. Nipak.
 - c. Dupont.

2. High-Density Polyethylene Pipe (64.7):

- a. Driscopipe 8600.
- b. Nipak.
- c. Dupont

3. 316 Stainless Steel Pipe:

- a. Empire Industries
- b. National Pipe Hanger Corporation

2.02 PIPE MATERIALS

- A. Refer to the individual piping system specification Sections in Division 15 for specifications on piping materials required from those listed from the following.

High-Density Polyethylene Pipe (64.7)

Normal Service: Leachate Water
 Pressure to approx. 80 psig
 Temperature to 140 degrees F

	Size	Specifications
PIPE	3/4-inch and larger	High-density polyethylene, SDR-9, ASTM D 3350, PE 3408.
TYPE OF JOINTS	3/4-inch and larger	Fusion welded, ASTM D 3261 or socket. ASTM D 2683
FITTINGS	3/4-inch and larger	High-density polyethylene, SDR-9, socket fusion type, with diameters compatible with pipe for fusion joining.
GASKETS	3/4-inch and larger	1/16-inch solid hypalon, full-face type.
FLANGES	3/4-inch and larger	PVC, 150-pound, flat-face, Schedule 80, socket type
(when required)		

Stainless Steel Pipe (66.1)
(Leacahte water)

Normal Service: Pressure to approx. 150 psig
 Temperature to 300 degrees F

	Size	Specifications
PIPE	1/2-inch through 6-inch	Types 316 or 316L stainless steel pipe, Schedule 5S. ASTM A 312 seamless or electric welded.
TYPE OF JOINTS	1/2-inch through 6-inch	Butt-welded
FITTINGS	1/2-inch through 6-inch Tubing fittings shall be Swagelock.	Types 316 or 316L stainless steel, schedule 5S, butt-welding. ASTM Standard A 403 and ANSI Standard B16.9, or tangential fittings as manufactured by Horace T. Potts Co. (Speedline) or by Picor, Inc. Fittings must be true Schedule 5 - not a heavier schedule taper-bored to schedule; 5 thickness at the ends.
FLANGED	1/2-inch through 6-inch	Types 316 or 316L stub ends, schedule
CONNECTIONS	2" and less 316 stainless steel sockets.	5S, butt-welding. Type A or B as covered by MSS or ANSI. All stub ends must be true schedule 5 -- not taper-bored. Alternate: Speedline T/D insert flanges. These must be continuous-welded on the inside flange face as described in 15051.1. Expanding is not permitted. Speedline or Camco 150-pound. C.S. lightweight backup flanges are permitted for stub ends.
GASKETS	1/2-inch through 6-inch	Compressed Fiber - Garlock Spiral Wound - Flexitallic Cloth Inserted Elastomeric - Manville

Stainless Steel Pipe (66.2)

Normal Service: Pressure to approx. 100 psig
 Temperature to 340 degrees F

	Size	Specifications
PIPE	1/2-inch and larger	Types 316 or 316L stainless steel, Schedule 10, ASTM A 312.
TYPE OF JOINTS	1/2-inch and larger	Butt-weld except where specific accessories require flanged or screwed connections.
FITTINGS	1/2-inch and larger	Types 316 or 316L stainless steel, 150-pound, weld neck, standard raised face, ANSI B16.5.
GASKETS	1/2-inch and larger	1/16-inch Garlock "Gylon" or Flexitallic Style CG stainless steel with Teflon fill. (NOTE: Flexitallic gaskets not suitable for Contramatic butterfly valves.)
THREAD SEALANT	1/2-inch and larger	Teflon Ribbon, 1/2-inch wide.

2.03 JOINING MATERIALS

- A. Gaskets for Flanged Joints: Gasket material shall be raised-face for stainless steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.02 INSTALLATION

- A. Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

- B. Piping shall be exposed, unless indicated otherwise.
- C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- D. Install exposed piping at right angles or parallel to concrete slabs. Diagonal runs are not permitted, unless expressly indicated on Drawings.
- E. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

3.03 FITTINGS AND SPECIALTIES

- A. Use fittings for all changes in direction and all branch connections.
- B. Remake leaking joints using new materials.
- C. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 1.5"-inch and smaller connections, and elsewhere as indicated.
- D. Install flanges in piping 2-inch and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.
- E. Joints for piping materials are specified within the respective piping system sections.

3.04 FIELD QUALITY CONTROL

- A. Testing: Refer to individual piping system Specification Sections.

END OF SECTION

SECTION 15110

PROCESS VALVES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Labor, materials, and equipment necessary for fabrication, production, installation, and erection of the items specified in this Section and as shown on Drawings or on Valve Schedule on Drawings.
- B. Items furnished under this Section shall be erected under Division 15. Flange bolts, and gaskets for valves shall be furnished and installed under Section 15100.

1.02 REFERENCES

- A. ANSI/ASME:
 - 1. B16.34, Ball Valves.
 - 2. AWWA C508, Check Valves

1.03 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
 - 1. Each valve, including accessories, shall be identified on Shop Drawings by its respective mark as noted on Valve Schedule.
- B. Warranty: Submit in accordance with requirements of Section 01, warranties covering the items included under this Section.

1.04 QUALITY ASSURANCE

- A. All Work under this Section shall be performed in accordance with standard practices as recommended by manufacturer and ASME.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work included.
 - 1. See Valve Schedule.

2.02 VALVE AND GATE IDENTIFICATION

- A. Each valve and gate shall be tagged with its distinguishing mark letter and number. Mark letter and number will be as listed on Valve Schedule. Identification tag shall be 1-1/2-inch in diameter, 18-gauge polished brass or aluminum with 1/2-inch-high, embossed, black-filled mark letter and number placed thereon. Tags shall be securely fastened to the valve or gate operator with No. 16 brass jack chain or plastic seals.

2.03 COMPONENTS

A. Ball Valves (BV):

1. Ball valves shall be of the tight closing, rubber seat type with rubber seat affixed to the rotor. The valves shall be of the sizes listed on Valve Schedule and shall be equipped with hydraulic cylinder operators as specified herein. Valve design shall be such as to eliminate metal-to-metal wedging or contact in the seating action. The valve shall be designed for 150 psi working pressure and 300 psi test pressure, and to effect tight shutoff against flow in both directions.
2. The ball valves shall be assembled for installation as shown on Drawings or noted on Valve Schedule with the hydraulic operating cylinder in a vertical position. Design of the valve shall be such that with the valve in the open position, the opening through the valve shall be equal to the nominal diameter of the adjacent pipeline and the head loss across the valve shall not exceed that of an equal length of straight pipe.
3. Stainless steel ball valves shall be full port type for the sizes indicated on the Drawings. Valve body and ends shall be constructed of forged Type 316 stainless steel and valve ends shall be NPT threaded connections for valves less than 2.5 inches. Provide type 316 stainless steel Flanged connections for valves 3 inches and larger. The ball shall have a full bore port design machined from a solid metal piece with highly polished surfaces. The ball and stem shall be manufactured from Type 316 stainless steel. Manually operated ball valves shall be furnished with lever operators manufactured of forged Type 316 stainless steel with a molded vinyl sleeve.

B. Check Valves (CV):

1. Swing check valves 2-inch and larger shall conform to AWWA C508, latest revision, and shall be designed for a minimum water working pressure of 150 psi. Check valves shall have type 316 stainless steel body and disc, type 316 stainless steel seats, swing type design, and ends shall be flanged, Class 150 in accordance with ANSI B16.1. When open, the valve shall have a straight way passage with a minimum flow area equal to the full pipe area.
2. Swing check valves shall absolutely prevent the return of water back through the valve when the inlet pressure decreases below the downstream pressure. The check valve shall be constructed such that the disc and body seat ring may be easily removed and replaced without removing the valve from the line. Each valve shall be hydrostatically tested at the factory, at a test pressure of 300 psi.

C. Air Release Valves (ARV)

1. Air Release Valves for Wastewater Service

- a. Design: Single body, double orifice to allow large volumes of air to escape or enter pipe.
 - 1) Maximum Operating Pressure: 250 PSI (17.2 Bar)
 - 2) Operating Range: 0 – 250 PSI (0 - 17.2 Bar)
 - 3) Valve seat does not contact the medium (air cushion).
 - 4) Two connections for effective flushing during maintenance work (top inlet flushing connection)
 - 5) All mechanical parts are manufactured of corrosion-resistant materials; valve body is stainless steel 316Ti.
- b. Valve End Connections:
 - 1) Valves smaller than 4 inches shall have threaded ends complying with ANSI B12.1.

2.04 VALVE JOINTS

- A. Flange Joint: Flanges shall meet the requirements of ANSI-B16.1 Standard Class 150, except that bolt holes at shaft hubs may be drilled and tapped on the flanges. Flange faces shall be coated with a rust inhibitor immediately after drilling.

PART 3 - EXECUTION

3.01 ERECTION

- A. Equipment provided under this Section shall be fabricated, assembled, erected, and placed in proper operation condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer approved by ENGINEER.
- B. Equipment furnished under this Section shall be installed under Section 15100.

3.02 FIELD QUALITY CONTROL

- A. Installation: Special attention shall be given by CONTRACTOR to ensure that items furnished under this Section are installed in accordance with manufacturer's recommendations.

3.03 INSTALLATION OF VALVES

- A. Valves of the size and type shown on the Drawings shall be set plumb and installed at the locations indicated on the Drawings. Valves shall be installed in accordance with manufacturer's installation instructions and with the details shown on the Drawings.
- B. Valves shall be installed such that they are supported properly in their respective positions, free from distortion and strain. Valves shall be installed such that their weight is not borne by pumps and equipment that are not designed to support the weight of the valve.
- C. Valves shall be carefully inspected during installation; they shall be opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Special care shall be taken to prevent any foreign matter from becoming lodged in the valve seat. Check and adjust all valves for smooth operation.
- D. Install valves with the operating stem in either horizontal or vertical position. Allow sufficient clearance around the valve operator for proper operation.
- E. Clean iron flanges by wire brushing before installing flanged valves. Clean carbon steel flange bolts and nuts by wire brushing, lubricate flange bolt threads with oil or graphite, and tighten nuts uniformly and progressively. Clean threaded joints by wirebrushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.
- F. Valves shall be tested hydrostatically, concurrently with the pipeline in which they are installed. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure used for the pressure tests. If valve joints leak during pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and hydrostatically retest the joints.

3.04 VALVE SCHEDULE

VALVE SCHEDULE (Per Pump Station)				
TYPE	P&ID Tag	SIZE	MANUFACTURER	MODEL
AIR RELEASE VALVE	C2-ARV-1	2"	DEZURIK	ASU,2,SCAV,T1,S2,R516,EPDM,S2-S2-S2
AIR RELEASE VALVE	C2-ARV-2	1"	DEZURIK	ASU,1,CAV,T1,S2,R516,EPDM,S2-S2-S2
BALL VALVE	C2-BV-1	2"	VALTORC	SERIES 110
BALL VALVE	C2-BV-2	1"	VALTORC	SERIES 110
BALL VALVE	C2-BV-3	1/2"	VALTORC	SERIES 110
BALL VALVE	C2-BV-4	1/2"	VALTORC	SERIES 110
BALL VALVE	C2-BV-5	1/2"	VALTORC	SERIES 110
BALL VALVE	C2-BV-6	3"	VALTORC	SERIES 180
BALL VALVE	C2-BV-7	3"	VALTORC	SERIES 180
CHECK VALVE	C2-CV-1	3"	VALTORC	SERIES 410
CHECK VALVE	C2-CV-2	2"	VALTORC	SERIES 410

END OF SECTION



DIVISION 16

ELECTRICAL

SECTION 16010

ELECTRICAL - GENERAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Comply with all terms and conditions of "General Conditions of the Contract for Construction".
- C. All repairs, modifications and corrective actions must be approved by the owner prior to implementation. Submit repair procedures in writing, include sketches and drawings for clarity.
- D. Subcontractors must adhere to all contract requirements of prime contractor and prime must adhere to all contract requirements of subcontractors. Subcontractors and Prime contractor agree to "include the full text" of each other's contracts including but not limited to:
 - 1. Insurance.
 - 2. Safety and security.
 - 3. Environmental liability.
 - 4. Meeting attendance.
 - 5. Repairs and corrective actions.
 - 6. Submittals.
 - 7. Dispute resolution.
- E. Owner shall have free communication with subcontractors and subcontractors with owner regardless of Prime contractor's directions or exceptions.
- F. For any work element (e.g., compacted soil liner that lies below the HPDE liner, electrical conduits that are encased in concrete) that will be covered, buried, or concealed, whether entirely or partially, by subsequent work elements, the Contractor must receive written approval from the Owner indicating acceptance of that work element before proceeding to subsequent work elements. Any work element that has been covered, buried, or concealed by the Contractor without written approval from the Owner shall be uncovered for inspection, testing, and approval, as necessary. The costs associated with uncovering work and performing subsequent repairs shall be borne by the Contractor.

1.02 SUMMARY

- A. Scope

1. This section specifies general requirements for electrical work. Detailed requirements for specific electrical items are specified in other sections but are subject to the general requirements of this section.
2. The electrical drawings and schedules included in this project manual are functional in nature and do not specify exact locations of equipment or equipment terminations.
3. The drawings contain electrical, and instrument and control details. The general scope includes:
 - a. Installation of new electrical services to support the new pumps and controllers.
 - b. Fabricate, factory test and field install new pump control panels.
 - c. Provide and install new level, pressure and flow sensors and transmitters.
 - d. Install new fiber optic cabling to existing Cell 1 pump control panels and new Cells 2 and 3 control panels below grade. Run new fiber optic cable on OUC poles to existing fiber termination box near rear gate security cameras.
 - e. Add service request to move the existing Cell 1 electrical service, provide supplemental Cell 1 grounding and surge protection and replace existing Cell 1 control panels. Provide new underground duct runs and install fiber and power pullboxes, H2O rated with steel/aluminum covers. Replace 8 level sensor, C-3 TVSS to each of four control panels, add TVSS and breaker to main service panelboard and provide a 30"x3/4" copper clad steel ground rod and #6 solid bare ground conductor to control panel ground bar.
4. The Electrical Contractor shall examine all mechanical and civil drawings and Specifications to determine actual locations, sizes, materials, and ratings of all equipment provided by others.
5. The Drawings and Specifications contemplate a finished piece of Work of such character and quality as described in and reasonably inferred from them, and fitting with the Work of other Electrical Contractors and the Owner. Items of Work shown on drawings and not specified or mentioned in the specifications and not shown on the drawings, shall be considered required as if they had been both specified and shown on the Drawings.
6. Imperative style, where used herein, shall imply the phrase "The Electrical Contractor Shall" precedes action verbs.
7. When record drawings are provided with the contract drawing set, they constitute the best available information pertaining to the relevant systems at

the time of design. Their accuracy is specifically not guaranteed and they are provided only for the Electrical Contractor's convenience. It is the Electrical Contractor's responsibility to field-verify the content of record drawings against actual field conditions prior to use.

B. Definitions

1. Provide: Furnish and install complete and ready for intended use.

1.03 GENERAL DESCRIPTION OF WORK

A. The Electrical Contractor shall provide all labor, material, tools, equipment and services required to complete the furnishing, installation, wiring, connection, calibration, adjustment, testing and operation of all electrical equipment, devices and components as indicated and implied by the plans and these Specifications.

1. Complete the procurement, installation, wiring, connection, calibration, adjustment, testing and operation of all electrical devices, components, accessories and equipment that is not shown or specified but which is nonetheless required to make the systems shown and specified function properly.
2. Complete the wiring to, connection to, adjustment and calibration of, and testing of furnished electrical components.
3. Install all equipment so it shall be readily accessible for maintenance. Installations shall have electrical clearances in accordance with NEC and shall be installed in locations that will provide adequate cooling.
4. Check electrical equipment prior to installation so that defective equipment is not installed.
5. Provide field services of qualified technicians to supervise and check out the installation of the equipment, to supervise and check out interconnecting wiring, to conduct start-up of operation of the equipment, and to correct any problems that occur during start-up.
6. Obtain and pay for Permits, licenses, approvals and other similar arrangements for work on this project as outlined in the "General Conditions of the Contract for Construction".

1.04 PROJECT DESCRIPTION

A. General

1. In general, the project shall consist of all electrical, control, and telemetry construction required to make a complete and operating system. Refer to 1.02 Summary above.

1.05 TEMPORARY OPERATION AND CONSTRUCTION POWER

- A. Provide temporary power as required for construction as indicated in “General Conditions of the Contract for Construction”.

1.06 THERMAL (TEMPERATURE) RATINGS OF EQUIPMENT TERMINATIONS

- A. Conform to the National Electrical Code Article 110-14C.
- B. Wiring and circuit breakers on this project are designed for 75°C operation above 100 amperes; 60°C for 100 amperes and below.
- C. Furnish products with electrical terminations rated 60°C minimum for 100 amperes and below; rated for 75°C minimum for ampacities above 100 amperes. Selected equipment may require terminations with higher ratings as specified and as otherwise required by Georgia-Pacific Engineering Standards.
- D. These requirements cover all electrical equipment provided under this Contract.

1.07 STANDARDS AND CODES

- A. References: This section contains references to the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
 - 1. National Electrical Code (NEC)
 - 2. Underwriters' Laboratories, Inc. (UL)
 - 3. National Electrical Manufacturers Association (NEMA)
 - 4. Canadian Standards Association (CSA)
 - 5. Electrical Testing Laboratories (ETL)
 - 6. Factory Mutual (FM)
 - 7. Referenced codes and standards in Georgia Pacific Engineering Standards Document EL12111-001 – Electrical Installation, General
- B. Identification of Listed Products
 - 1. All materials and equipment specified herein shall be approved by Underwriters Laboratory (UL) for the purpose for which they are used and shall bear the UL listing label.
 - 2. When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority to undergo a special inspection at the manufacturer’s place of assembly. All

costs and expenses incurred for such inspections shall be included in the original contract price.

1.08 AREA CLASSIFICATIONS

A. The following classification of areas shall be used as a reference in determining application of material covered by this Section unless specifically shown otherwise on the drawings. Areas that fall under two or more of the following classifications shall conform to the minimum requirements of all of the area classifications listed for that area.

1. Outdoor and Damp Areas: Vaults, all outdoor areas

- a. Raceways shall be PVC coated aluminum. Conduit entrances shall be threaded and fittings shall have gasketed covers. Threaded fastening hardware and rods shall be 316 stainless steel. Raceway supports such as channel, clamps, and brackets shall be 316 stainless steel or aluminum. Raceways shall be terminated with grounding bushings and sealed with nonhardening electricians putty to a depth of 1 inch into conduit.
- b. Panels, boxes, and enclosures shall be NEMA 4X - 316 stainless steel. Enclosures shall be mounted 1 inch from walls to provide an air space unless specifically shown otherwise. Device boxes shall be 316 stainless steel.

2. Below Grade Areas:

- a. Conduits shall be Schedule 80 PVC. Conduits shall be sealed with nonhardening electricians putty to a depth of 1 inch into conduit.

3. General Purpose Areas: All other areas not described above.

- a. Raceways shall be aluminum.
- b. Exposed boxes shall be NEMA 4 316 stainless steel.

1.09 ELECTRICAL SUBMITTALS

- A. All submittals for electrical are to be submitted at one time. Partial submittals will be returned without review. No additional contract time or cost will be allowed or considered for failure to follow this instruction.
- B. Submit materials in electronic format for review.
- C. Submit one hard paper copy for selected materials and assemblies as specified in technical sections.

- D. Include completed Owner-required transmittals, Technical datasheets, and Drawing and Document Requirement Forms for inclusion with submittal data for selected systems as outlined in individual Georgia-Pacific Engineering Standards documents.
- E. Submit for; approval, construction, as-shipped and record drawings as applicable to systems or assembly, and as required by Georgia-Pacific Engineering Standards.
- F. Where submittal requirements are not specifically outlined in Engineering Standards, at minimum provide the following:
 - 1. Coversheet indicating individual products included in the submittal package.
 - 2. List of proposed materials with complete part ordering numbers and options.
 - 3. Product datasheets for individual materials indicating applicable code compliance, listing and labeling information, physical dimensions and material construction, description of operation and performance, electrical characteristics, capacities, working and servicing clearances, mounting provisions, and other pertinent information necessary to determine suitability for the intended application based on conditions of service.

1.10 PROJECT RECORD DRAWINGS

- A. The Electrical Contractor shall maintain one set of record drawings at the job showing any deviations in the electrical systems from the original design. Updated RECORD DRAWINGS shall be brought to the weekly project review meetings for review by the owner and Engineer of Record.
- B. Markings shown on the drawings shall conform with the following color coding (marked with pencil):
 - 1. Red - Additions, changes in routing, etc., showing placement different than shown on the original drawings
 - 2. Green - Deletions, modifications in routings etc., deleting lines depicting placements different than shown on the original drawing
 - 3. Black - Dimensional data showing exact placement of concealed or buried equipment, raceways, etc.

1.11 GUARANTEE

- A. As required by Contract.

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIALS

- A. General

1. Equipment and materials shall be new and free from defects. All material and equipment of the same or a similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.
 2. Deliver equipment to site in original containers, and store in a manner that protects materials from deterioration or damage.
- B. Equipment Finish
1. Unless otherwise specified, electrical equipment and materials shall be painted by the manufacturer.
- C. Galvanizing
1. Factory-apply hot-dip zinc galvanic coating CLASS III to items indicated as “galvanized” unless otherwise noted.

2.02 OPERATION AND MAINTENANCE MANUALS

1. Provide materials for Operation and Maintenance. Materials shall show complete point to point wiring, recommended spares, and all part numbers and manufacturers.

PART 3 - EXECUTION

3.01 GENERAL

- A. Storage and Installation Environment
1. The Electrical Contractor shall store all electrical equipment in a dry environment free from dust, moisture, sprays or vapors which may be detrimental to their new condition. After installation of equipment, the Electrical Contractor shall take care to protect all equipment from all dust, moisture, paint and other spray, harmful vapors.
 2. Equipment with integral heaters and fans shall not be installed until power is available at the location, and the heater and fan shall be energized within 6 hours of the equipment being installed.
- B. Housekeeping
1. Areas shall be kept neat and clean. At the end of each daily shift all unused materials shall be stored in locked storage and all debris generated shall be picked up and removed from the Plant Site.

3.02 TESTS

- A. The Electrical Contractor shall conduct testing in accordance with applicable OUC Engineering Standards.

3.03 FINAL ACCEPTANCE

- A. Prior to final acceptance, the Engineer will perform one or more site observation trips to develop a "punch list" of items deemed incomplete. The Electrical Contractor and Control System Integrator shall be present while these inspections are taking place and shall be available for opening cabinets and operating and adjusting the system as is necessary for the Engineer to verify all equipment is installed and operates to the requirements of the contract documents.
- B. The Electrical Contractor shall complete all items of work, including wire markers, nameplates, final tests and final test reports prior to requesting final acceptance inspections. All equipment shall be checked for proper operation and all signals verified for correct calibration and wiring. Fixtures shall have been cleaned and burned out or defective lamps shall have been replaced.

3.04 TRAINING

- A. Electrician and integrator shall provide individual training sessions for plant personnel. Sessions shall include a 1 hour classroom power point presentation pointing out all relevant information regarding system layouts, naming conventions, cable routings, system operations, etc.
- B. Each Power Point shall be submitted 4 weeks prior to lecture date. Contractor is responsible for coordinating lecture date and providing hard copies of the lecture material to follow along with the power point.
- C. Following each power point presentation, the contractor shall conduct a 2 hour field presentation walking through all the controls, device locations, power shutoff locations, etc., to be followed by a 1 hour question and answer session.

END OF SECTION

SECTION 16060

GROUNDING AND BONDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes: Grounding systems and equipment.
- B. Section includes grounding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Instrumentation grounding.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For qualified testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:

1. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.
 - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - b. Include recommended testing intervals.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA, Underwriters Laboratory or Factory Mutual.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, soft-drawn copper.
2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.

2.02 CONNECTORS

- A. Listed and labeled by Underwriters Laboratory of Factory Mutual for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.03 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch in diameter by 10 feet. Provide listed unions for ground rods over 10'0" in length as called for in plans.

2.04 TEST WELLS

- A. Test wells shall be cast iron with cast iron lids.

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 6 AWG and smaller, and stranded conductors for No. 4 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum or as indicated on plans
 1. Bury at least 24 inches below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation and bond to control panel ground counterpoise at each end of duct bank

- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
 - 5. Connections to enclosures: Mechanical minimum of two fasteners.
- E. Metallic conduits shall be terminated with grounding bushings and grounded to all pull boxes and enclosures.

3.02 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.03 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
 2. Receptacle circuits.
 3. Single-phase motor and appliance branch circuits.
 4. Three-phase motor and appliance branch circuits.
 5. Flexible raceway runs.
- C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- E. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
1. For data and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 2. Service and Central Equipment Locations: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- F. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.04 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole and shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

- G. Ground Ring: Install a grounding conductor, electrically connected to each concrete pad structure ground rod and to each indicated item, extending around the perimeter of area or item indicated.
 - 1. Install copper conductor not less than No. 2/0 AWG for ground ring.
 - 2. Bury ground ring not less than 24 inches from equipment slabs and foundations.

3.05 LABELING

- A. Comply with requirements in Section 16075 "Electrical Identification" for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor, grounding equalizer and at the grounding electrode conductor where exposed.
 - 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include

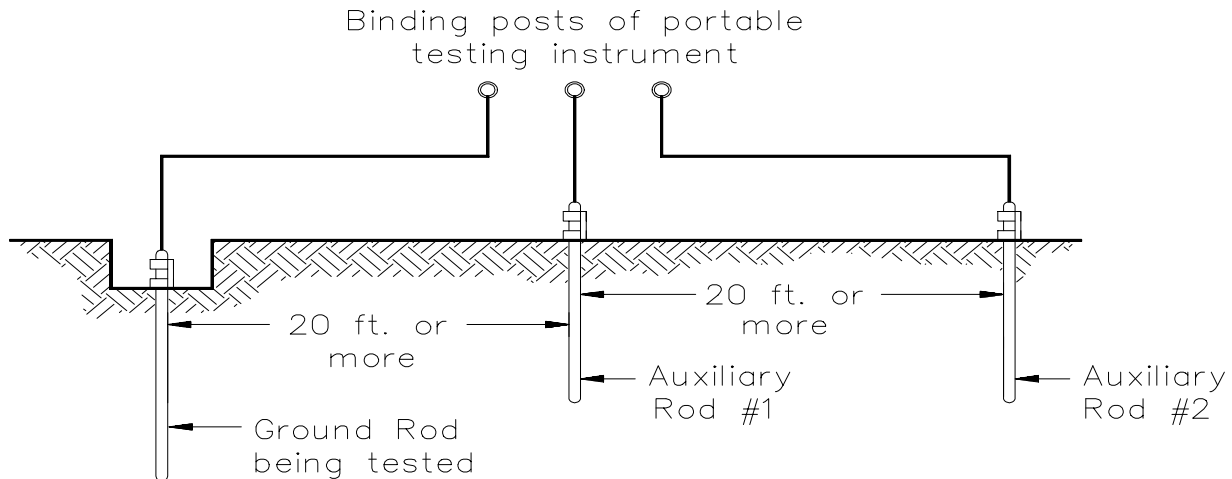
observations of weather and other phenomena that may affect test results.
Describe measures taken to improve test results.

- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
 - 1. See electrical ground rod test report at the end of this section.
- E. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 - 3. Pad-Mounted Equipment: 5 ohms.
 - 4. Manhole/handhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

ATTACHMENT: GROUND ROD TEST REPORT

16060 - ELECTRICAL GROUND ROD TEST REPORT



GROUND ROD RESISTANCE TESTING

PROCEDURE:

To measure ground resistance, two additional temporary grounds, consisting of short rods 2 or 3 ft long, shall be driven in the ground at least 20 ft. away from the rod being tested. A direct-reading ground resistance tester shall then be connected to the three ground rods by means of insulated leads. The battery operated ground resistance tester reads the resistance of the ground rod being tested directly in ohms. The ground rod location / designation and its measured ohm value shall be recorded in chart below.

GROUND ROD LOCATION / DESIGNATION	OHM VALUE
1.	*
2.	*
3.	*
COMPOSITE GROUND	*

* Ohm value of a single ground rod shall not exceed 15 Ohms. If additional ground rod(s) are added, the "composite" ground electrode shall have a maximum acceptable reading of 15 Ohms which shall be recorded in chart above.

SECTION 16070
SUPPORTING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.02 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01, Shop Drawings and Submittals, covering the items included under this Section. Shop Drawing submittals shall include:
 - 1. Product Data for each type of product specified.

1.03 QUALITY ASSURANCE

- A. Electrical components shall be listed and labeled by UL, ETL, CSA, or FM.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
 - 1. Slotted Metal Angle and U-Channel Systems:
 - a. Allied Tube & Conduit.
 - b. American Electric.
 - c. B-Line Systems, Inc.
 - 2. Conduit Sealing Bushings:
 - a. Bridgeport Fittings, Inc.
 - b. Elliott Electric Mfg. Corp.
 - c. Spring City Electrical Mfg. Co.

2.02 COATINGS

- A. Coating: Supports, support hardware, and fasteners for interior, non-corrosive locations shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material

characteristic. Products for use outdoors, in NEMA 4 areas, corrosive areas, wash-down areas, or embedded in concrete shall be 316 stainless steel.

2.03 MANUFACTURED SUPPORTING DEVICES

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. Fasteners. Types, materials, and construction features as follows:
 - 1. Expansion Anchors: 316 stainless steel.
 - 2. Toggle Bolts: 316 stainless steel.
 - 3. Hanger Rods: 0.375-inch diameter 316 stainless steel.
- C. Conduit Sealing Bushings: Factory fabricated, watertight conduit sealing bushing assemblies suitable for sealing around conduit or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
- D. Cable Supports for Vertical Conduit: Factory fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable iron casting with hot-dip galvanized finish.
- E. U-Channel Systems: 12 gauge or 0.105-inch-thick 316 stainless steel channels, with 9/16- inch-diameter holes, at a minimum of 8 inches on center in top surface. Provide fittings and accessories that mate and match with U-channel and are of same manufacturer.

2.04 FABRICATED SUPPORTING DEVICES

- A. Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. 316 stainless steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.03 SUBMITTALS

- A. Product Data: For each electrical identification product indicated below.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.04 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.05 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project. Identification on plan drawings are not the final OUC equipment identifiers. Coordinate with OUC for final equipment designation.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch-wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- G. Write-On Tags: Polyester tag, 0.015-inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- F. Write-On Tags: Polyester tag, 0.015-inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- G. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- H. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.03 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-

resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Write-On Tags: Polyester tag, 0.015-inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

2.04 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines. Tape shall be detectable nonferrous type.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Construction:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft.
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.05 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.06 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16-inch thick for signs up to 20 sq. inches and 1/8-inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.07 EQUIPMENT IDENTIFICATION LABELS

- A. Provide engraved phenolic tags, coordinate lettering and background colors with OUC plant personnel, on all panels, cabinets, boxes, enclosures, etc.
 - 1. Minimum 5/16" lettering
 - 2. Secure with 316 stainless steel screws or stainless-steel rivets.

2.08 CABLE TIES

- A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.
- B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F.
 - 5. Color: Black.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Verify identity of each item before installing identification products.

- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

- b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- B. Install instructional sign including the color code for grounded and ungrounded conductors using adhesive-film-type labels.
 - C. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.
 - D. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.
 - E. Conductors to be extended in the Future: Attach write-on tags to conductors and list source.
 - F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
 - G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for cables in raceway.

- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
- J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 - 2. Equipment to Be Labeled:
 - a. Panelboards.
 - b. Enclosures and electrical cabinets.
 - c. Switchboards.
 - d. Enclosed controllers.
 - e. Push-button stations.
 - f. Contactors.
 - g. Monitoring and control equipment.
 - h. UPS equipment.

END OF SECTION

SECTION 16082

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
 - a. D877, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
 - b. D923, Standard Practice for Sampling Electrical Insulating Liquids.
 - c. D924, Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
 - d. D971, Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
 - e. D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration.
 - f. D1298, Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
 - g. D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
 - h. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field.
 - i. D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
 - j. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes.
2. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.

- b. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - c. C2, National Electrical Safety Code.
- 3. National Electrical Manufacturers Association (NEMA):
 - a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
 - b. PB 2, Deadfront Distribution Switchboards.
- 4. InterNational Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70B, Recommended Practice for Electrical Equipment Maintenance.
 - c. 70E, Standard for Electrical Safety in the Workplace.
 - d. 101, Life Safety Code.
- 6. National Institute for Certification in Engineering Technologies (NICET).
- 7. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.02 SUBMITTALS

A. Submittals:

- 1. Submit 30 days prior to performing inspections or tests:
 - a. Schedule for performing inspection and tests.
 - b. Sample copy of equipment inspection form(s).
 - c. Sample copy of individual device test form.
- 2. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test:
- 3. Operation and Maintenance Data:
 - a. In accordance with Section 16010, Operation and Maintenance Data.

- b. After test or inspection reports and certificates have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.

1.03 QUALITY ASSURANCE

A. Testing Firm Qualifications:

1. Corporately and financially independent organization functioning as an unbiased testing authority.
2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
4. Registered Professional Engineer to provide comprehensive Project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
5. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories.

- B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.

- C. Test instrument calibration shall be in accordance with NETA ATS.

1.04 SEQUENCING AND SCHEDULING

- A. Perform inspection and electrical tests after equipment listed herein has been installed.
- B. Perform tests with apparatus de-energized whenever feasible.
- C. Inspection and electrical tests on energized equipment shall be:
 1. Scheduled with Owner prior to de-energization.
 2. Minimized to avoid extended period of interruption to the operating plant equipment.
- D. Notify Owner at least 24 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Perform tests in accordance with specifications, plans and industry accepted standards.
- B. Tests and inspections shall establish:
 - 1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
 - 2. Installation operates properly.
 - 3. Equipment is suitable for energization.
 - 4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.
- C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
- D. Set, test, and calibrate, circuit breakers, power monitoring meters, and other applicable devices in accordance with values established by short circuit, coordination, and harmonics studies as specified in Section 26 05 73, Overcurrent Protective Device Coordination Study.
- E. Adjust mechanisms and moving parts of equipment for free mechanical movement.
- F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- G. Verify nameplate data for conformance to Contract Documents and approved Submittals.
- H. Realign equipment not properly aligned and correct unlevelness.
- I. Properly anchor electrical equipment found to be inadequately anchored.
- J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.
- K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- L. Provide proper lubrication of applicable moving parts.
- M. Inform Engineer of working clearances not in accordance with NFPA 70.

N. Investigate and repair or replace:

1. Electrical items that fail tests.
2. Active components not operating in accordance with manufacturer's instructions.
3. Damaged electrical equipment.

O. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.
4. Repair or replace, as determined by Engineer door and panel sections having dented surfaces.
5. Repair or replace, as determined by Engineer poor fitting doors and panel sections.
6. Repair or replace improperly operating latching, locking, or interlocking devices.
7. Replace missing or damaged hardware.
8. Finish:
 - a. Provide matching paint and touch up scratches and mars.
 - b. If required due to extensive damage, as determined by Engineer, refinish entire assembly.

P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

3.02 CHECKOUT AND STARTUP

A. Voltage Field Test:

1. Check voltage at service disconnects at Thickening Building and RAS pump station when installation is essentially complete and is in operation.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
3. Record supply voltage (all three phases simultaneously on same graph) for 24 hours during normal working day.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.
2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
3. If phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.03 PANELBOARDS

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
5. Perform visual and mechanical inspection for overcurrent protective devices.

B. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Each phase of each bus section.
 - c. Phase-to-phase and phase-to-ground for 1 minute.
 - d. With breakers open.
 - e. With breakers closed.
 - f. Control wiring except that connected to solid state components.
 - g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

2. Ground continuity test ground bus to system ground.

3.04 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Physical and insulator damage.
2. Proper winding connections.
3. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
4. Defective wiring.
5. Proper operation of fans, indicators, and auxiliary devices.
6. Removal of shipping brackets, fixtures, or bracing.
7. Free and properly installed resilient mounts.
8. Cleanliness and improper blockage of ventilation passages.
9. Verify tap-changer is set at correct ratio for rated output voltage under normal operating conditions.
10. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.5 for each:
 - 1) Winding-to-winding.
 - 2) Winding-to-ground.
 - b. Test Duration: 10 minutes with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
 - c. Results temperature corrected in accordance with NETA ATS, Table 100.14.
 - d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

- e. Insulation resistance test results to compare within 1 percent of adjacent windings.

3.05 LIQUID FILLED TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Physical and insulator damage.
2. Proper winding connections.
3. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
4. Defective wiring.
5. Proper operation of fans, indicators, and auxiliary devices.
6. Effective core and equipment grounding.
7. Removal of shipping brackets, fixtures, or bracing.
8. Tank leaks and proper liquid level.
9. Integrity and contamination of bus insulation system.
10. Verify tap-changer is set at correct ratio for rated voltage under normal operating conditions.
11. Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.5 for each:
 - 1) Winding-to-winding.
 - 2) Winding-to-ground.
 - b. Test Duration: 10 minutes with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
 - c. Results temperature corrected in accordance with NETA ATS, Table 100.14.

- d. Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
- e. Insulation resistance test results to compare within 1 percent of adjacent windings.

3.06 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

- 1. Inspect each individual exposed power cable No. 1/0 and larger for:
 - a. Physical damage.
 - b. Proper connections in accordance with single-line diagram.
 - c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
 - d. Color coding conformance with specification.
 - e. Proper circuit identification.
- 2. Mechanical Connections For:
 - a. Proper lug type for conductor material.
 - b. Proper lug installation.
 - c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
- 3. Shielded Instrumentation Cables For:
 - a. Proper shield grounding.
 - b. Proper terminations.
 - c. Proper circuit identification.
- 4. Control Cables For:
 - a. Proper termination.
 - b. Proper circuit identification.
- 5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 4/0 and Larger:

1. Insulation Resistance Tests:

- a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors
- b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
- c. Evaluate ohmic values by comparison with conductors of same length and type.
- d. Investigate values less than 50 megohms.

2. Continuity test by ohmmeter method to ensure proper cable connections.

C. Low-voltage cable tests may be performed by installer in lieu of independent testing firm.

3.07 MEDIUM-VOLTAGE CABLES, 5 KV and 15 KV MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed cable for:

- a. Physical damage plus jacket and insulation condition.
- b. Proper connections in accordance with single-line diagram or approved Submittals.
- c. Proper shield grounding.
- d. Proper cable support.
- e. Proper cable termination.
- f. Cable bends not in conformance with manufacturer's minimum allowable bending radius.
- g. Proper arc and fireproofing in common cable areas.
- h. Proper circuit and phase identification.

2. Mechanical Connections:

- a. Proper lug type for conductor material.
- b. Proper lug installation.

- c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturers.
 - 3. Conductors Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.
- B. Electrical Tests:
- 1. Insulation Resistance Tests:
 - a. Utilize 5,000-volt and 15,000-volt megohmmeter for 5 kV and 15 kV conductors.
 - b. Test each cable individually with remaining cables and shields grounded.
 - c. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
 - d. Evaluate ohmic values by comparison with conductors of same length and type.
 - e. Investigate values less than 50 megohms.
 - 2. Shield Continuity Tests:
 - a. By ohmmeter method on each section of conductor.
 - b. Investigate values in excess of 10 ohms per 1,000 feet of conductors.
 - 3. Acceptance Tests:
 - a. In accordance with IEEE 400, ICEA S-93-639, NEMA WC 74, ICEA S-94-649, and ICEA S-97-682 for insulated conductors.
 - b. Each conductor section tested with:
 - 1) Splices and terminations in place but disconnected from equipment.
 - 2) Remaining conductors and shields grounded in accordance with IEEE 400.
 - c. Apply maximum test voltage per NETA ATS, Table 100.6, based on method (DC, AC, PD or VLF) used.
 - d. Measure only leakage current associated with conductor.
 - e. Utilize guard ring or field reduction sphere to suppress corona at disconnected terminations.

- f. Maximum test voltage shall not exceed limits for terminators specified in IEEE 48, IEEE 386, or manufacturer's specifications.
- g. Apply test voltage in a minimum of five equal increments until maximum acceptable test voltage is reached.
 - 1) Increments not to exceed ac voltage rating of conductor.
 - 2) Record dc leakage current at each step after a constant stabilization time consistent with system charging current.
- h. Raise conductor to specified maximum test voltage and hold for 15 minutes or as specified by conductor manufacturer. Record leakage current at 30 seconds and 1 minute, and at 1-minute intervals, thereafter.
- i. Immediately following test, ground conductor for adequate time period to drain insulation stored charge.
- j. Test results evaluated on a pass/fail basis.

3.08 SAFETY SWITCHES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

- 1. Proper blade pressure and alignment.
- 2. Proper operation of switch operating handle.
- 3. Adequate mechanical support for each fuse.
- 4. Proper contact-to-contact tightness between fuse clip and fuse.
- 5. Cable connection bolt torque level in accordance with NETA ATS, Table 100.12.
- 6. Proper phase barrier material and installation.
- 7. Verify fuse sizes and types correspond to one-line diagram or approved Submittals.
- 8. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

3.09 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

- A. General: Inspection and testing limited to circuit breakers rated 100 amperes and larger and to motor circuit protector breakers rated 100 amperes and larger.
- B. Visual and Mechanical Inspection:

1. Proper mounting.
2. Proper conductor size.
3. Feeder designation according to nameplate and one-line diagram.
4. Cracked casings.
5. Connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Operate breaker to verify smooth operation.
7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.

C. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 480-volt and 600-volt circuit breakers.
 - b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
 - c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
 - d. Test values to comply with NETA ATS, Table 100.1.
2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.
3. Primary Current Injection Test to Verify:
 - a. Breaker adjustable settings shall be provided by Engineer.
 - b. Long-time minimum pickup and delay.
 - c. Short-time pickup and delay.
 - d. Ground fault pickup and delay.
 - e. Instantaneous pickup by run-up or pulse method.

- f. Trip characteristics of adjustable trip breakers shall be within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
- g. Trip times shall be within limits established by NEMA AB 4, Table 5-3. Alternatively, use NETA ATS, Table 100.7.
- h. Instantaneous pickup value shall be within values established by NEMA AB 4, Table 5-4. Alternatively, use NETA ATS, Table 100.8.

3.10 METERING

A. Visual and Mechanical Inspection:

- 1. Verify meter connections in accordance with appropriate diagrams.
- 2. Verify meter multipliers.
- 3. Verify meter types and scales conform to Contract Documents.
- 4. Check calibration of meters at cardinal points.
- 5. Check calibration of electrical transducers.

3.11 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

- 1. Equipment and circuit grounds in motor control center, and panelboard assemblies for proper connection and tightness.
- 2. Ground bus connections in motor control center, assemblies for proper termination and tightness.
- 3. Effective transformer core and equipment grounding.
- 4. Accessible connections to grounding electrodes for proper fit and tightness.
- 5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

- 1. Fall-of-Potential Test:
 - a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
 - b. Main ground electrode system resistance to ground to be no greater than 5 ohm(s).

2. Two-Point Direct Method Test:

- a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
- b. Equipment ground resistance shall not exceed main ground system resistance by 0.50 ohm.

3.12 GROUND FAULT SYSTEMS

A. Inspection and testing limited to:

1. Zero sequence grounding systems.
2. Residual ground fault systems.

B. Visual and Manual Inspection:

1. Neutral main bonding connection to ensure:
 - a. Zero sequence sensing system is grounded ahead of neutral disconnect link.
 - b. Ground strap sensing system is grounded through sensing device.
 - c. Neutral ground conductor is solidly grounded.
2. Verify control power has adequate capacity for system.
3. Manually operate monitor panels for:
 - a. Trip test.
 - b. No trip test.
 - c. Nonautomatic rest.
4. Zero sequence system for symmetrical alignment of core balance transformers about current carrying conductors.
5. Relay check for pickup and time under simulated ground fault conditions.
6. Verify nameplate identification by device operation.

C. Electrical Tests:

1. Test system neutral insulation resistance with neutral ground link removed; minimum 1 megohm.

2. Determine relay pickup by primary current injection at the sensor. Relay pickup current within plus or minus 10 percent of device dial or fixed setting.
3. Test relay timing by injecting 300 percent of pick-up current or as specified by manufacturer. Relay operating time in accordance with manufacturer's time-current characteristic curves.
4. Test system operation at 55 percent rated control voltage, if applicable.
5. Test zone interlock system by simultaneous sensor current injection and monitoring zone blocking functions.

3.13 AC INDUCTION MOTORS

- A. General: Inspection and testing limited to motors rated 10 horsepower and larger.
- B. Visual and Mechanical Inspection:
 1. Proper electrical and grounding connections.
 2. Shaft alignment.
 3. Blockage of ventilating air passageways.
 4. Operate motor and check for:
 - a. Excessive mechanical and electrical noise.
 - b. Overheating.
 - c. Correct rotation.
 - d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionability and proper operation.
 - e. Excessive vibration, in excess of values in NETA ATS, Table 100.10.
 5. Check operation of space heaters.
- C. Electrical Tests:
 1. Insulation Resistance Tests:
 - a. All motors greater than 10hp shall be tested.
 - b. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 100.1 for:
 - 1) Motors above 200 horsepower for 10-minute duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.

- 2) Motors 200 horsepower and less for 1-minute duration with resistances tabulated at 30 seconds and 60 seconds.
- c. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.
2. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.
3. Measure running current and voltage and evaluate relative to load conditions and nameplate full-load amperes.

3.14 LOW-VOLTAGE MOTOR CONTROL

A. Visual and Mechanical Inspection:

1. Proper barrier and shutter installation and operation.
2. Proper operation of indicating and monitoring devices.
3. Proper overload protection for each motor.
4. Improper blockage of air-cooling passages.
5. Proper operation of drawout elements.
6. Integrity and contamination of bus insulation system.
7. Check door and device interlocking system by:
 - a. Closure attempt of device when door is in OPEN position.
 - b. Opening attempt of door when device is in ON position.
8. Check key interlocking systems for:
 - a. Key captivity when device is in ON position.
 - b. Key removal when device is in OFF position.
 - c. Closure attempt of device when key has been removed.
 - d. Correct number of keys in relationship to number of lock cylinders.
 - e. Existence of other keys capable of operating lock cylinders; destroy duplicate sets of keys.
9. Check nameplates for proper identification of:
 - a. Equipment title and tag number with latest one-line diagram.

10. Verify fuse and circuit breaker sizes and types conform to Contract Documents.
11. Verify current and potential transformer ratios conform to Contract Documents.
12. Check bus connections for high resistance by low-resistance ohmmeter: Ohmic value to be zero.
13. Check operation and sequencing of electrical and mechanical interlock systems by:
 - a. Closure attempt for locked open devices.
 - b. Opening attempt for locked closed devices.
 - c. Key exchange to operate devices in OFF-NORMAL positions.
14. Verify performance of each control device and feature furnished as part of motor control center.
15. Control Wiring:
 - a. Compare wiring to local and remote control, and protective devices with elementary diagrams.
 - b. Check for proper conductor lacing and bundling.
 - c. Check for proper conductor identification.
 - d. Check for proper conductor lugs and connections.
16. Exercise active components.
17. Inspect contactors for:
 - a. Correct mechanical operations.
 - b. Correct contact gap, wipe, alignment, and pressure.
 - c. Correct torque of connections.
18. Compare overload heater rating with full-load current for proper size.
19. Compare motor protector with motor characteristics for proper size.

B. Electrical Tests:

1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.

- b. Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.
 - c. Contactor phase-to-ground and across open contacts for 1 minute on each phase.
 - d. Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.
 - e. Test values to comply with NETA ATS, Table 100.1.
- 2. Current Injection through Overload Unit at 300 Percent of Motor Full- Load Current and Monitor Trip Time:
 - a. Trip time in accordance with manufacturer's published data.
 - b. Investigate values in excess of 120 seconds.
- 3. Control Wiring Tests:
 - a. Apply secondary voltage to control power and potential circuits.
 - b. Check voltage levels at each point on terminal board and each device terminal.
 - c. Insulation resistance test at 1,000 volts dc on control wiring, except that connected to solid state components; 1 megohm minimum insulation resistance.
- 4. Operational test by initiating control devices to affect proper operation.

3.15 AUTOMATIC TRANSFER SWITCHES

- A. Visual and Mechanical Inspection:
 - 1. Check doors and panels for proper interlocking.
 - 2. Check connections for high resistance by low-resistance ohmmeter.
 - 3. Check positive mechanical and electrical interlock between normal and alternate sources.
 - 4. Check for proper operation:
 - a. Manual transfer function switch.
 - b. Generator under load and nonload conditions.
 - c. Auto-exerciser of generator under load and no-load conditions.

5. Verify settings and operation of control devices.
- B. Electrical Tests:
1. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1, for each phase with switch CLOSED in both source positions.
 - b. Phase-to-phase and phase-to-ground for 1 minute.
 - c. Test values in accordance with manufacturer's published data.
 2. Contact Resistance Test:
 - a. Contact resistance in microhms across each switch blade for both source positions.
 - b. Investigate values exceeding 500 micro-ohms.
 - c. Investigate values deviating from adjacent pole by more than 50 percent.
 3. Set and calibrate in accordance with Specifications, manufacturer's recommendations, and information provided by Engineer.
 - a. Voltage and frequency sensing relays.
 - b. Time delay relays.
 - c. Engine start and shutdown relays.
 4. Perform automatic transfer tests by:
 - a. Simulating loss of normal power.
 - b. Return to normal power.
 - c. Simulating loss of alternate power.
 - d. Simulating single-phase conditions for normal and alternate sources.
 5. Monitor and verify operation and timing of:
 - a. Normal and alternate voltage sensing relays.
 - b. Engine-start sequence.
 - c. Timing delay upon transfer and retransfer.

- d. Engine cool down and shutdown.
- e. Interlocks and limit switch functions.
- f. Engine cool down and shutdown feature.

3.16 LOW VOLTAGE SURGE ARRESTORS

A. Visual and Mechanical Inspection:

- 1. Adequate clearances between arrestors and enclosures.
- 2. Ground connections to ground bus.

B. Electrical Tests:

1. Varistor Type Arrestors:

- a. Clamping voltage test.
- b. Rated RMS voltage test.
- c. Rated dc voltage test.
- d. Varistor arrestor test values in accordance with IEEE C62.33, Section 4.4 and Section 4.9.

3.17 MEDIUM-VOLTAGE SURGE ARRESTORS AND SURGE CAPACITORS

A. Visual Inspection:

- 1. Ground connections to ground electrode.
- 2. Shortest practical jumper connections to line.

B. Electrical Tests:

- 1. Grounding electrode resistance test in accordance with IEEE 81, Section 8.2.1.5 using three-point fall-of-potential method.
- 2. Insulation power factor.
- 3. Insulation resistance.
- 4. RF noise test using Stoddart noise test set with applied voltage of 1.18 times maximum continuous operating voltage.
- 5. Insulation power factor leakage current, watts loss, and insulation resistance test in accordance with manufacturer's test values. RIV value not to exceed 10 microvolts above background noise.

6. Leakage current and watts loss tests.

END OF SECTION

SECTION 16110

RACEWAYS, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This section specifies raceways for electrical conductors including fittings and supports. Raceways shall be provided for power, control, instrumentation, grounding, lighting, receptacles, and signaling systems. Raceways consist of conduits, tubing, and tray systems. For the purpose of this specification, conduit and tubing is described collectively as conduit.

1.03 STANDARDS AND CODES

- A. All materials and equipment specified herein shall be within the scope of Nationally Recognized Testing Laboratory (NRTL) examination services, be approved by the NRTL for the purpose for which they are used, and shall bear the appropriate listing label.
- B. Materials shall be UL, FM or CSA labeled.
- C. When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority to undergo a special inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price.

1.04 SUBMITTALS

- A. The Electrical Contractor shall submit catalog data showing material information and conformance with Specifications in accordance with the "Submittals" requirements of section 16010.
- B. Conduit routing and layout plan, under no circumstance shall conduit be allowed to run horizontal across slabs or grade causing a trip hazard.

PART 2 - PRODUCTS

2.01 GENERAL

A. Material

1. All materials shall be new, free from defects, of current manufacture, of quality specified or shown. Each type of material shall be of the same manufacturer throughout the work.

B. Unscheduled Raceway

1. With the exception of lighting, communication, paging, security and receptacle circuits, the type and size of raceway shall be as specified on the drawings or schedules. Lighting and receptacle raceway are unscheduled and shall be sized by the Electrical Contractor in accordance with the NEC. Minimum size shall be 3/4 inch for exposed and 1 inch for embedded raceway.

C. Scheduled Raceway

1. The size of raceway shall be as specified on the drawings or schedules, with type as applicable for specific environment and application use.

2.02 RACEWAY

A. Application:

1. All conduits shall be PVC or rigid PVC coated aluminum, unless otherwise noted.
2. All connections to vibrating equipment or motors shall be liquidtight flexible metallic conduit.
3. Underground power, control and telephone conduits shall be schedule 80 PVC or concrete encased schedule 40 PVC. All sweeps and risers for transition from below grade to above grade shall be rigid PVC coated aluminum, unless indicated otherwise.
4. All elbows shall be factory long sweep 90's, no field bends.
5. All conduits above grade shall be PVC coated aluminum or 316 stainless steel.

B. Miscellaneous Fittings

1. Conduit unions shall be T&B Company, watertight Erickson aluminum or stainless steel couplings.
2. Fittings for plastic coated, flexible conduit shall be Appleton Electric Company, Type "STB" or equal.
3. Condulet sealing fittings shall be Crouse-Hinds Type EYS or EZS or equal.

4. Conduit Tests and Inspection. All conduit shall pass the appropriate bending, ductility, impact, and thickness of zinc coating tests.

2.03 CONDUIT & CABLE SUPPORTS

A. Conduit Supports

1. 316 Stainless steel framing channel shall be used to support groups of conduit. Individual conduit supports shall 316 stainless steel. Conduit supports for PVC or epoxy coated rigid aluminum and PVC conduit systems shall be one hole PVC or epoxy coated clamps or PVC conduit wall hangers. Raceways larger than 1-1/2" shall use two-hole straps.

B. Racks

1. Horizontals members of support racks shall be constructed from framing channel. 316 Stainless channels. Channels attached directly to concrete surfaces shall be 14 gauge minimum thickness, 1-5/8 inch deep. Channel section shall be sufficient to limit deflection to 1/360 of span.
2. Vertical members of supports racks shall be concrete or welded aluminum C-channel and base.

2.04 CONDUIT SCHEDULE

- A. Refer to conduit schedule for raceway sizing and routing description.

PART 3 - EXECUTION

3.01 CONDUIT

A. General

1. Conduits shall be planned and laid out below slab. Provide for owner and Engineer of Record review and approval conduit layouts plans indicating routing, location and use of every required conduit run. Under no circumstances shall conduit be allowed to run horizontal across slabs or grade causing a trip hazard.
2. The Electrical Contractor shall limit the number of directional changes of the conduit to a total not more than 270 degrees in any run between pull boxes. Conduit runs shall be limited to 400 feet, less 100 feet or fraction thereof, for every 90 degrees of change in direction. Bends and offsets shall be avoided where possible but, where necessary, shall be made without flattening or kinking, or shall be factory preformed bends. Turns shall be made with case metal fittings or conduit bends. Welding, brazing or otherwise heating of conduit is not acceptable.

3. Where required for pulling cable and as necessary to meet the requirements of the previous Paragraph, the Electrical Contractor shall provide cast junction or pull boxes.
4. Conduit entering metallic boxes or cabinets shall be secured by locknuts on both the interior and exterior of the box or cabinet and shall have an insulating grounding or bonding bushing constructed over the conduit end. Conduit entering all other boxes shall be terminated with a threaded hub. Cast boxes and nonmetallic enclosures shall have threaded hubs. Joints shall be made with standard couplings or threaded unions. Metal parts of nonmetallic boxes and plastic coated boxes shall be bonded to the conduit system. Running threads shall not be used in lieu of conduit nipples, nor shall excessive thread be used on any conduit. The ends of conduit shall be cut square, reamed and threaded with straight threads.
5. Unless otherwise specified, conduit entering field equipment enclosures shall enter the bottom or side of the box.
6. Individual runs of conduit shall be installed to maintain a minimum ¼" air space between conduit and mounting surface.
7. All conduits entering or leaving enclosures shall be sealed to a depth of 1 inch with non-hardening electricians putty.

B. Conduit Penetrations

1. Conduits entering manholes and handholes shall be horizontal. Conduits shall not enter through the concrete bottom of handholes and manholes.
2. Conduits penetrations through manholes and handholes shall use bell-ends properly installed and grouted. Refer to plan details.
3. Wherever conduits enter handholes, vaults, pullboxes or structures below grade, seal the conduit opening (after installation of conductors and cables), with conduit sealing material, to prevent water from entering the structure, enclosure, etc. Sealing compound to be a pliable, removable putty-type compound listed for the application.

C. Conduit Separation

1. Signal conduits shall be separated from AC power or control conduits. The separation shall be a minimum of 12 inches for metallic conduits and 24 inches for nonmetallic conduits.

3.02 RACEWAY NUMBERING

- A. Refer to Section 16075 Electrical Identification.

END OF SECTION

SECTION 16120

WIRE AND CABLE

PART 1 - GENERAL

1.01 SUMMARY

- A. This section specifies conductors and cables rated to 600 volts used for power, lighting, receptacle, signal, and control circuits.

1.02 STANDARDS AND CODES

- A. All materials and equipment specified herein shall be UL, FM or CSA listed and bear the appropriate listing label.
- B. When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority to undergo a special inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price.

1.03 SUBMITTALS

- A. Submit all catalog data in accordance with the Submittals requirements in Section 16010. Show material information and confirm compliance with these specifications.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Conductor sizes shall be as specified on the drawings or schedules.
- B. Conductors shall conform to all applicable ASTM standards.

2.02 BRANCH CIRCUIT CONDUCTORS

- A. Conductors shall be provided with the following characteristics:
 - 1. Voltage: 600 volts.
 - 2. Conductor: Bare soft annealed copper, stranded or solid.
 - 3. Insulation: RHW-2 in duct banks and conduit outside, below grade and damp, wet and corrosive locations.
 - 4. THWN-2/THHN, 90-degree C dry, 75-degree C wet polyvinylchloride (PVC) where circuits remain inside a control panels.
 - 5. Flame resistance: UL 83.

6. Manufacturer: Okonite; Southwire; or equal.

2.03 POWER AND CONTROL CONDUCTORS AND CABLE, 600 VOLT

A. Single Conductor:

1. Single conductor cable shall be stranded and shall be used in conduits for power and control circuits.
2. Conductor shall be provided with the following characteristics:
 - a. Voltage: 600 volts.
 - b. Conductor: Uncoated, soft annealed copper, stranded.
 - c. Insulation: Insulation: RHW-2 in duct banks and conduit outside, below grade and for damp, wet and corrosive locations.
 - d. THWN-2/THHN, 90-degree C dry, 75-degree C wet polyvinylchloride (PVC) allowed where circuits remain inside a control panel.
 - e. Flame resistance: UL 83.
 - f. Manufacturer: Okonite, Southwire; or equal.

B. Multi-conductor:

1. Cable shall be stranded and shall be used in conduits for power and control circuits.

2.04 CONNECTORS

- A. Wing-nut style connectors are not allowed for stranded conductors.

2.05 SPLICE INSULATION

- A. Not allowed.

2.06 WIRING SCHEDULE

- A. Refer to cable schedule for description of conductors required.

2.07 WIRE MARKERS

- A. Refer to Section 16075 – Electrical Identification.

PART 3 - EXECUTION

3.01 GENERAL

- A. Each power and control conductor shall be identified at each terminal to which it is connected.
- B. Pulling wire and cable into conduit or trays shall be completed without damaging or putting undue stress on the cable insulation. Soapstone, talc or UL listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable. Raceway construction shall be complete, cleaned, and protected from the weather before cable is placed in the raceway.

3.02 600 VOLT CONDUCTOR AND CABLE

- A. Conductors in panels and electrical equipment, 6 AWG and smaller, shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing shall be made up with plastic cable ties. Lacing is not necessary in plastic panel wiring duct. Conductors crossing hinges shall be bundled into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.
- B. Slack shall be provided in junction and pull boxes, handholes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls of the box. Amount of slack shall be equal to largest dimension of the box. Where plastic panel wiring duct is provided for wire runs, lacing is not required.
- C. Solid wire shall not be lugged, nor shall electrical spring connectors be used on any except for solid wires in lighting and receptacle circuits. Lugs and connectors shall be installed with a compression tool.
- D. Splices are not allowed.
- E. Terminations are subject to inspection by the Engineer prior to and after insulating. Terminations at 460-volt motors shall be made by bolt-connecting the lugged connectors. Connections shall be insulated and sealed with factory-engineered kits. Bolt connection area shall be kept free of mastics and fillers to facilitate rapid stripping and re-entry. Motor connection kits shall accommodate a range of cable sizes for both in-line and stub-type configurations. Connection kits shall be independent of cable manufacturer's tolerances.
- F. In the case where multiple field located instrumentation and control devices require parallel or series wiring configuration, it shall be done at one location in one junction box or marshalling enclosure with terminals. Interconnection of instrumentation and control devices shall not be done within conduit bodies (i.e. LBs, condulets, etc.)

3.03 SIGNAL CABLING

- A. Circuit runs shall be of individually shielded twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever 3-wire circuits are required. Terminal blocks shall be provided at instrument cable junctions unless otherwise specified. Signal circuits shall be run without splices between instruments, terminal boxes, or panels.
- B. Shields shall not be used as a signal path, except for coaxial cable circuits operating at radio frequencies.
- C. Unless otherwise specified, shields shall be bonded to the signal ground bus at the control panel and isolated from ground and other shields at other locations. Terminals shall be provided for running signal leads and shield drain wires through junction boxes.
- D. Spare circuits shall be terminated on terminal blocks at both ends of the cable run and be electrically continuous through terminal boxes. Shield drain wires for spare circuits shall not be grounded at either end of the cable run. Terminal boxes shall be provided at instrument cable splices. If cable is buried or in raceway below grade at splice, an instrument stand shall be provided as specified with terminal box mounted approximately 3 feet above grade.

3.04 COLOR CODING

- A. All wiring in industrial machines and equipment shall be in accordance with NFPA 79. Notify owner of any deficiencies noted during installation.

3.05 TERMINAL MARKING

- A. Refer to Section 16075 – Electrical Identification.

3.06 WIRE BENDING RADIUS

- A. The radius of bends in all non-shielded wire (conductors and cables) shall not be less than eight (8) times the outside diameter of the wire. Shielded covered wire shall not be bent to a radius less than twelve (12) times the diameter of the wire. Any wire installed with bends less than the allowed diameter and which the Engineer deems has caused that insulation to be damaged, shall be removed and new wire shall be installed.

3.07 GENERAL TESTS

- A. Megger all wires and cables prior to termination, record data for each branch circuit on an individual test report, sign report and turn over to owner for review prior to power up circuits.

END OF SECTION

SECTION 16125

FIBER OPTIC COMMUNICATION SYSTEM

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. Institute of Electrical Electronic Engineers, Inc. (IEEE); 802.3 Telecommunication and Information Exchange Between Systems.
 2. International Organization for Standardization (ISO).
 3. National Electrical Code (NEC).
 4. Telecommunications Industry Association (TIA); Electronics Industry Association (EIA)
 - a. 492, Specifications for Optical Waveguide Fibers.
 - b. 568, Commercial Building Telecommunications Cabling Standard.
 - c. 569, Commercial Building Standards for Telecommunications Pathways and Spaces.
 - d. 607, Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.02 ABBREVIATIONS

A.	AUI	attachment unit interface.
B.	dB	decibel.
C.	DNI	desktop network interface.
D.	FDDI	fiber distributed data interface.
E.	FOCS	Fiber Optic Communication Subsystem.
F.	FOIRL	Fiber Optic Inter Repeater Link.
G.	LAN	local area network.
H.	MHz	megahertz.
I.	micro	$\times 10^{-5}$
J.	Mbps	megabits per second.
K.	N	newton.
L.	n, nano	$\times 10^{-9}$
M.	nm	nanometer
N.	OTDR	optical time-domain reflectometer.
O.	PICS	Process Instrumentation and Control System.
P.	μm	micrometer

- Q. UPS uninterruptible power supply
- R. V ac volts alternating current
- S. WAN wide area network.

1.03 SYSTEM DESCRIPTION

- A. This section covers requirements for Fiber Optic Communication Subsystem (FOCS).
- B. The function of FOCS is to transmit digital data between network nodes. Requirements listed identify the minimum acceptable system performance.
- C. Provide a FOCS based on referenced standards for use in the following local and wide area networks:
 - 1. Ethernet.
 - 2. Fast Ethernet.
- D. Network(s) will be used by PICS to distribute data and coordinate Owner's operations.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Division 01.
- B. Action Submittals:
 - 1. Site layout diagram showing:
 - a. Access holes, with identification.
 - b. Abovegrade cable routings, with pole and cable identification.
 - c. Belowgrade conduit routings between access holes and buildings, with conduit counts and identification.
 - d. Cable routings through ducts and to patch panels, fiber centers, or network nodes, with cable and node identification.
 - 2. Cable schedule showing:
 - a. Cable identification.
 - b. Fiber counts for each cable and identification of used fiber pairs.
 - c. Cable length and attenuation, with 2 connector pairs and no splices, based on TIA/EIA 568, Annex H.

3. Component Data:
 - a. Manufacturer and model number.
 - b. General data and description.
 - c. Engineering specifications and data sheet.
 - d. Scaled drawings and mounting arrangements.

C. Informational Submittals:

- 1 Manufacturer's statement that installer is certified to perform installation Work.

2. Subcontractor Qualifications:

- a. FOCS Subcontractor: Minimum of 5 years' experience providing, integrating, installing, and commissioning of similar systems.
- b. FOCS Subcontractor's Site Representative: Minimum of 5 years' experience installing similar systems.
- c. Owner acceptance of FOCS Subcontractor does not exempt FOCS subcontractor or Contractor from meeting Contract Document requirements nor does it give prior acceptance of subsystems, equipment, materials, or services.
 - 1) Statement of Experience: List of at least 3 fiber optic data communications systems comparable to the system specified which have been furnished and placed into operation by prospective FOCS Subcontractor. For each system, provide following information:
 - a) Owner's name, address, telephone number, and name of current operations supervisor or other contact.
 - b) Description of system hardware configuration, including major equipment items, number of nodes, and communication standards implemented.
 - c) System block diagram.
 - 2) Qualification of Personnel:
 - a) Resumes giving management and technical qualifications of supervisory, local service representative, and key personnel.

- b) For each maintenance organization, identify location of base of service and how required coverage will be achieved.
- 3. Manufacturer's Certificate of Compliance.
- 4. Manufacturer's suggested installation practice.
- 5. Testing related submittals.
 - a. OTDR certification, current within last 12 months.
 - b. Test Documentation. As specified under paragraph Pre-Installation Testing.
 - c. Post-Installation Test Documentation.
 - 1) As specified under paragraph Post-Installation Testing.
 - 2) An updated version of the link calculations specified under paragraph Shop Drawings including:
 - a) Actual cable lengths used.
 - b) Actual losses measured by the tests.
 - c) Revised light margin calculations.
- 6. Operation and Maintenance Data: As specified in Division 1, Operation and Maintenance Data.
 - a. Updated versions of all Shop Drawings.
 - b. Post-Installation Test Documentation.
 - c. Component Manuals: Include manuals to cover installation, operation, maintenance, troubleshooting, and calibration.
 - d. List of spare parts and expendable provided and list of recommended spare parts.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Optical Fiber Cable and Cable Splice Centers:
 - 1. Outside, Underground/Submerged: Minus 20 to 40 degrees C.
 - 2. Outside, Overhead: Minus 40 to 80 degrees C.

3. Outside, Aboveground in Conduit: Minus 40 to 80 degrees C.
 4. Inside: 0 to 40 degrees C.
- B. Equipment:
1. Outside, Aboveground: Minus 40 to 80 degrees C.
 2. Control Rooms, Equipment Rooms and Telecommunications Closets: 30 to 55 percent relative humidity, 18 to 24 degrees C.
 3. Other Interior Areas: 0 to 100 percent relative humidity, 5 to 35 degrees C.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fiber Optic Cable:
1. Refer to Section 13413
- B. Ethernet Fiber-To-Copper Transceivers:
1. LBH100A-HD-ST-24
 3. Manufacturers and Products:
 - a. Black Box.
- C. Fiber Centers:
1. Function: Provides a secure place to terminate fiber optic cables.
 2. Features:
 - a. Compartments: Two; one for fiber optic cable, one for jumpers to individual equipment.
 - b. Coil Former: Former to wind slack cable. Provides controlled long-radius bends.
 - c. Connectors: Minimum 24 ST connectors for entry and exit.
 - d. Size: Maximum 18 inches by 12 inches by 4 inches.
 - e. Construction: 1.5-millimeter steel with noncorrosive finish.

- f. Mountings: Suitable for permanent attachment inside weather tight enclosure.
 - g. Doors: Separate doors for cable and jumper and lockable.
 - 3. Manufacturers and Products:
 - a. Ortronics; OR-615SMFC.
 - b. Corning.
 - D. Connectors
 - 1. SFP, ST and SC as required and as indicated in plans.
 - 2. Quantity: Connectorize fibers, minimum per cable:
 - a. Single-mode: All fibers.
 - b. Multimode: All fibers.
 - 3. Attenuation:
 - a. In accordance with requirements of TIA/EIA 568, Section 12.4.4.
 - b. Maximum of 0.75 dB per connector pair.
 - 4. Manufacturer:
 - a. Corning
 - b. Amp
 - c. Cisco
 - E. Jumper Cables:
 - 1. In accordance with requirements of TIA/EIA 568, Section 12.5.
 - 2. Function: To connect from fiber centers to network nodes, such as computer workstations.
 - 3. Fiber Characteristics: In accordance with requirements for fiber optic cable.
 - 4. Cable Configuration:
 - a. Individual tight-buffer thermoplastic, fibers single or multimode, to match fibers being jumpered on.

- b. Protected with kevlar strength members and enclosed in thermoplastic jacket.
- 5. Length: Standard, to meet requirements shown, plus minimum 3 meters at workstations.
- 6. Connectors:
 - a. As required by Article Connectors.
 - b. On-axial Pull Strength: 33 N.
 - c. Normal-to-Axial Pull Strength: 22 N.
- 7. Communications Management Outlets:
 - a. In accordance with TIA/EIA 568, Section 12.4.5.
 - b. Function: Provide organized system for connecting workstations into precabled communications.
 - c. Cover Plates:
 - 1) Flush and extension mount, as required to provide bend radius and space for coiled cable.
 - 2) Materials: ABS plastic.
 - 3) Color: White, unless otherwise indicated.
 - 4) Identifiers: Color-coded identification strips.
 - d. Connectors:
 - 1) ST connectors, counts as shown.
 - a) Multimode: ST.
 - 2) Sleeves: Phosphor bronze.
 - 3) Mounting: Face.
 - e. Manufacturers and Products:
 - 1) Ortronics; Series II.
 - 2) AMP; Fixed Shroud Duplex (FSD) System.

PART 3 EXECUTION

3.01 PREPARATION

- A. Conduits are provided under Division 16, Electrical.

1. Ensure that the installed conduit system is acceptable for fiber optic system requirements, including:
 - a. Conduits: Size and number.
 - b. Access Holes, Handholes, and Pull Boxes: Location and size, to ensure cables can be installed without exceeding manufacturer's pulling limitations.
 - c. Outlet Boxes: Size to coordinate with outlet cover plates for adequate volume and bend radius.
 2. Spare Conduits:
 - a. No cables shall be pulled into spare conduits.
 - b. 100 percent spare conduit capacity required for all buried conduits only, i.e., for every conduit with one or more cables in it, there shall be one spare equal-size conduit with no cables.
 3. Expansion Plugs: Seal conduits to stop ingress of water and grit with fabricated expansion plugs.
- B. Fiber Optic Cable:
1. Installation by manufacturer certified installer.
 2. All fiber to be pulled, terminated, and tested by installer. Patch cords to equipment will be completed by others.
 3. Install cables in accordance with manufacturer's requirements.
 4. Install cable directly from shipping reels. Ensure that cable is not:
 - a. Dented, nicked, or kinked.
 - b. Subjected to pull stress greater, or bend radius less, than manufacturer's specification.
 - c. Subjected to treatment that may damage fiber strands during installation.
 5. If calculation indicate that the cable will attenuate signals more than 8 dB, reroute as necessary and document in final as-built configuration submittals.
 6. Splices: Install fiber optic cables in unspliced lengths from fiber centers to switches or hubs.

7. Identification: Identify cable on both ends, in access holes and at pull points it goes through.
8. Sealing: Seal cables into ducts to stop ingress of water and grit with fabricated expansion plugs.
9. Access Holes:
 - a. Provide supports for cables in access and handholes at minimum of 24 inches on-center along sides.
 - b. While maintaining minimum bend radius, lace cables neatly to supports to keep them out of way of personnel.

C. Cable Terminations:

1. Terminate cables in accordance with TIA/EIA 568.
2. Fan out fiber cable to allow direct connectorization of connectors. Sleeve over individual fibers with transparent furcation tubes. At point of convergence of furcation tubes, provide strain relief with metal or high-density plastic fan-out collar.
3. Break-Out Kits:
 - a. Terminate cables using manufacturer-supplied break-out kits.
 - b. Terminate in accordance with recommendations.
4. Slack:
 - a. Fiber Centers, I-lubs, and Switches: Minimum, 3-meter slack fiber at each end, coiled neatly in cable management equipment.
 - b. Communications Management Outlets: Minimum, 10 feet of slack fiber, coiled neatly in outlet box.
5. Connectors:
 - a. Terminate 100 percent of fibers in each cable to specified connectors.
 - b. Connect into fiber management system.

D. Ethernet Fiber-to-Copper Transceivers:

1. Install transceivers in accordance with manufacturer's instructions.
2. Location: Install transceivers securely in field panels, close to network nodes and fiber centers.

3. Power: Energize each transceiver from its field panel's UPS, if applicable.
4. Connections:
 - a. Connect transceiver to fiber optics and network node.
 - b. Lace fiber optics neatly in place, routed through wireways.

3.02 FIELD QUALITY CONTROL

- A. Test components of installation in accordance with standards and specifications.
- B. Provide equipment, instrumentation, supplies and skilled staff necessary to perform testing.
- C. Advise Engineer at least 48 hours in advance of each test. Engineer or owner shall have the option to witness and participate actively in tests.
- D. Document test results of each cable to confirm that at least specified number of fibers meet standards, in accordance with Supplement titled As-Built Fiber Optic Cable Installation.
- E. For each conduit, complete As-Built Conduit Installation form included as Supplement to this section.
- F. Document results of transceiver tests.

3.03 TESTS AND INSPECTION

- A. In accordance with Division 1, Equipment Testing and Facility Startup.
- B. Conduit:
 1. Test and Seal Spare Conduits.
 2. Conduit Testing:
 - a. Blow full-diameter mouse through each spare conduit to verify they are unrestricted over full length.
 - b. If any conduit is not unrestricted over full length, advise Engineer.
- C. Cable Testing:
 1. Test Cables Twice:
 - a. On the reel, just prior to installation.
 - b. Post-installation.

- c. Compare results.
 - d. Submit results.
 - 2. TIA/EIA 568: Demonstrate that 100 percent fibers in each cable meet requirements of TIA/EIA 568, Annex H, as modified here:
 - a. Maximum attenuation as specified in Part II, Fiber Optic Cable.
 - b. Measure attenuation in both directions, not in one direction only.
 - c. For multimode fibers only: Measure attenuation at both 850 nm and 1,300 nm.
 - 3. Replace and retest cables that do not have specified number of fibers that meet attenuation standards.
- D. Ethernet Repeaters:
 - 1. Do not provide repeaters until tests have demonstrated that unrepeaters fiber optic communications are not successful.
 - 2. If Tests Are Not Successful:
 - a. Install repeaters in accordance with manufacturer's instructions.
 - b. Location: Install repeaters securely on 19-inch racks in field panels.
 - c. Power: Energize repeaters from field panel's UPS.
 - d. Connections:
 - 1) Connect repeaters to fiber optics via fiber centers.
 - 2) Lace fiber optics neatly in place. Do not route fiber optics through in field panels.
 - e. Demonstration Test:
 - 1) Demonstrate correct operation of each repeater using network communications.
 - 2) Document results of each test.

3.04 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative: The manufacturer's representative shall be present on-site for the minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance and inspection.
2. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

B. See Sections in Division 1, Equipment Testing and Facility Startup.

3.05 TRAINING

A. Provide compact disc instructional training.

1. Make-up of fiber terminations.
2. Splicing optical fiber cables, including fiber splices.
3. Testing quality of connectors, splices and fibers.

3.06 SUPPLEMENTS

A. Supplements listed below, following "End of Section," are part of this Specification.

1. As-Built Fiber Optic Cable Installation Plans.
2. As-Built Conduit Installation Plans.

END OF SECTION

SECTION 16280

SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Surge Protection Devices (SPD) for use on 208 volt and 480 volt, alternating current systems, and motor switchgear mounted applications.

1.02 REFERENCES

- A. Underwriters Laboratories Inc. (UL):
 - 1. 1449 - High Performance Suppression System.
 - 2. 1283 - High Frequency Extended Range Power Filter.
- B. American National Standards Institute (ANSI):
 - 1. C62.41-91 - Category C3 (Service Entrance).
 - 2. C62.45-91 - Category C Surge.

1.03 SUBMITTALS

- A. Shop Drawings: Include component layout and wiring terminations.
- B. Product data.
- C. Manufacturer's installation instructions.
- D. Operating and maintenance data.
- E. Warranties.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of transient voltage surge suppressor systems for minimum 5 years with satisfactory performance record.
- B. Regulatory Requirements: UL rating of Surge Protection Device shall meet or exceed UL rating of panelboard, motor control center, or other equipment in which SPD is installed. UL rating of equipment in which suppressor is installed shall not be affected by suppressor.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate with and furnish suppressors to switchgear manufacturer prior to shipment of equipment to site.

1.06 WARRANTY

- A. Warrant to correct defective products for minimum 15 years in accordance with manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 SURGE PROTECTION DEVICE

- A. Ratings: 120/208 and 277/480 volt grounded wye. Low voltage 30VDC.
- B. Manufacturers: One of the following:
 - 1. Surge Suppression Inc.
 - 2. Current Technology.
 - 3. Ditek Corp.
 - 4. Emerson Network Power.
 - 5. Erico-Critec
- C. Components:
 - 1. Fused disconnect for remote mounted units, breaker for integral mounted units.
 - 2. Status indicating pilot lights.
 - 3. Dry contacts.
 - 4. Replaceable components.
- D. Characteristics:
 - 1. Single Pulse Surge Current Capacity per Phase: 200,000 amperes.
 - 2. Capacity Per Protection Modes:
 - a. L-N Mode: 100,000 amperes.
 - b. L-G Mode: 100,000 amperes.

- c. N-G Mode: 100,000 amperes.
 - d. L-L Mode: 100,000 amperes.
- 3. Surge Life Cycle: 1.2 by 50 micro-seconds 20 kilovolt open circuit voltage, 8/20 micro-second waveform 10 kiloamperes short circuit current Category C3 Bi-wave in accordance with ANSI C62.41 and C62.45.
- 4. Suppression and Filter Technology: Manufacturer's standard.
- 5. Continuous Operating Voltage: Minimum 115 percent of nominal.
- 6. Suppression Voltage In Protective Modes: As follows when tested in accordance with UL 1449:
 - a. For 480 volt systems: 1) L-N: 1200
 - b. For 208 volt systems: 1) L-N: 800
- 7. Minimum American Wire Gauge Copper in Surge or Noise Suppression Path: Number 6.
- 8. Field Replaceable Fusing: Current limiting, protecting each pole.
- E. Control and instrumentatins.
 - 1. Suppressors on Analog Signal Lines:
 - a. Test Waveform: Linear 8 microsecond rise in current form amps to a peak current value followed by an exponential decay of current reaching one-half the peak value in 20 microseconds.
 - b. Surge Rating: Tested and rated for 50 occurrences of 2,000-amp peak test.
 - 1) dc Clamping Voltage: 20 to 40 percent above operating voltage for circuit.
 - 2) dc Clamping Voltage Tolerance: Less than plus or minus 10 percent.
 - 3) Maximum Loop Resistance: 18 ohms per conductor.
 - 4) Physical Characteristics:
 - c. Mounted in Enclosures: Encapsulated in flame retardant epoxy.
 - d. For Analog Signals Lines: Erico UTB30SP for 24VDC.
 - e. For 120 Vac Lines: Erico UTB110SP.

- f. Field Mounted at Two-Wire Instruments:
 - 1) Encapsulated in 316 stainless steel pipe nipples.
 - 2) EDCO SS64 series.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install suppressors in accordance with manufacturer's instructions.

END OF SECTION

SECTION 16442

PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Branch-circuit panelboards, service entrance rated.

1.03 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.04 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.

7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Panelboard Schedules: For installation in panelboards.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals.

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish list of recommended maintenance materials and unit pricing for each type and rating.

1.07 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.09 PROJECT CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures 98F with 95% non-condensing humidity.
2. Altitude not exceeding 6600 feet.

1.10 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors, panels and access hatches to pump pipe risers
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.
- B. Enclosures: Surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Outdoors, NEMA 4 316 stainless steel.
 - 2. Hinged Front Cover: Entire front trim hinged to box and with 316 stainless steel door within hinged trim cover with 3-point lockable handle.
 - 3. Finishes:
 - a. Panels and Trim: 316 stainless.
 - 4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover. Provide types loads with exact equipment tag not generic names and no hand written cards.
- C. Incoming Mains Location to be coordinated with site routing of raceways.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.

- 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: 65KAIC Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by:
 - 1. Square-D
 - 2. General Electric
 - 3. Eaton
- B. Panelboards: NEMA 4 316 stainless steel service entrance rated branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with 3-point lockable handle.
- F. Fully rated branch breakers, no series rated.

2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front- Retain first subparagraph below for GFCI circuit breakers for personnel ground-fault protection as required by NFPA 70; retain second subparagraph for GFEP circuit breakers (e.g., for self-limiting, heat-trace cables) as required by NFPA 70.

3. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position. Applies to selected devices where required to meet NEC disconnecting means.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting:
 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Mount top of trim 72 inches above finished pad/grade unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box.
- F. Install overcurrent protective devices and controllers not already factory installed.

G. Install filler plates in unused spaces.

H. Comply with NECA 1.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 16075 "Electrical Identification."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final equipment designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 16075 "Electrical Identification."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 16075 "Electrical Identification."

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Instruments and Equipment:

- 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION



APPENDIX

A

Existing PLC-1/2

PLC-1

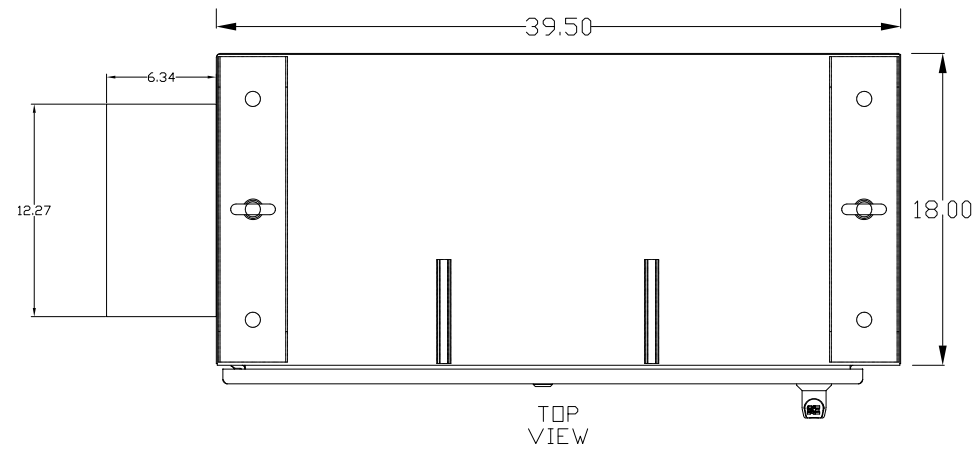
NORTH & SOUTH SEDIMENTATION PONDS

SHEET	DRAWING DESCRIPTION
1	TABLE OF CONTENTS
2	BILL OF MATERIAL
3	PANEL LAYOUT
4	POWER DIAGRAM
5	COMMUNICATIONS
6	DISCRETE INPUTS
7	DISCRETE INPUTS
8	RELAY OUTPUTS
9	ANALOG INPUTS
10	ANALOG INPUTS
11	ANALOG INPUTS

Item #	Description	Manufacturer Part No.	PLC-1 Sediment Ponds	PLC-2 Recycle Ponds	Spares
SCE Saginaw Control & Engineering					
1	Type 4X 304 SS Powder coated white Free Standing , for flange mounted disconnect, 72H X 39.5W X 18D	CUR5-72XM4018SS6	Type 4X 1	Type 4X 1	
	60" x 32" back panel	SCE-64P37	1	1	
	Large steel print pocket powder coated white	SCE-PP101203	1	1	
2	Fan heater w/thermostat, 400 watt, 120 volt	SCE-HF8001B	1	1	
3	Fixture, LED Light	SCE-LF24	1	1	
4	ICEcube Air Conditioner 316SS painted white	IQ2200VS-126-SS316	1	1	
	ICEcube Air Conditioner remote monitoring	(CM)-XC4-CP2-X03	1	1	
ALLEN BRADLEY Terminal Blocks					
5	TERMINAL BLOCK END ANCHOR	1492-EAJ35	20	20	
6	TERMINAL BLOCK JUMPER, 10 POLE	1492-GJJ5-10	8	8	
7	DIN RAIL, STANDARD	199-DR1	1	1	
8	DIN RAIL, RAISED	1492-DR6	2	2	
9	FUSED TERMINAL BLOCK, NEON INDICATOR, 120 VAC	1492-H4	5	5	
10	FUSED TERMINAL BLOCK, LED INDICATOR, 24 VDC	1492-H5	5	5	
11	FUSED TERMINAL BLOCK END BARRIER	1492-N37	8	8	
12	FUSE BLOCK SIDE JUMPERS 10 POLE	1492-N49	1	1	
13	FUSE BLOCK SIDE JUMPER INSULATING SLEEVE	1492-SJS	1	1	
14	RELAY, SPDT, 120VAC COIL, 10AMP CONTACTS	700-HK36A1-4	8	8	2
15	RELAY, SOCKET	700-HN121	8	8	2
16	CIRCUIT BREAKER, 20AMP, SINGLE POLE	1489-A1C200	1	1	
17	CIRCUIT BREAKER, 10AMP, SINGLE POLE	1489-A1C100	4	4	
18	CIRCUIT BREAKER, 5AMP, SINGLE POLE	1489-A1C050	3	3	
19	TERMINAL BLOCK 1 TIER	1492-J6-BL	25	25	
20	TERMINAL BLOCK 1 TIER	1492-J6-W	25	25	
21	TERMINAL BLOCK 1 TIER	1492-J6-RE	25	25	
22					
23	TERMINAL BLOCK 1 TIER	1492-J6-B	25	25	
24	TERMINAL BLOCK 2 TIER	1492-JD3-Y	25	25	
25	Weidmuller 10/6(10MM) Term. Blk. Markers	1677220000	506	544	
26	Brady Heatex Thermal H112 wire labels (2000 pcs.)	502448	452	484	
Square D Disconnect					
27	Square D Main Circuit Breaker	HGL26020	1	1	
28	Square D Cable mechanism, 36"	9422CSF30	1	1	
29	Square D Handle mechanism	9422A2	1	1	
30					
BUSSMANN FUSES					
31	FUSE, 2A, 250V, FAST ACTING	AGC-2	15	15	10
32	Bussmann Class CC 600V Touchsafe 2 Pole Fuse Block	CHCC2I	1	1	
33	Bussmann Class CC 600V 20 amp Fuse	FNQ-R-20	2	2	4
Phoenix Contact Surge					
34	Phoenix PLT-SEC-T3-120-P Plug (Power Mains)	2905234	1	1	
35	Phoenix PLT-SEC-T3-B3 Plug Header	2905557	1	1	
36	Phoenix PT 1x2-24DC-ST Plug (one analog signal)	2856032	24	24	
37	Phoenix PT 1x2-BE Base	2856113	24	24	
38	Phoenix TerminiTrab TT-SLKK5-F/110AC (Discrete signals)	2765602	32	32	
39	Phoenix End Cover D-UKK 3/5 BK	2770228	2	2	
Pandult Wire Duct					
40	WIRING DUCT, 2"W x 4"H	F2X4LG6	24	24	
41	WIRING DUCT COVER, 2"W	C2LG6	24	24	
42	WIRING DUCT, 3"W x 4"H	F3X4LG6	6	6	
43	WIRING DUCT COVER, 3"W	C3LG6	6	6	
Power Supplies					
44	Sola Uninterruptable Power Supply 850W DIN Rail Mountable	SDU850	1	1	
45	Sola Dry contact relay interface kit	RELAYCARD-SDU	1	1	
46	Phoenix Contact 24VDC 5 Amp Power Supply	2866750	1	1	1
47	Sola automation Transformer, 2Kva, Group C, 120/208/240/277 volt Primary, 120/240 Volt Secondary	HS12F2A S	1	1	
Communications					
48	BLACKBOX CAT6 ETHERNET PATCH CABLE, 3 FT.	EVNSL641-0003	2	2	
49	BLACKBOX CAT6 ETHERNET PATCH CABLE, 10 FT.	EVNSL641-0010	1	1	1
50	BLACK BOX MEDIA CONVERTER, 10 / 100 Mbps, Copper to Fiber, 24vdc, Multimode, ST	LBH100A-HD-ST-24	2	2	1
51	Phoenix Contact 4 Port Ethernet Switch	2891152	1	1	
52	FIS Patch cord, fiber, 62.5/125Um, Multimode, duplex, ST-ST, 2-meters		1	1	1
53	Corning Fiber Patch Panel	SPH-01P	2	2	
54	Corning Fiber Patch Panel ST Inserts	CCH-CP06-15T	2	2	
Miscellaneous Panel Equipment					
55	SQ. D GROUND BAR KIT	PK-23GTA	2	2	
56	SQ. D GROUND BAR INSULATOR KIT	PKGTAB	2	2	
57	Mechanical Gnd Lug.(CED), Positech	MCD1-1025	1	1	
58	Receptacle	CR151, 15 A	1	1	
	Handy Box	#58361 1/2	1	1	
	Handy Box Cover		1	1	
	Plastic Bushing	3210, 1/2"	1	1	

Item #	Description	Manufacturer	Manufacturer Part No.	PLC-1 Sediment Ponds	PLC-2 Recycle Ponds	Specified Spare Parts
1	M340 12 Slot PLC Backplane	Modicon	BMX XBP 1200H	1	1	0
2	M340 PLC Power Supply	Modicon	BMX CPS 3500H	1	1	1
3						
4	M340 PLC Processor	Modicon	BMX P34 2020H	1	1	1
5						
6	M340 PLC 16 pt 120VAC Digital Input Module	Modicon	BMX DA1 1604H	2	2	1
7	M340 PLC 8 pt Relay Output Module	Modicon	BMX DRA 0805H	1	1	1
8	M340 PLC 8 ch 4-20 mA Analog Input Module	Modicon	BMX AMI 0810H	3	3	1
9						
10						
11	M340 PLC I/O Module 20 pt. Flying Leads Connectors	Modicon	BMX FTW301	3	3	0
12	M340 PLC I/O Module 28 pt. Shld Flying Leads Connectors	Modicon	BMX FTW308s	3	3	0
13						
14						
15						
16	MAGELIS Terminal w/ Touch-Sensitive Screen	Modicon	HMIGTO5310	1	1	0
17						
18						
19	OVATION Ethernet Link Controller	Emerson	5X00419G01/1X00569H01	1	1	1
20	OVATION Modbus Master License	Emerson	ELCMODMST	1	1	0
21						
22						
23						

0			MODIFICATION	ENGINEER	 CURRYCONTROLSCOMPANY 4245 S. Plpkin Road - Lakeland- FL 33811 P.O. Drawer 5408 - Lakeland, FL 33807 (863) 646-5781 - FAX: (863) 646-3899	PLC-1: NORTH & SOUTH SEDIMENTATION PONDS BILL OF MATERIAL	ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER LINED PONDS DEWATERING PROJECT ORANGE COUNTY, FLORIDA	JOB #	J16-8941
0			AS BUILT	LIC. #				DIRECTORY	DRAWINGS
0			CONSTRUCTION	FIRM LIC. #				FILE NAME	8941-BOM-001
A	04.16.16	EJD	SUBMITTAL	MANAGER					
REV.	DATE	APVD.	REMARKS	SCALE					



YELLOW BACKGROUND
BLACK LETTERS

⚠ DANGER

YELLOW WIRING
IS NOT
DE-ENERGIZED
BY DISCONNECT

AUTHORIZED
PERSONNEL ONLY
ALLOWED TO ENTER

⚠ WARNING

ARC FLASH AND SHOCK HAZARD
APPROPRIATE PPE REQUIRED

Do not operate controls or open covers
without appropriate personal protection
equipment.
Failure to comply may result in injury or
death!

Refer to NFPA 70E for minimum PPE requirements.

OSHA WARNING LABELS
(INCLUDING ARC FLASH)

COLOR CODE TERMINAL BLOCKS:

BLACK : 120V POWER CIRCUITS DE-ENERGIZED WHEN MAIN DISCONNECT IS OPENED

WHITE : 120V NEUTRAL CONDUCTORS

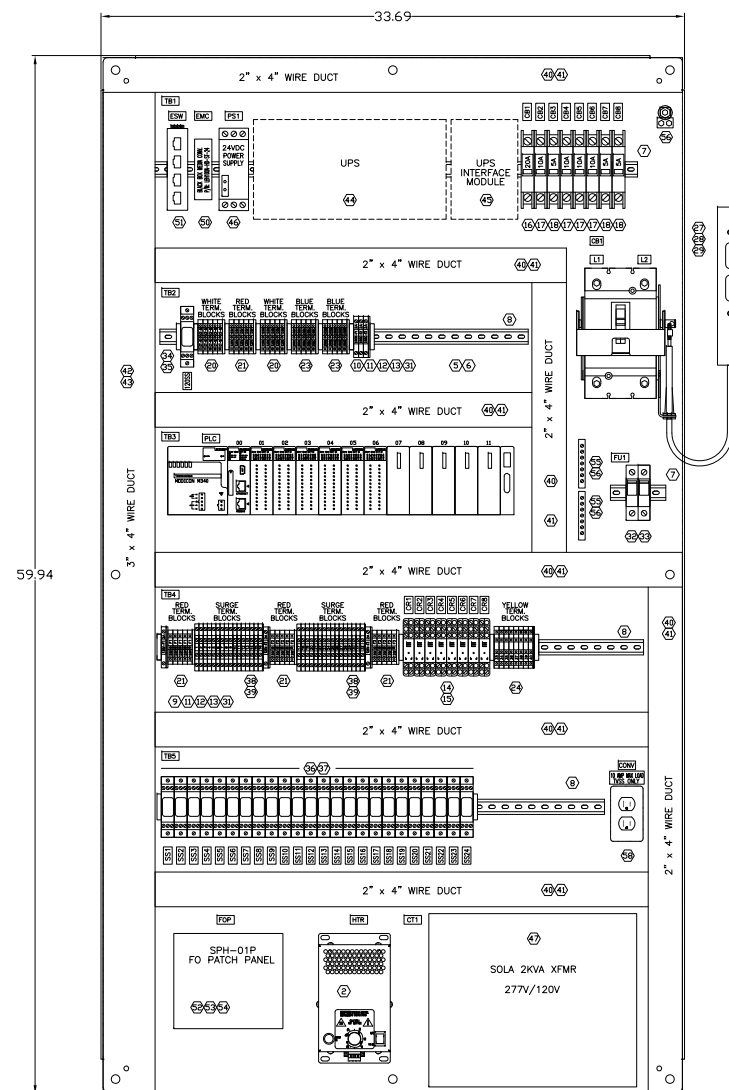
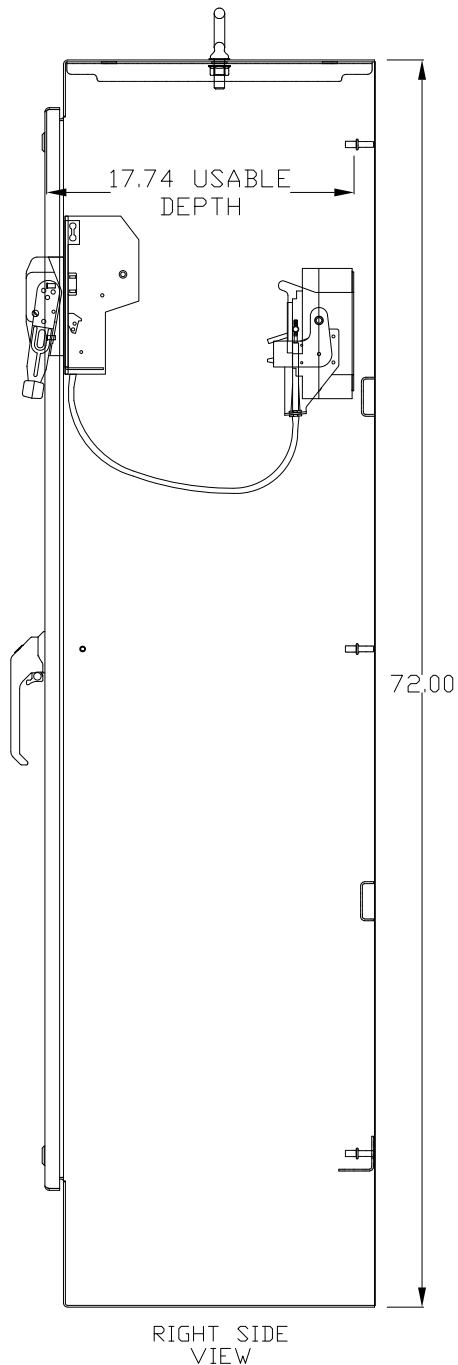
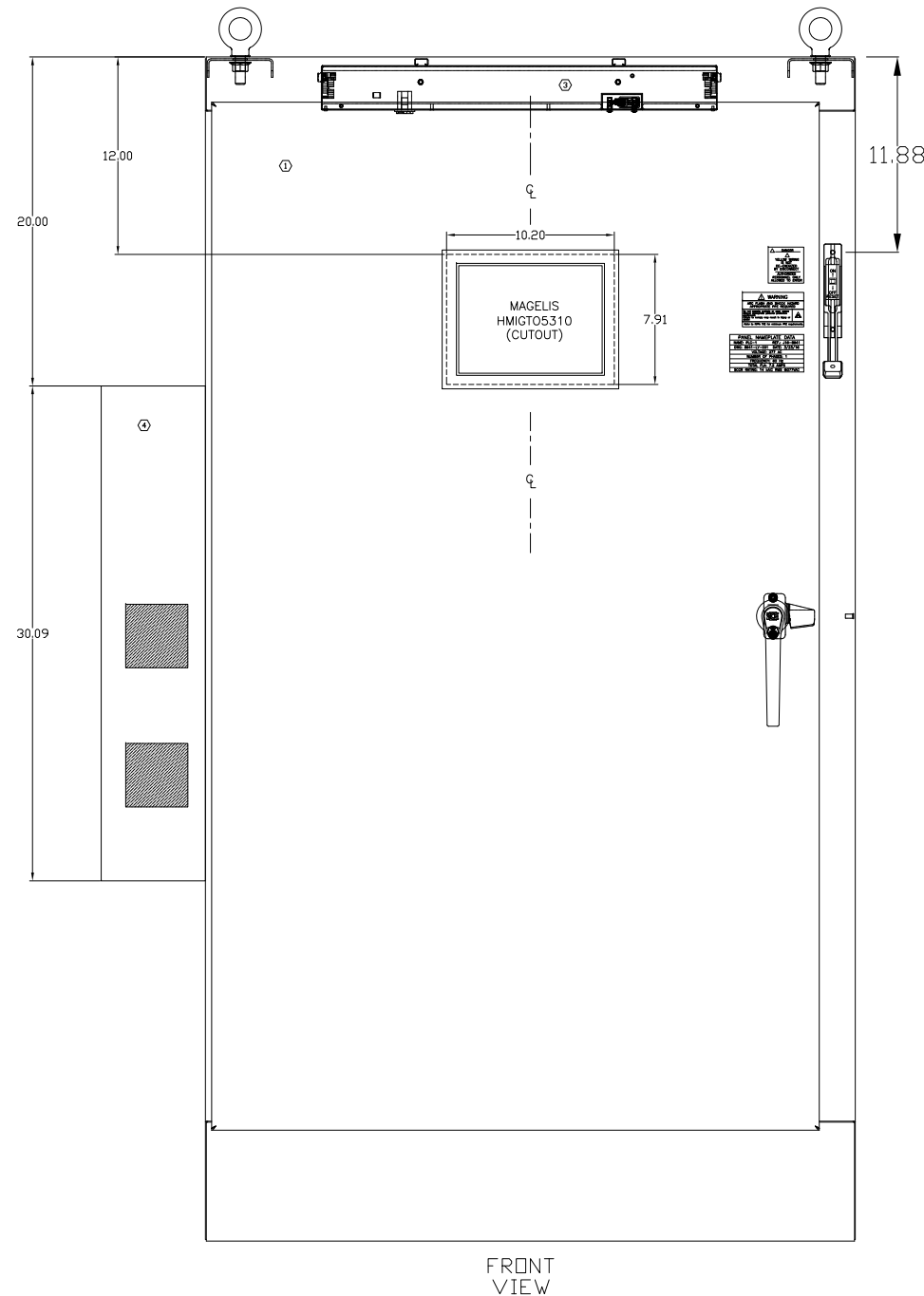
RED : 120V CONTROL CIRCUITS DE-ENERGIZED WHEN MAIN DISCONNECT IS OPENED

YELLOW : 120V CONTROL CIRCUITS WHICH REMAIN HOT WHEN MAIN DISCONNECT IS OPENED

BLUE : DC WIRING

GRAY : SHIELDS IN DC WIRING

GREEN : GROUND TERMINAL BLOCKS



0			MODIFICATION	ENGINEER
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0			CONSTRUCTION	FIRM LIC. #
A	04.16.16	EJD	SUBMITTAL	MANAGER
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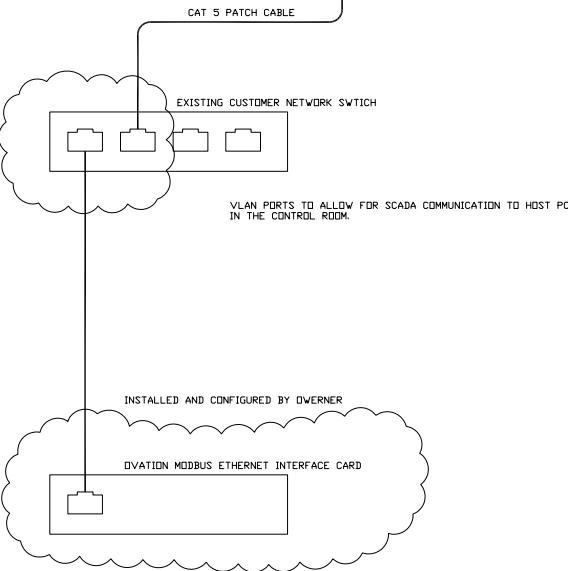
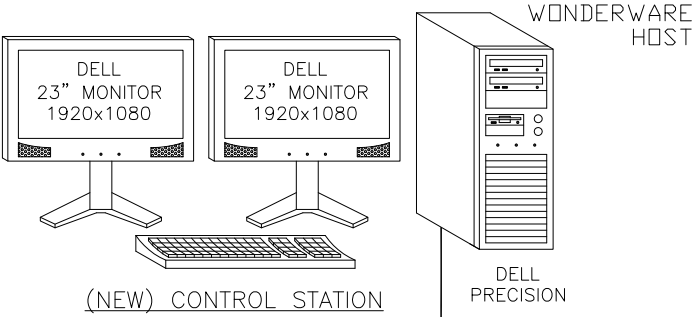
CURRYCONTROLSCOMPANY
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P.O. Drawer 5408 - Lakeland, FL 33807
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PLC-1: NORTH & SOUTH
SEDIMENTATION PONDS
PANEL LAYOUT

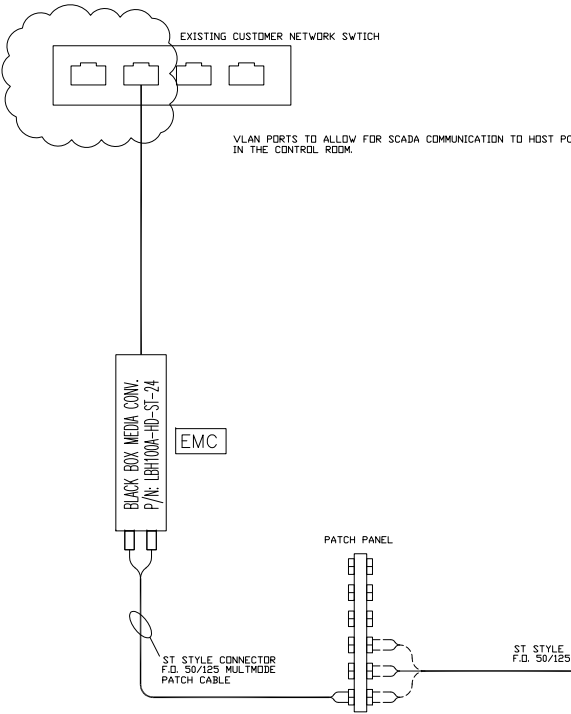
ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA

JOB # J16-8941
DRAWINGS
FILE NAME 8941-LY-001
SHEET OF

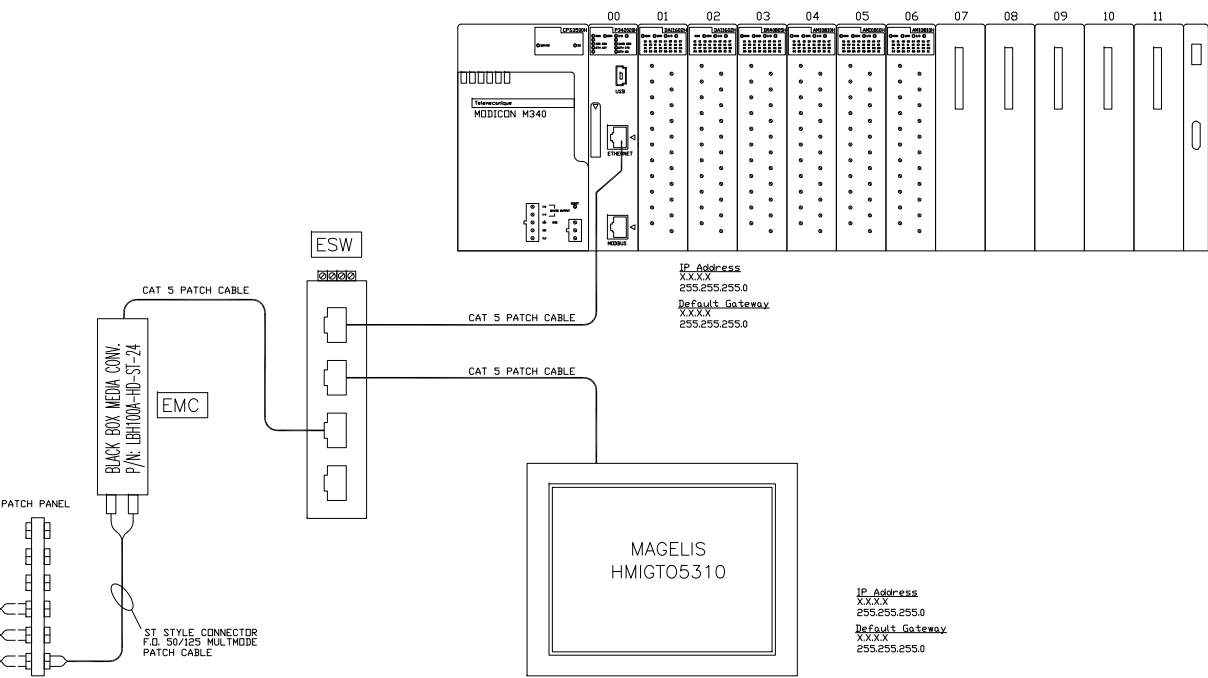
OPERATORS CONTROL ROOM
(NEW) CONTROL STATION



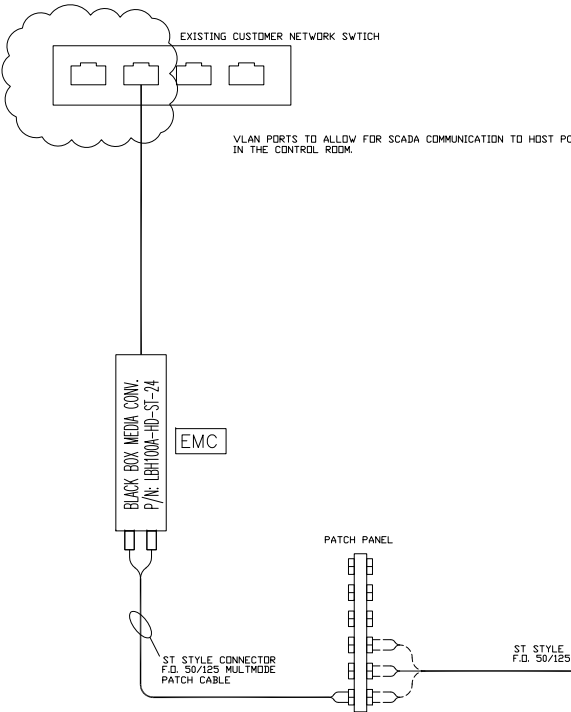
SOUTH OFFLOADING BLDG



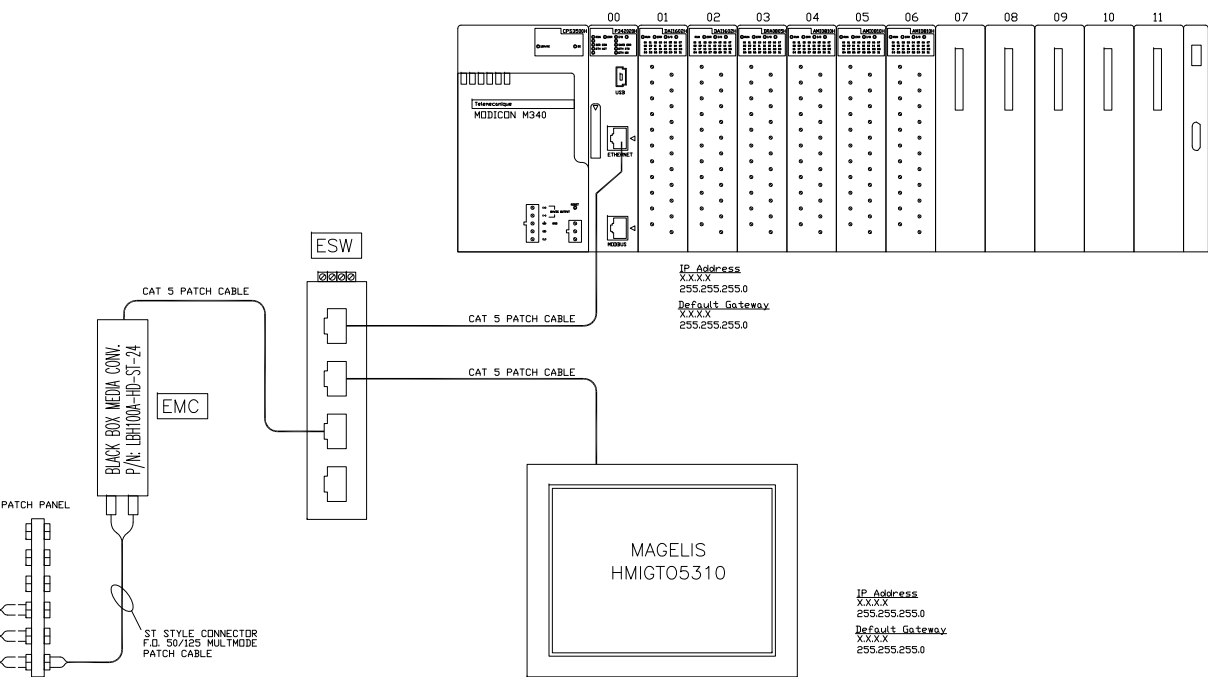
PLC1 PANEL (NORTH & SOUTH)



CRUSHER BLDG



PLC2 PANEL (EAST & WEST)



0			MODIFICATION
0			AS BUILT
0			CONSTRUCTION
A	03.28.16	EJD	SUBMITTAL
REV.	DATE	APVD.	REMARKS

ENGINEER
LIC. #
FIRM LIC. #
MANAGER
SCALE

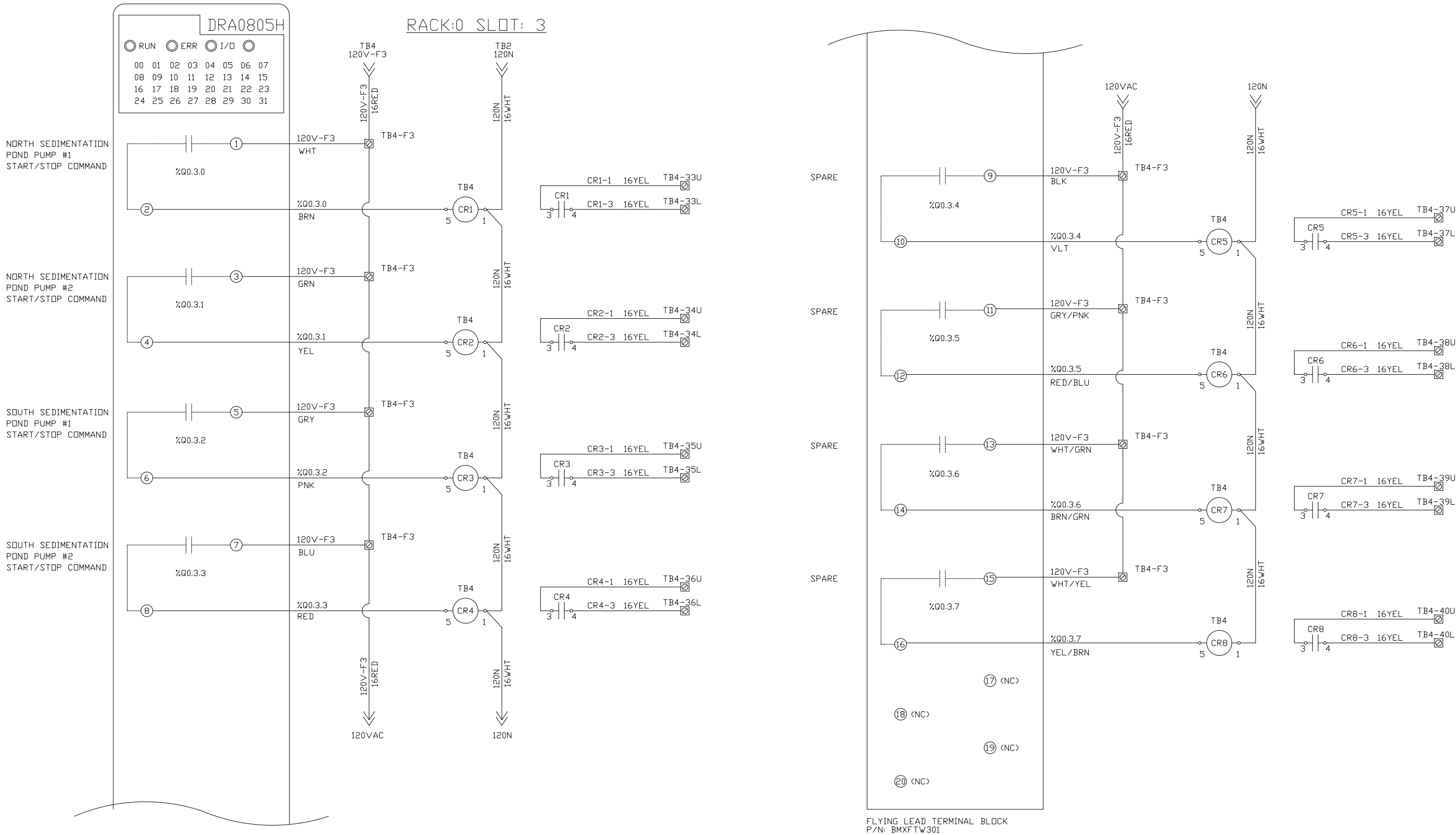


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SYSTEM COMMUNICATIONS

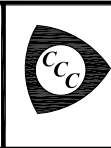
ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA

JOB #	J16-8941
DIRECTORY	DRAWINGS
FILE NAME	8941-PLC-001
SHEET	OF



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0			AS BUILT
0			CONSTRUCTION
A	03.21.16	EJD	SUBMITTAL
REV.	DATE	APV.D.	REMARKS

ENGINEER
LIC. #
FIRM LIC. #
MANAGER
SCALE



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P.O. Drawer 5408 - Lakeland, FL 33807
(863) 646-5781 - FAX: (863) 646-3899

**PLC-1: NORTH & SOUTH
SEDIMENTATION PONDS
PLC:0 SLOT:3
RELAY OUTPUT CARD**

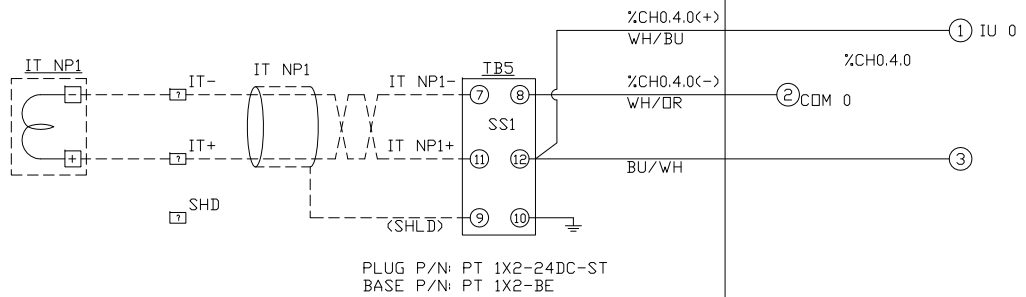
**ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA**

JOB #	J16-8941
DIRECTORY	DRAWINGS
FILE NAME	8941-DD-001
SHEET	OF

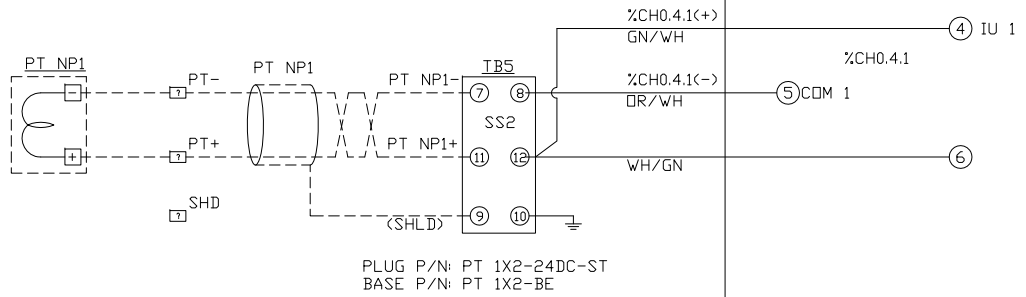
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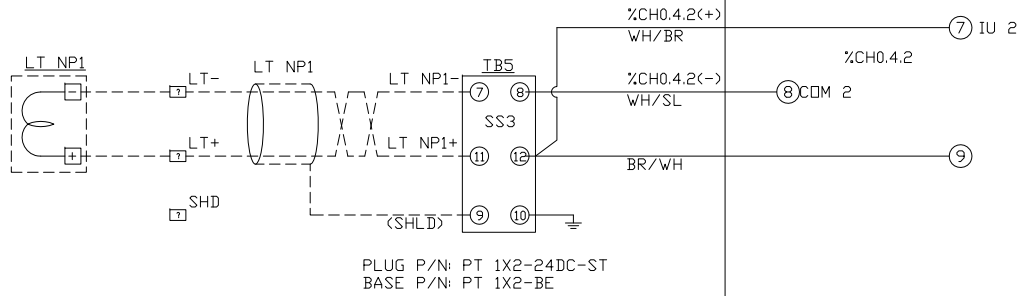
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00 01 02 03 04 05 06 07
08 09 10 11 12 13 14 15
16 17 18 19 20 21 22 23
24 25 26 27 28 29 30 31



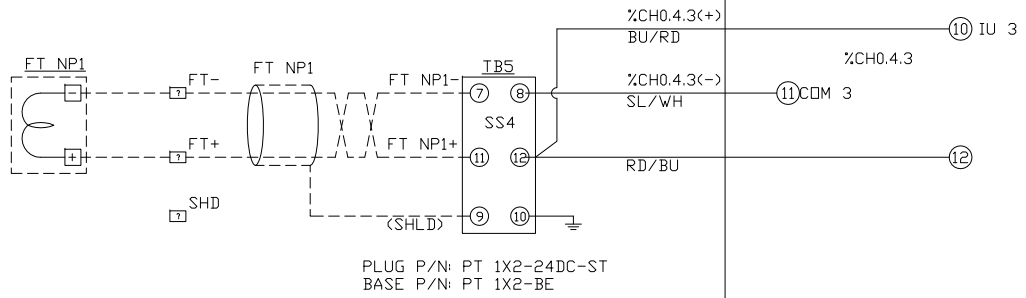
NORTH SEDIMENTATION POND
PUMP #1 MOTOR AMPS
(4-20mA)
0-???? AMPs



NORTH SEDIMENTATION POND
PUMP #1 PRESSURE
(4-20mA)
0-???? PSI



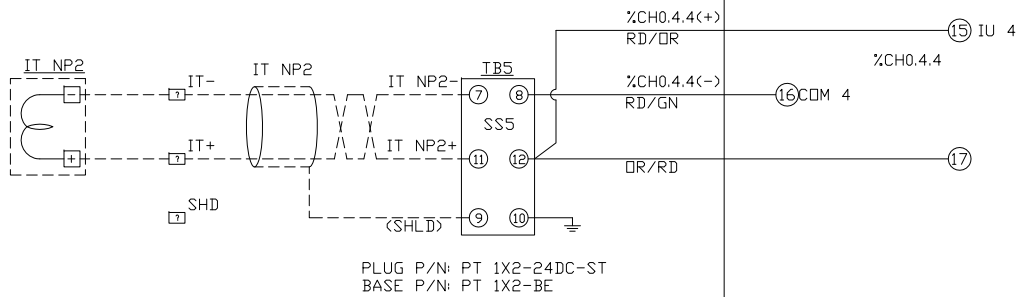
NORTH SEDIMENTATION POND
PUMP #1 LEVEL
(4-20mA)
0-???? FEET



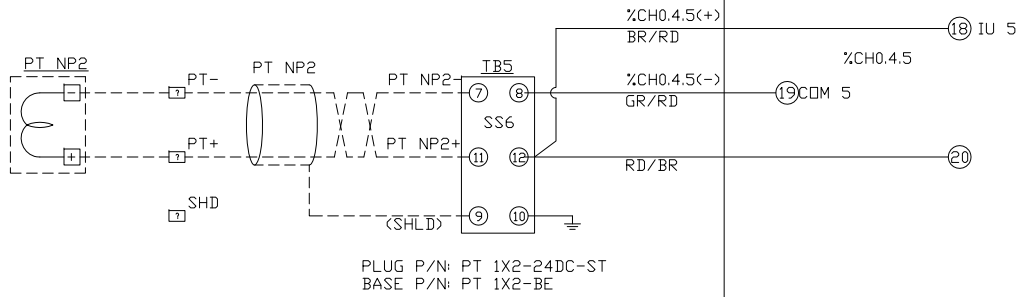
NORTH SEDIMENTATION POND
PUMP #1 FLOW
(4-20mA)
0-???? GPM

13 (NC)

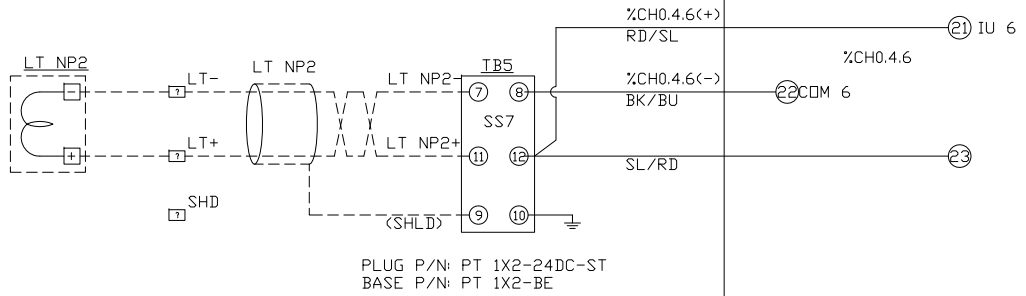
14 (NC)



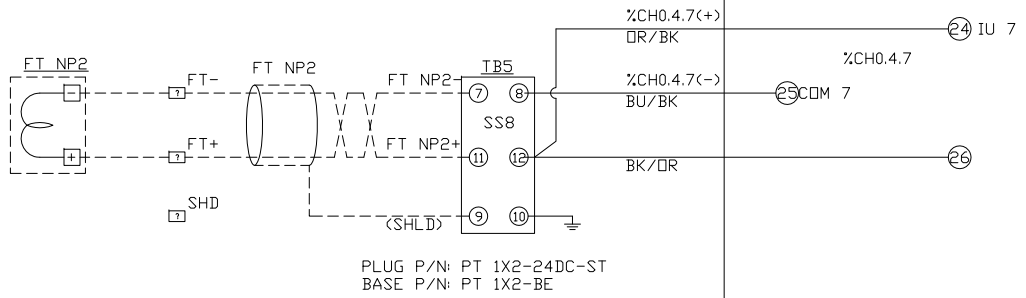
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PUMP #2 MOTOR AMPS
(4-20mA)
0-???? AMPs



NORTH SEDIMENTATION POND
PUMP #2 PRESSURE
(4-20mA)
0-???? PSI



NORTH SEDIMENTATION POND
PUMP #2 LEVEL
(4-20mA)
0-???? FEET



NORTH SEDIMENTATION POND
PUMP #2 FLOW
(4-20mA)
0-???? GPM

27 (NC)

28 (NC)

* 8 ISOLATED CHANNELS

P/N: BMXFTW308S PREWIRED RTB

NOTES:

- * WHEN USING AMI 0810 AI MODULE BE SURE USE TO USE THE 28 PIN TERMINAL BLOCK. P/N: BMX FTW 308S
- * IF NOTHING IS CONNECTED TO A CHANNEL THAT IS CONFIGURED, THE PLC WILL INDICATE I/D ERROR AS A BROKEN WIRE.

LEGEND:

- ITEMS OR DEVICES LOCATED IN THE FIELD, REMOTE TO A PANEL.
- WIRING INTERNAL TO PANEL
- WIRING EXTERNAL TO PANEL

0			MODIFICATION
0			AS BUILT
0			CONSTRUCTION
A	03.21.16	EJD	SUBMITTAL
REV.	DATE	APV.D.	REMARKS

ENGINEER
LIC. #
FIRM LIC. #
MANAGER
SCALE



CURRYCONTROLSCOMPANY

4245 S. Pipkin Road - Lakeland, FL 33811
P.O. Drawer 5408 - Lakeland, FL 33807
(863) 646-5781 - FAX: (863) 646-3899

PLC-1: NORTH & SOUTH
SEDIMENTATION PONDS
PLC:0 SLOT:4
ANALOG INPUT CARD

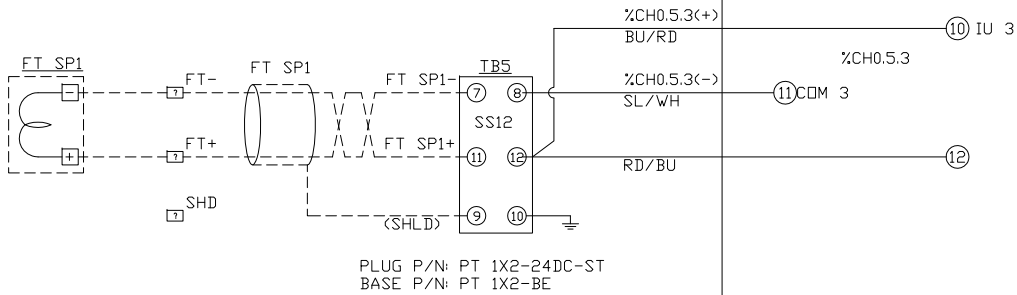
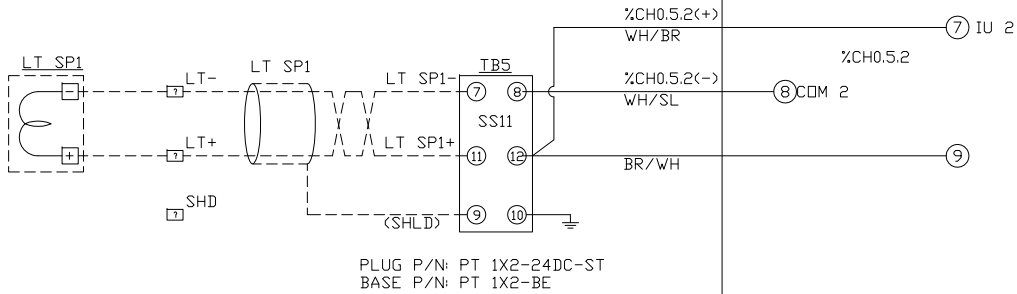
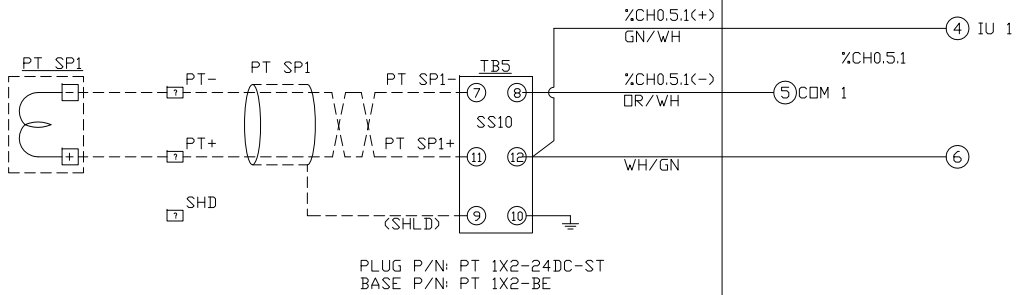
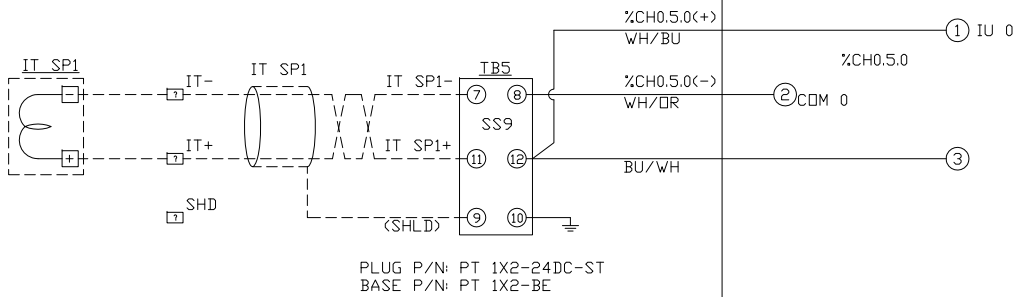
ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA

JOB #	J16-8941
DIRECTORY	DRAWINGS
FILE NAME	8941-AI-001
SHEET	OF

RACK: 0 SLOT: 5

AMI0810H

☐	RUN	☐	ERR	☐	I/D	☐	
00	01	02	03	04	05	06	07
08	09	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31



⑬ (NC)

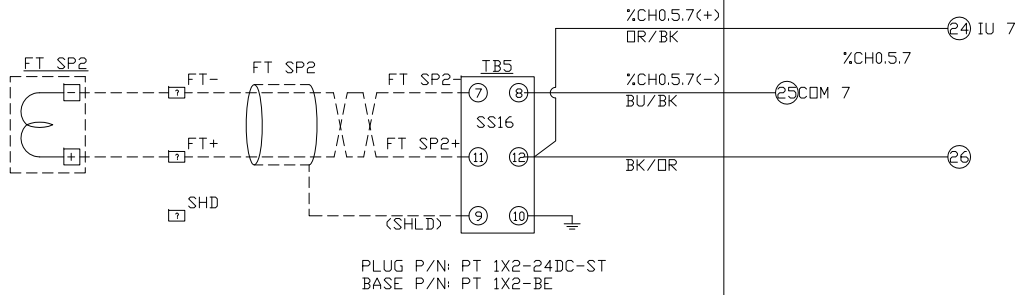
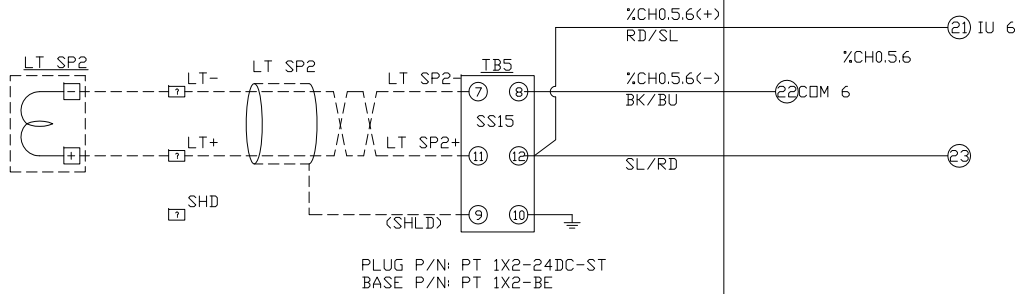
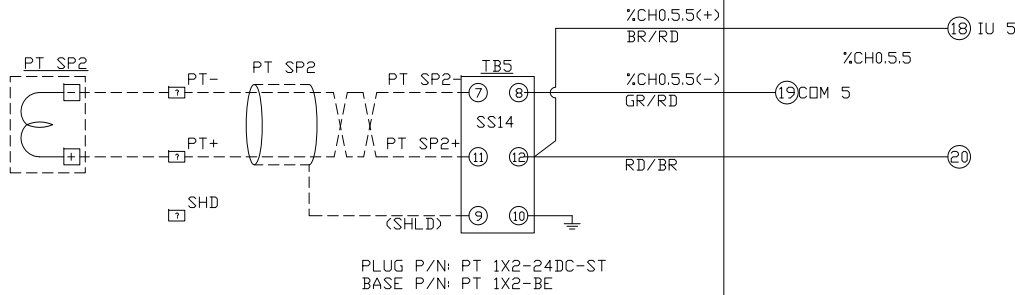
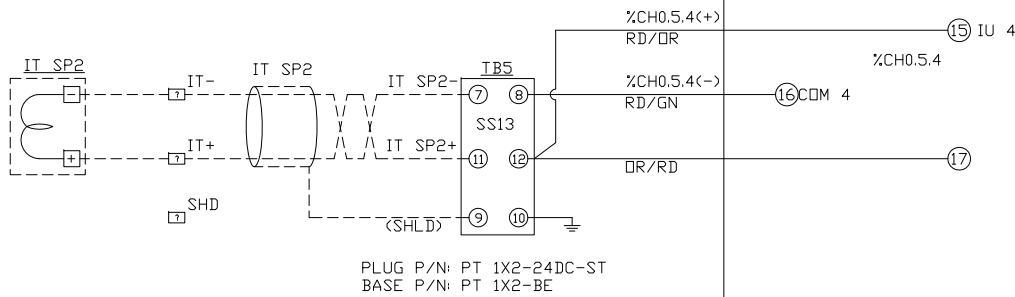
⑭ (NC)

SOUTH SEDIMENTATION POND
PUMP #1 MOTOR AMPS
(4-20mA)
0-???? AMPs

SOUTH SEDIMENTATION POND
PUMP #1 PRESSURE
(4-20mA)
0-???? PSI

SOUTH SEDIMENTATION POND
PUMP #1 LEVEL
(4-20mA)
0-???? FEET

SOUTH SEDIMENTATION POND
PUMP #1 FLOW
(4-20mA)
0-???? GPM



㉗ (NC)

㉘ (NC)

* 8 ISOLATED CHANNELS

P/N: BMXFTW308S PREWIRED RTB

NOTES:

- * WHEN USING AMI 0810 AI MODULE BE SURE USE TO USE THE 28 PIN TERMINAL BLOCK.
P/N: BMX FTW 308S
- * IF NOTHING IS CONNECTED TO A CHANNEL THAT IS CONFIGURED, THE PLC WILL INDICATE I/D ERROR AS A BROKEN WIRE.

LEGEND:

-  ITEMS OR DEVICES LOCATED IN THE FIELD, REMOTE TO A PANEL.
-  WIRING INTERNAL TO PANEL
-  WIRING EXTERNAL TO PANEL

0			MODIFICATION
0			AS BUILT
0			CONSTRUCTION
A	03.21.16	EJD	SUBMITTAL
REV.	DATE	APV.D.	REMARKS

ENGINEER
LIC. #
FIRM LIC. #
MANAGER
SCALE



CURRYCONTROLSCOMPANY

4245 S. Plpkin Road • Lakeland • FL 33811
P.O. Drawer 5408 • Lakeland, FL 33807
(863) 646-5781 • FAX: (863) 646-3899

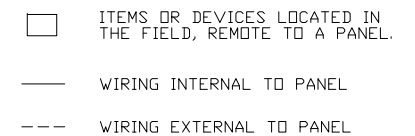
PLC-1: NORTH & SOUTH
SEDIMENTATION PONDS
PLC:0 SLOT:5
ANALOG INPUT CARD

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA

JOB #	J16-8941
DIRECTORY	DRAWINGS
FILE NAME	8941-AI-002
SHEET	OF



- LEGEND:



0			MODIFICATION	ENGINEER	 CURRYCONTROLSCOMPANY 4245 S. PIPKIN ROAD - LAKELAND- FL 33811 P.O. DRAWER 5408 - LAKELAND, FL 33807 (863) 646-5781 - FAX: (863) 646-3899	PLC-1: NORTH & SOUTH SEDIMENTATION PONDS PLC:0 SLOT:6 ANALOG INPUT CARD	ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER LINED PONDS DEWATERING PROJECT ORANGE COUNTY, FLORIDA	JOB #	J16-8941
0			AS_BUILT	LIC. #				DRAWINGS	
0			CONSTRUCTION	FIRM LIC. #				FILE NAME	8941-AI-003
A	03.21.16	EJO	SUBMITTAL	MANAGER					
REV.	DATE	APVD.	REMARKS	SCALE					
								SHEET	OF

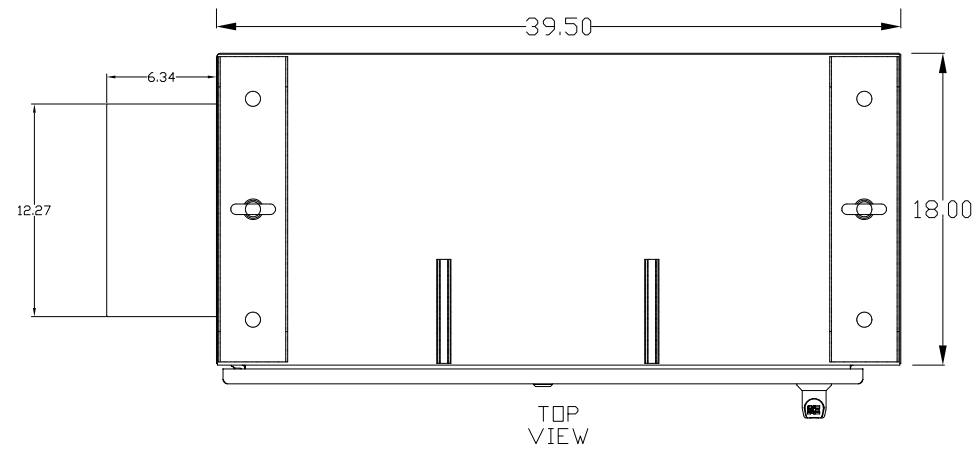
PLC-2
EAST & WEST RECYCLE PONDS

SHEET	DRAWING DESCRIPTION
1	TABLE OF CONTENTS
2	BILL OF MATERIAL
3	PANEL LAYOUT
4	POWER DIAGRAM
5	COMMUNICATIONS
6	DISCRETE INPUTS
7	DISCRETE INPUTS
8	RELAY OUTPUTS
9	ANALOG INPUTS
10	ANALOG INPUTS
11	ANALOG INPUTS

Item #	Description	Manufacturer Part No.	PLC-1 Sediment Ponds	PLC-2 Recycle Ponds	Spares
SCE Saginaw Control & Engineering					
1	Type 4X 304 SS Powder coated white Free Standing , for flange mounted disconnect, 72H X 39.5W X 18D	CUR5-72XM4018SS6	Type 4X 1	Type 4X 1	
	64"x37" back panel	SCE-64P37	1	1	
	Large steel print pocket powder coated white	SCE-PP101203	1	1	
2	Fan heater w/thermostat, 400 watt, 120 volt	SCE-HF8001B	1	1	
3	Flxture, LED Light	SCE-LF24	1	1	
4	ICEcube Air Conditioner 316SS painted white	IQ2200VS-126-SS316	1	1	
	ICEcube Air Conditioner remote monitoring	(CM)-XC4-CP2-X03	1	1	
ALLEN BRADLEY Terminal Blocks					
5	TERMINAL BLOCK END ANCHOR	1492-EAJ35	20	20	
6	TERMINAL BLOCK JUMPER, 10 POLE	1492-GJ5-10	8	8	
7	DIN RAIL, STANDARD	199-DR1	1	1	
8	DIN RAIL, RAISED	1492-DR6	2	2	
9	FUSED TERMINAL BLOCK, NEON INDICATOR, 120 VAC	1492-H4	5	5	
10	FUSED TERMINAL BLOCK, LED INDICATOR, 24 VDC	1492-H5	5	5	
11	FUSED TERMINAL BLOCK END BARRIER	1492-N37	8	8	
12	FUSE BLOCK SIDE JUMPERS 10 POLE	1492-N49	1	1	
13	FUSE BLOCK SIDE JUMPER INSULATING SLEEVE	1492-SJS	1	1	
14	RELAY, SPDT, 120VAC COIL, 10AMP CONTACTS	700-HK36A1-4	8	8	2
15	RELAY, SOCKET	700-HN121	8	8	2
16	CIRCUIT BREAKER, 20AMP, SINGLE POLE	1489-A1C200	1	1	
17	CIRCUIT BREAKER, 10AMP, SINGLE POLE	1489-A1C100	4	4	
18	CIRCUIT BREAKER, 5AMP, SINGLE POLE	1489-A1C050	3	3	
19	TERMINAL BLOCK 1 TIER	NEED TO COLOR CODE TERMINALS	BLACK	1492-J6-BL	25
20	TERMINAL BLOCK 1 TIER	NEED TO COLOR CODE TERMINALS	WHITE	1492-J6-W	25
21	TERMINAL BLOCK 1 TIER	NEED TO COLOR CODE TERMINALS	RED	1492-J6-RE	25
22					
23	TERMINAL BLOCK 1 TIER	NEED TO COLOR CODE TERMINALS	BLUE	1492-J6-B	25
24	TERMINAL BLOCK 2 TIER	NEED TO COLOR CODE TERMINALS	YELLOW	1492-JD3-Y	25
25	Weidmuller 10/6(10MM) Term. Blk. Markers	1677220000	506	544	
26	Brady Heatex Thermal H112 wire labels (2000 pcs.)	502448	452	484	
Square D Disconnect					
27	Square D Main Circuit Breaker	HGL26020	1	1	
28	Square D Cable mechanism, 36"	9422CSF30	1	1	
29	Square D Handle mechanism	9422A2	1	1	
30					
BUSSMANN FUSES					
31	FUSE, 2A, 250V, FAST ACTING	AGC-2	15	15	10
32	Bussmann Class CC 600V Touchsafe 2 Pole Fuse Block	CHCC2I	1	1	
33	Bussmann Class CC 600V 20 amp Fuse	FNQ-R-20	2	2	4
Phoenix Contact Surge					
34	Phoenix PLT-SEC-T3-120-P Plug (Power Mains)	2905234	1	1	
35	Phoenix PLT-SEC-T3-B3 Plug Header	2905557	1	1	
36	Phoenix PT 1x2-24DC-ST Plug (one analog signal)	2856032	24	24	
37	Phoenix PT 1x2-BE Base	2856113	24	24	
38	Phoenix TermiTrab TT-SLKK5-F/110AC (Discrete signals)	2765602	32	32	
39	Phoenix End Cover D-UKK 3/5 BK	2770228	2	2	
Pandult Wire Duct					
40	WIRING DUCT, 2"W x 4"H	F2X4LG6	24	24	
41	WIRING DUCT COVER, 2"W	C2LG6	24	24	
42	WIRING DUCT, 3"W x 4"H	F3X4LG6	6	6	
43	WIRING DUCT COVER, 3"W	C3LG6	6	6	
Power Supplies					
44	Sola Uninterruptable Power Supply 850W DIN Rail Mountable	SDU850	1	1	
45	Sola Dry contact relay interface kit	RELAYCARD-SDU	1	1	
46	Phoenix Contact 24VDC 5 Amp Power Supply	2866750	1	1	1
47	Sola automation Transformer, 2Kva, Group C, 120/208/240/277 volt Primary, 120/240 Volt Secondary	HS12F2A S	1	1	
Communications					
48	BLACKBOX CAT6 ETHERNET PATCH CABLE, 3 FT.	EVNSL641-0003	2	2	
49	BLACKBOX CAT6 ETHERNET PATCH CABLE, 10 FT.	EVNSL641-0010	1	1	1
50	BLACK BOX MEDIA CONVERTER, 10 / 100 Mbps, Copper to Fiber, 24vdc, Multimode, ST	LBH100A-HD-ST-24	2	2	1
51	Phoenix Contact 4 Port Ethernet Switch	2891152	1	1	
52	FIS Patch cord, fiber, 62.5/125Um, Multimode, duplex, ST-ST, 2-meters		1	1	1
53	Corning Fiber Patch Panel	SPH-01P	2	2	
54	Corning Fiber Patch Panel ST Inserts	CCH-CP06-15T	2	2	
Miscellaneous Panel Equipment					
55	SQ. D GROUND BAR KIT	PK-23GTA	2	2	
56	SQ. D GROUND BAR INSULATOR KIT	PKGTAB	2	2	
57	Mechanical Gnd Lug.(CED), Positech	MCD1-1025	1	1	
58	Receptacle	CR151, 15 A	1	1	
	Handy Box	#58361 1/2	1	1	
	Handy Box Cover		1	1	
	Plastic Bushing	3210, 1/2"	1	1	

Item #	Description	Manufacturer	Manufacturer Part No.	PLC-1 Sediment Ponds	PLC-2 Recycle Ponds	Specified Spare Parts
1	M340 12 Slot PLC Backplane	Modicon	BMX XBP 1200H	1	1	0
2	M340 PLC Power Supply	Modicon	BMX CPS 3500H	1	1	1
3						
4	M340 PLC Processor	Modicon	BMX P34 2020H	1	1	1
5						
6	M340 PLC 16 pt 120VAC Digital Input Module	Modicon	BMX DAI 1604H	2	2	1
7	M340 PLC 8 pt Relay Output Module	Modicon	BMX DRA 0805H	1	1	1
8	M340 PLC 8 ch 4-20 mA Analog Input Module	Modicon	BMX AMI 0810H	3	3	1
9						
10						
11	M340 PLC I/O Module 20 pt. Flying Leads Connectors	Modicon	BMX FTW30I	3	3	0
12	M340 PLC I/O Module 28 pt. Shld Flying Leads Connectors	Modicon	BMX FTW308s	3	3	0
13						
14						
15						
16	MAGELIS Terminal w/ Touch-Sensitive Screen	Modicon	HMIGTO5310	1	1	0
17						
18						
19	OVATION Ethernet Link Controller	Emerson	5X00419G01/1X00569H01	1	1	1
20	OVATION Modbus Master License	Emerson	ELCMODMST	1	1	0
21						
22						
23						

0			MODIFICATION	ENGINEER	 CURRYCONTROLSCOMPANY 4245 S. PkPkin Road - Lakeland- FL 33811 P.O. Drawer 5408 - Lakeland, FL 33807 (863) 646-5781 - FAX: (863) 646-3899	PLC-2: EAST & WEST RECYCLE PONDS BILL OF MATERIAL	ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER LINED PONDS DEWATERING PROJECT ORANGE COUNTY, FLORIDA	JOB #	J16-8941
0			AS BUILT	LIC. #				DIRECTORY	DRAWINGS
0			CONSTRUCTION	FIRM LIC. #				FILE NAME	8941-BDM-101
A	04.16.16	EJD	SUBMITTAL	MANAGER					
REV.	DATE	APVD.	REMARKS	SCALE					



YELLOW BACKGROUND
BLACK LETTERS

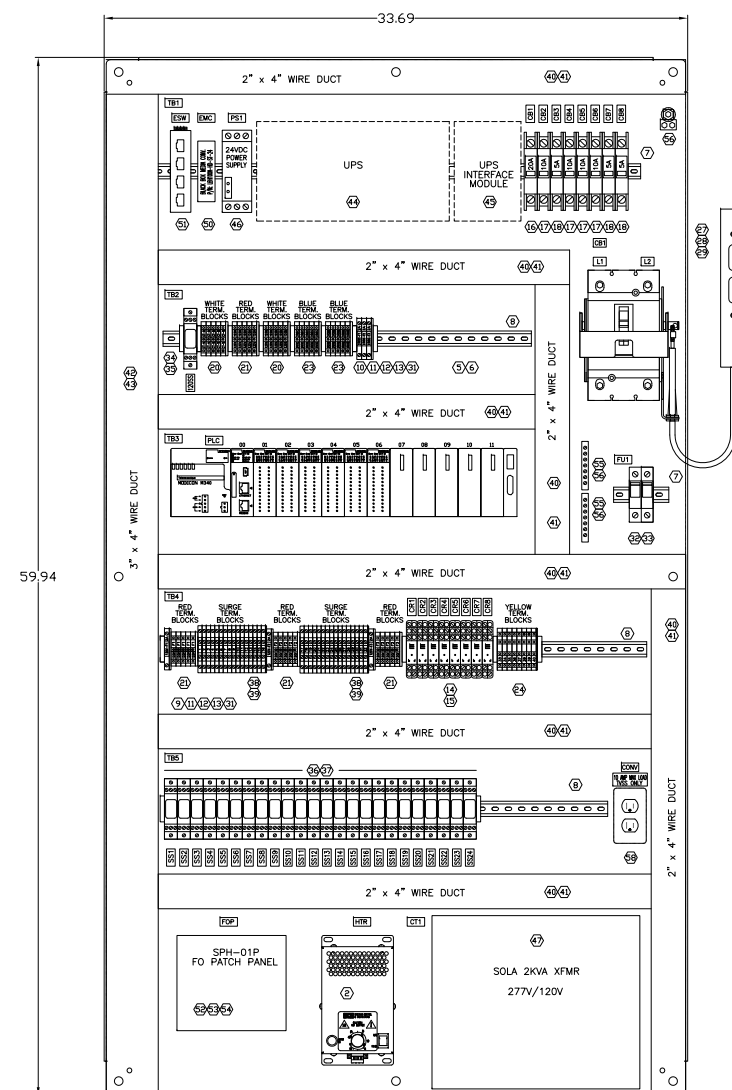
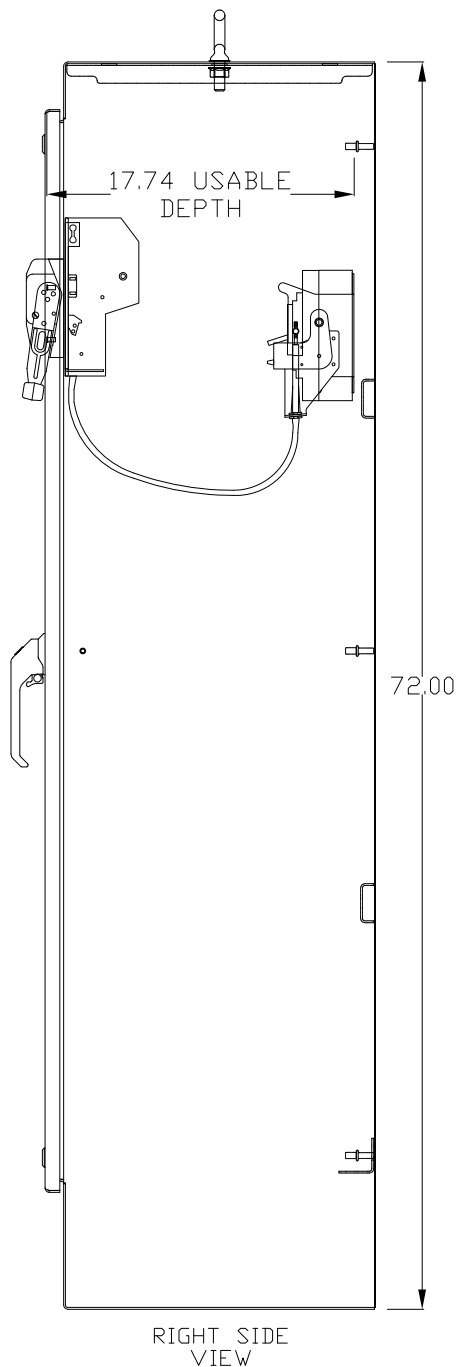
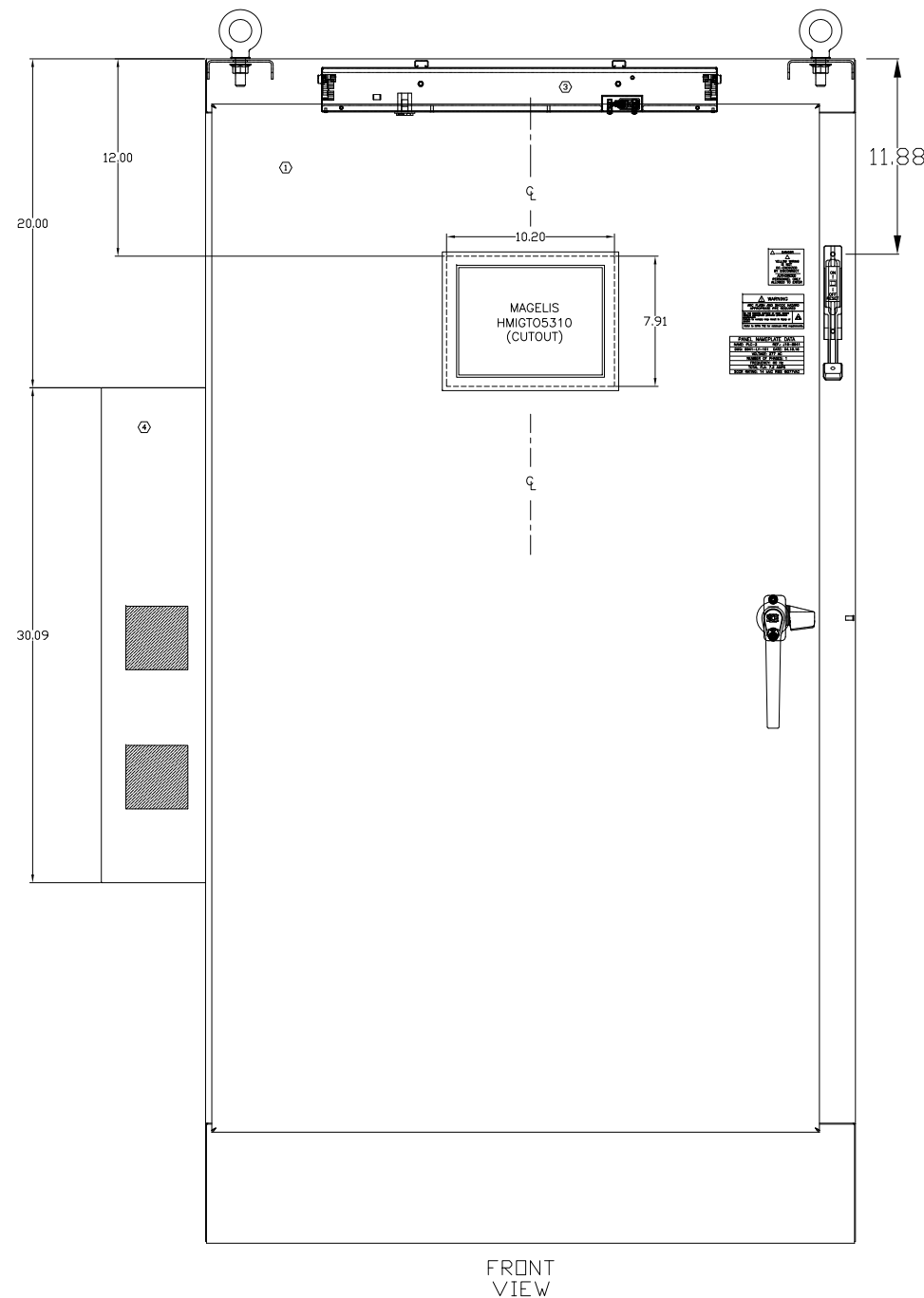
⚠ DANGER
⚠
YELLOW WIRING
IS NOT
DE-ENERGIZED
BY DISCONNECT
AUTHORIZED
PERSONNEL ONLY
ALLOWED TO ENTER

⚠ WARNING
ARC FLASH AND SHOCK HAZARD
APPROPRIATE PPE REQUIRED
Do not operate controls or open covers
without appropriate personal protection
equipment.
Failure to comply may result in injury or
death!
Refer to NFPA 70E for minimum PPE requirements.

OSHA WARNING LABELS
(INCLUDING ARC FLASH)

COLOR CODE TERMINAL BLOCKS:

BLACK : 120V POWER CIRCUITS DE-ENERGIZED WHEN MAIN DISCONNECT IS OPENED
WHITE : 120V NEUTRAL CONDUCTORS
RED : 120V CONTROL CIRCUITS DE-ENERGIZED WHEN MAIN DISCONNECT IS OPENED
YELLOW : 120V CONTROL CIRCUITS WHICH REMAIN HOT WHEN MAIN DISCONNECT IS OPENED
BLUE : DC WIRING
GRAY : SHIELDS IN DC WIRING
GREEN : GROUND TERMINAL BLOCKS



0			MODIFICATION	ENGINEER
0			AS BUILT	LIC. #
0			CONSTRUCTION	FIRM LIC. #
A	4.16.16	EJD	SUBMITTAL	MANAGER
REV.	DATE	APVD.	REMARKS	SCALE



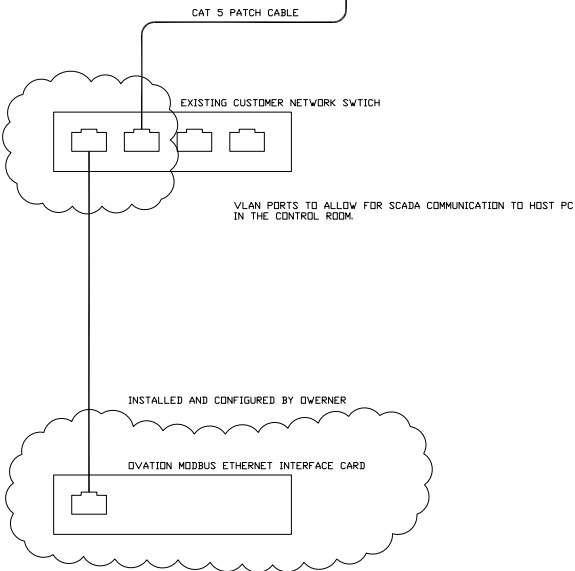
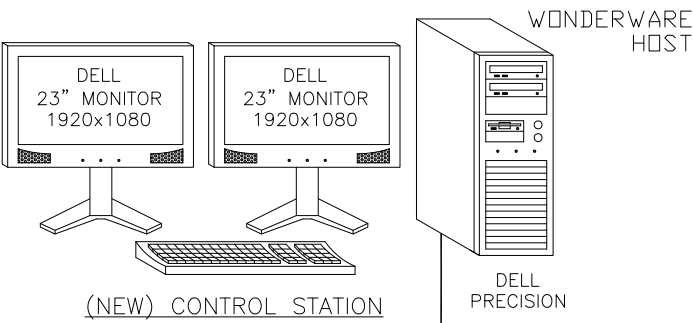
CURRYCONTROLSCOMPANY
4245 S. PkLn Road - Lakeland- FL 33811
P.O. Drawer 5408 - Lakeland, FL 33807
(863) 646-5781 - FAX: (863) 646-3899

PLC-2: EAST & WEST
RECYCLE PONDS
PANEL LAYOUT

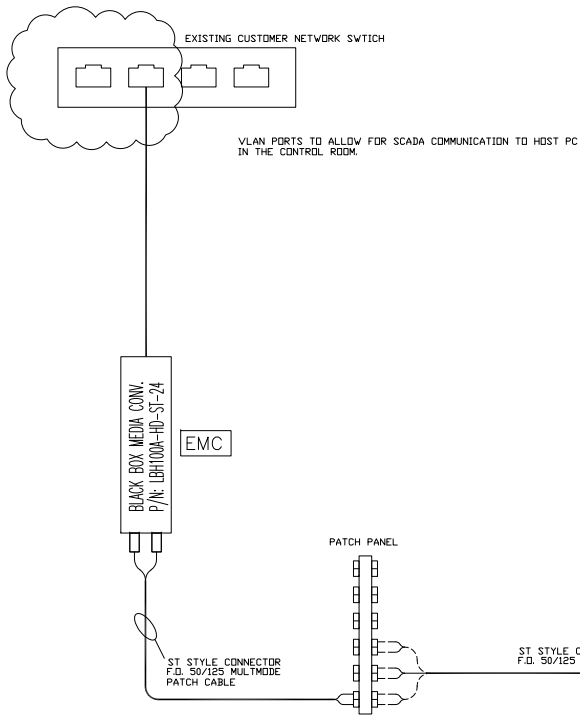
ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA

JOB # J16-8941
DIRECTORY DRAWINGS
FILE NAME 8941-LY-101
SHEET OF

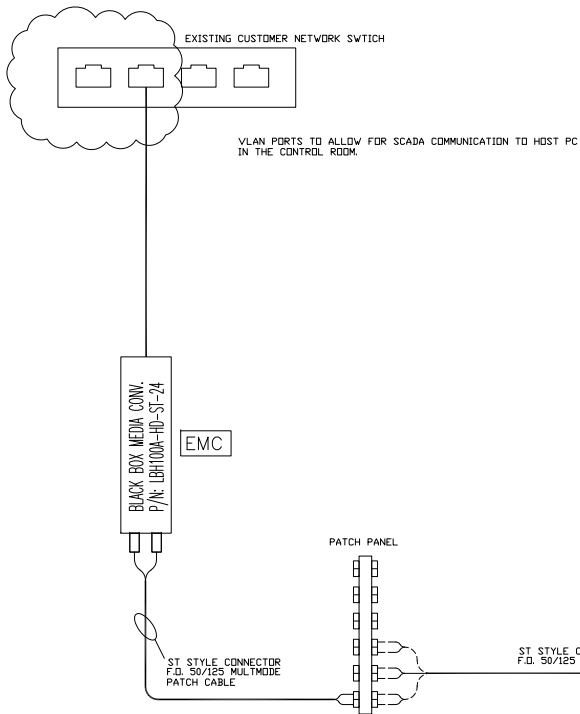
OPERATORS CONTROL ROOM
(NEW) CONTROL STATION



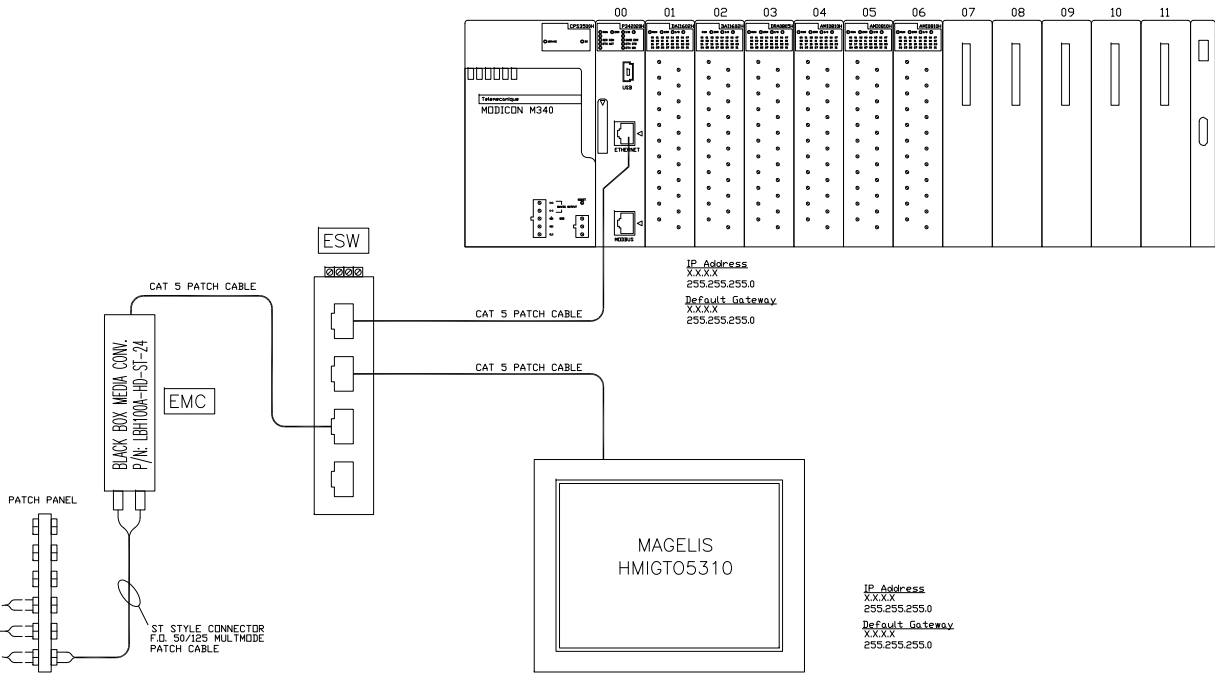
SOUTH OFFLOADING BLDG



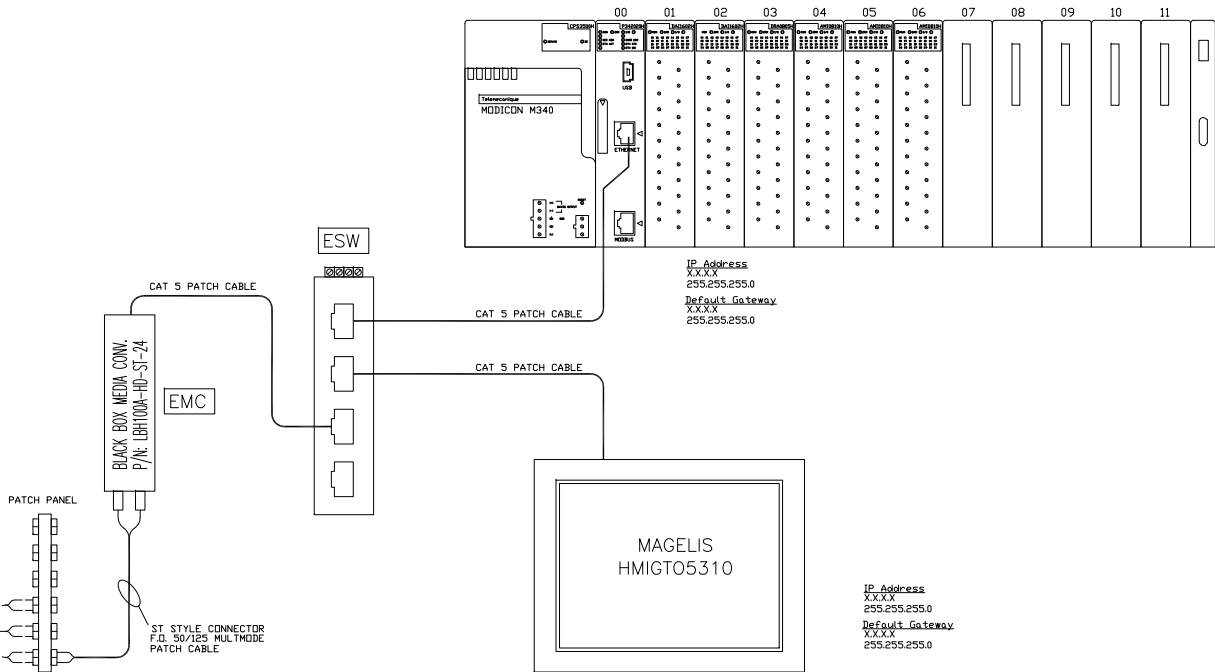
CRUSHER BLDG



PLC1 PANEL (NORTH & SOUTH)

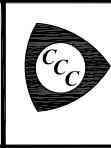


PLC2 PANEL (EAST & WEST)



0			MODIFICATION
0			AS BUILT
0			CONSTRUCTION
A	04.16.16	EJD	SUBMITTAL
REV.	DATE	APVD.	REMARKS

ENGINEER
LIC. #
FIRM LIC. #
MANAGER
SCALE

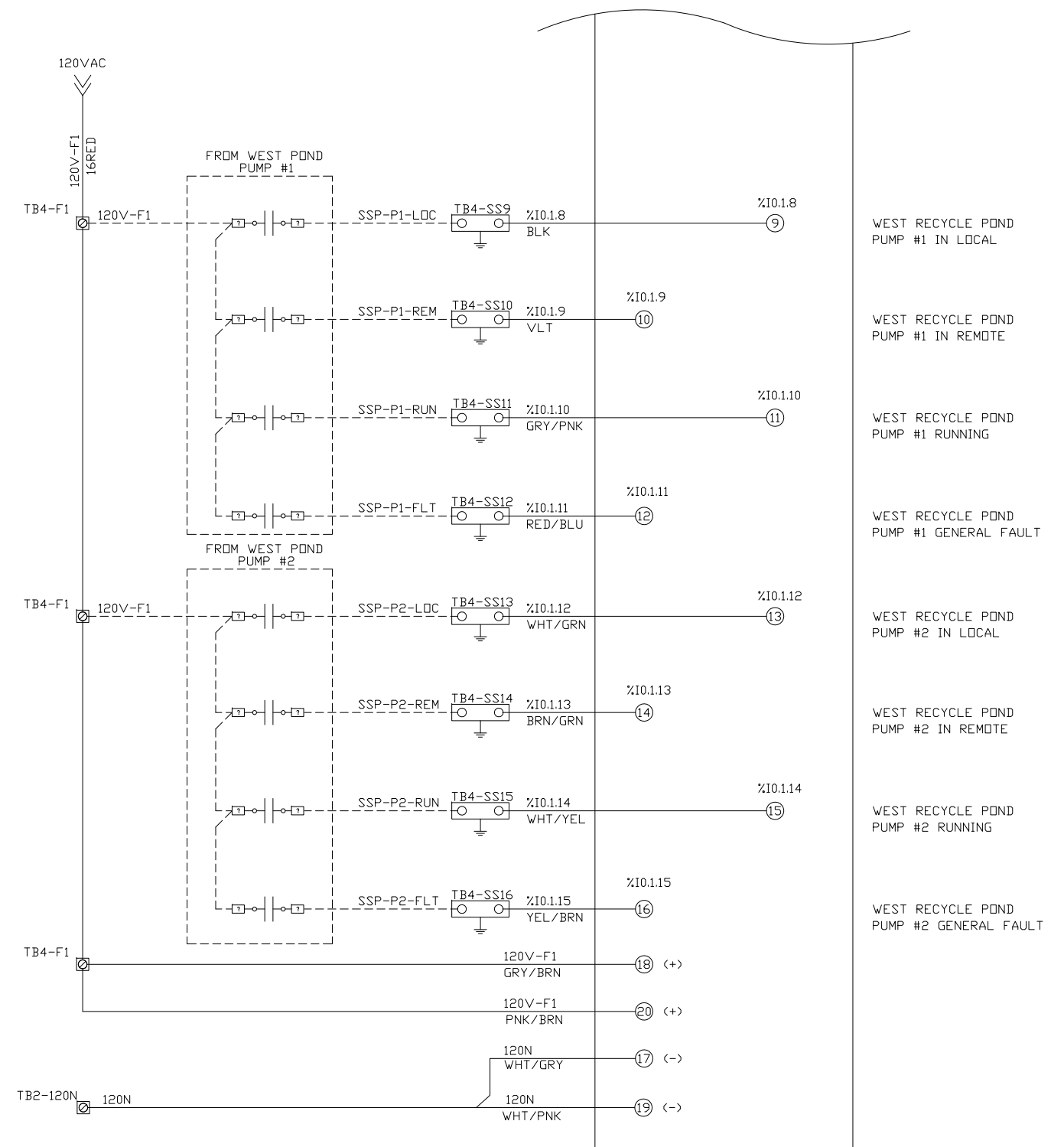
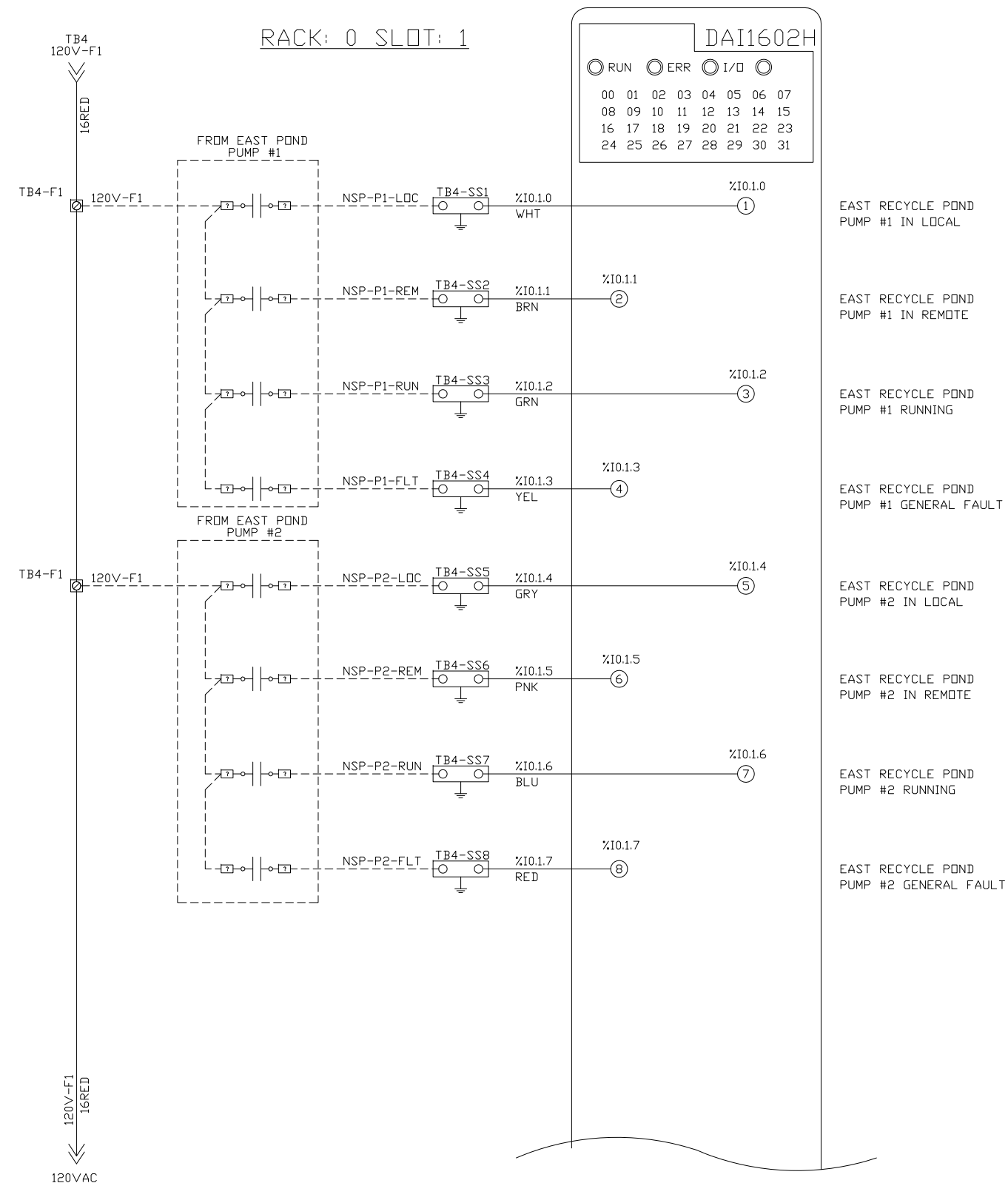


CURRYCONTROLSCOMPANY
4245 S. Plpkin Road - Lakeland- FL 33811
P.O. Drawer 5408 - Lakeland, FL 33807
(863) 646-5781 - FAX: (863) 646-3899

SYSTEM COMMUNICATIONS

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA

JOB #	J16-8941
DIRECTORY	DRAWINGS
FILE NAME	8941-PLC-101
SHEET	OF



LEGEND:

☐ ITEMS OR DEVICES LOCATED IN THE FIELD, REMOTE TO A PANEL.

— WIRING INTERNAL TO PANEL

--- WIRING EXTERNAL TO PANEL

0			MODIFICATION	ENGINEER
0			AS BUILT	LIC. #
0			CONSTRUCTION	FIRM LIC. #
A	04.16.16	EJD	SUBMITTAL	MANAGER
REV.	DATE	APVD.	REMARKS	SCALE



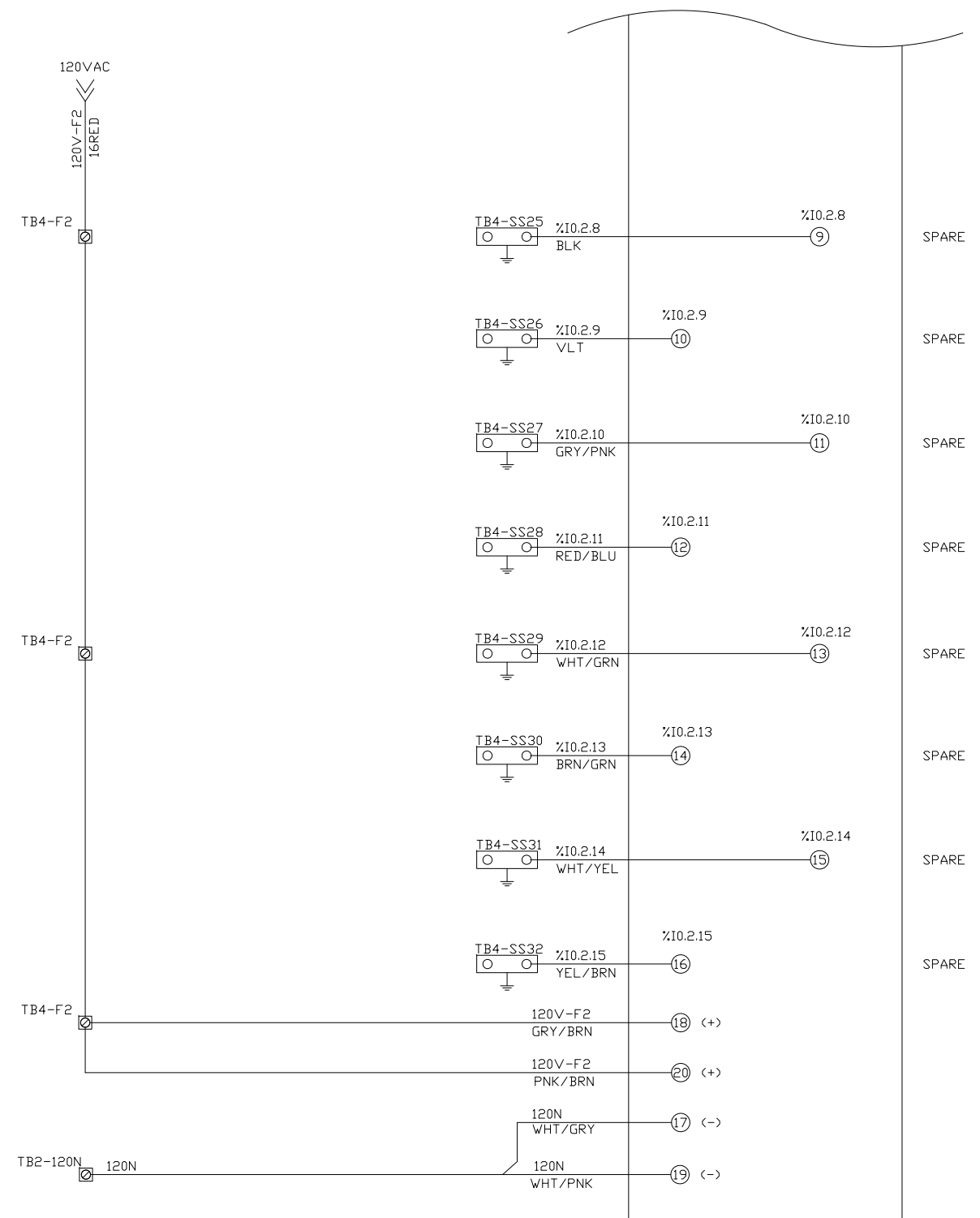
CURRYCONTROLSCOMPANY

4245 S. Plpkin Road - Lakeland- FL 33811
P.O. Drawer 5408 - Lakeland, FL 33807
(863) 646-5781 - FAX: (863) 646-3899

PLC-2: EAST & WEST
RECYCLE PONDS
PLC:0 SLOT:1
DIGITAL INPUT CARD

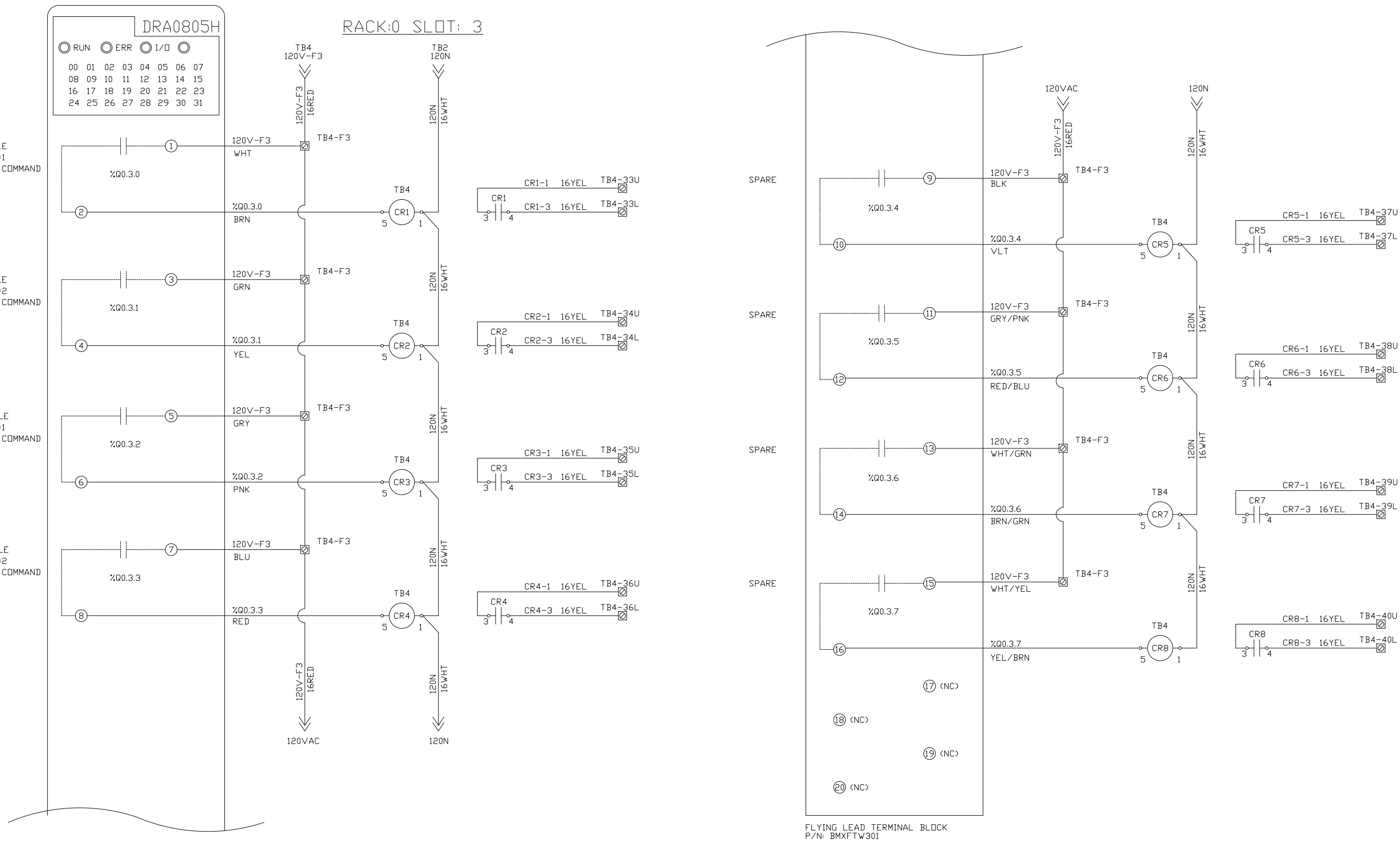
ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA

JOB #	J16-8941
DIRECTORY	DRAWINGS
FILE NAME	8941-DI-101
SHEET	OF



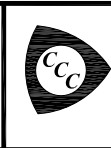
--- WIRING EXTERNAL TO PANEL

0			MODIFICATION	ENGINEER	 CURRYCONTROLSCOMPANY 4245 S. Pipkin Road - Lakeland- FL 33811 P.O. Drawer 5408 - Lakeland, FL 33807 (863) 646-5781 - FAX: (863) 646-3899	PLC-2: EAST & WEST RECYCLE PONDS PLC:0 SLOT:2 DIGITAL INPUT CARD	ORLANDO UTILITIES COMMISSIO N STANTON ENERGY CENTER LINED PONDS DEWATERING PROJECT ORANGE COUNTY, FLORIDA	JOB #	J16-8941
0			AS BUILT	LIC. #				DRAWINGS	
0			CONSTRUCTION	FIRM LIC. #				FILE NAME	8941-DI-102
A	04.16.16	EJD	SUBMITTAL	MANAGER					
REV.	DATE	APVD.	REMARKS	SCALE					



0			MODIFICATION
0			AS BUILT
0			CONSTRUCTION
A	04.16.16	EJD	SUBMITTAL
REV.	DATE	APVD.	REMARKS

ENGINEER
LIC. #
FIRM LIC. #
MANAGER
SCALE



CURRYCONTROLSCOMPANY
4245 S. Pipkin Road - Lakeland, FL 33811
P.O. Drawer 5408 - Lakeland, FL 33807
(863) 646-5781 - FAX: (863) 646-3899

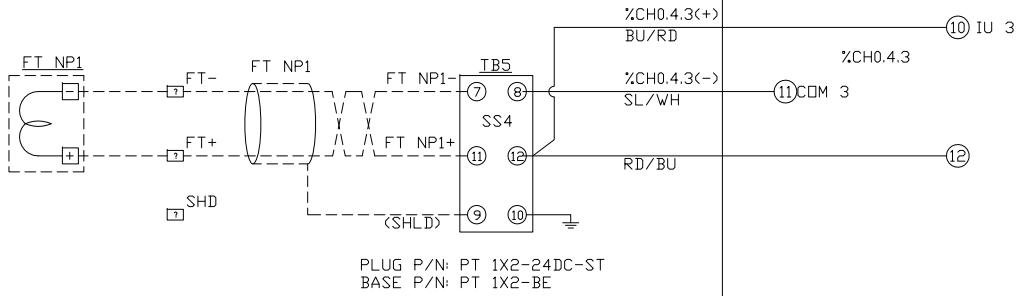
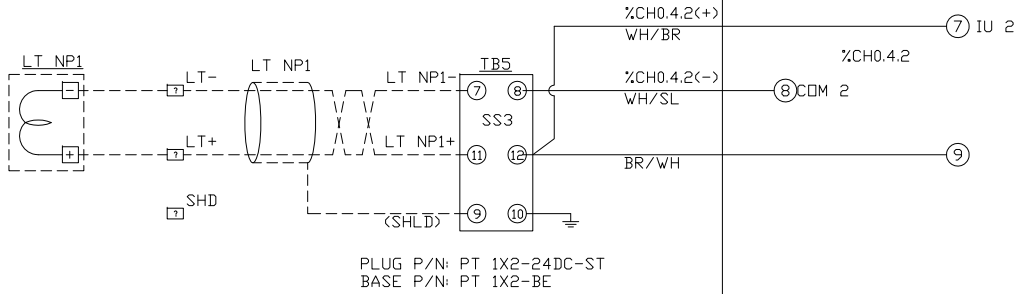
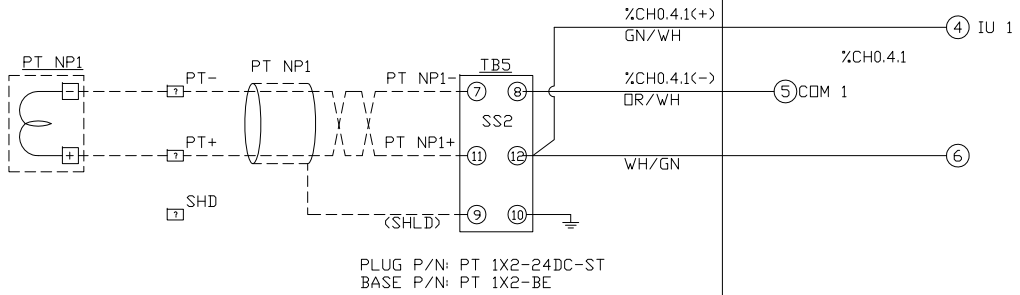
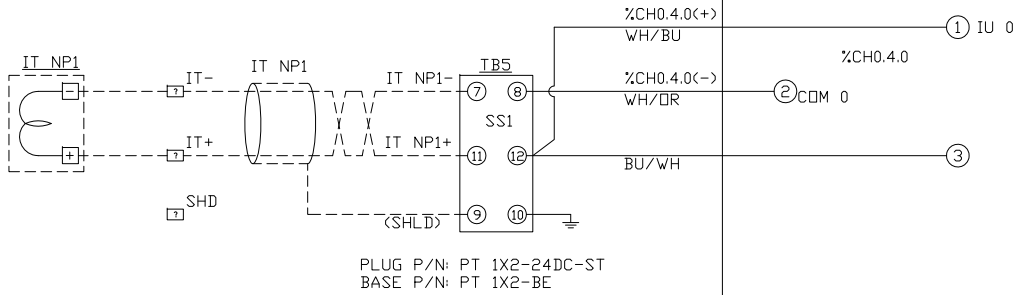
PLC-2: EAST & WEST
RECYCLE PONDS
PLC:0 SLOT:3
RELAY OUTPUT CARD

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA

JOB #	J16-8941
DIRECTORY	DRAWINGS
FILE NAME	8941-DD-101
SHEET	OF

RACK: 0 SLOT: 4

AMI0810H																													
○ RUN ○ ERR ○ I/O ○																													
00	01	02	03	04	05	06	07																						
08	09	10	11	12	13	14	15																						
16	17	18	19	20	21	22	23																						
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⑬ (NC)

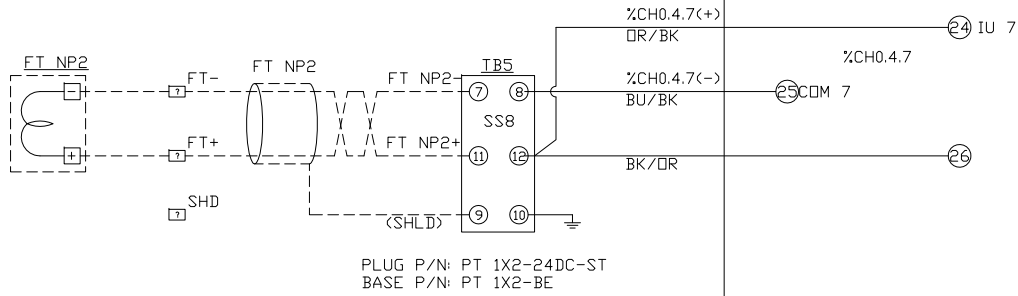
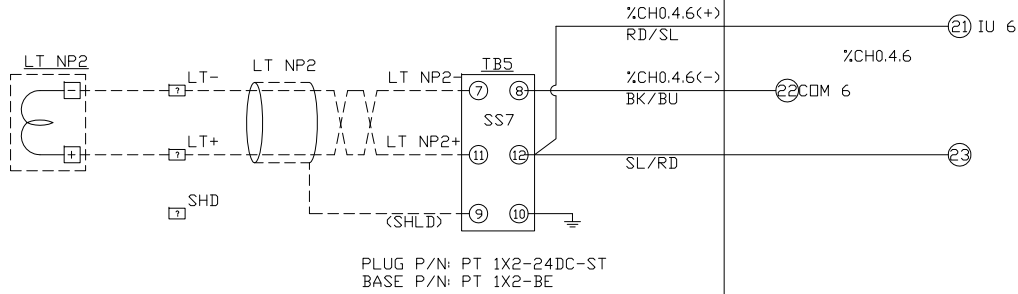
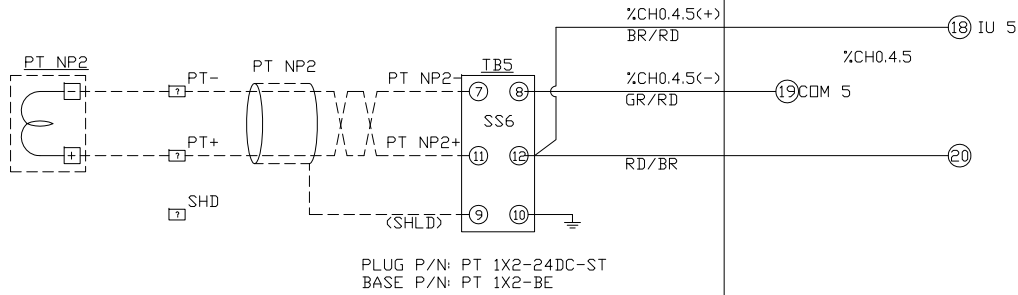
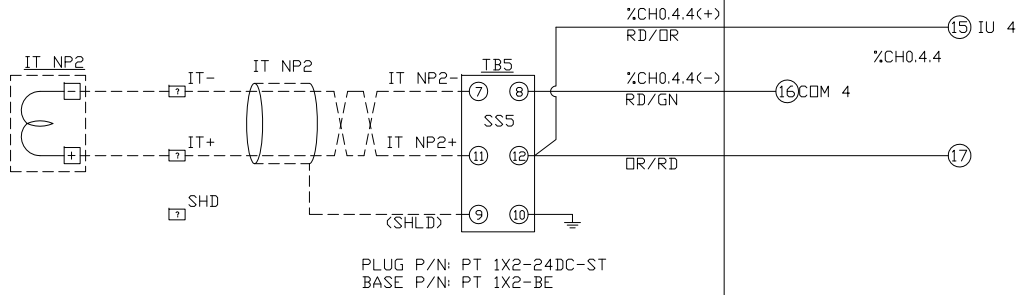
⑭ (NC)

EAST RECYCLE POND
PUMP #1 MOTOR AMPS
(4-20mA)
0-???? AMPs

EAST RECYCLE POND
PUMP #1 PRESSURE
(4-20mA)
0-???? PSI

EAST RECYCLE POND
PUMP #1 LEVEL
(4-20mA)
0-???? FEET

EAST RECYCLE POND
PUMP #1 FLOW
(4-20mA)
0-???? GPM



㉗ (NC)

㉘ (NC)

EAST RECYCLE POND
PUMP #2 MOTOR AMPS
(4-20mA)
0-???? AMPs

EAST RECYCLE POND
PUMP #2 PRESSURE
(4-20mA)
0-???? PSI

EAST RECYCLE POND
PUMP #2 LEVEL
(4-20mA)
0-???? FEET

EAST RECYCLE POND
PUMP #2 FLOW
(4-20mA)
0-???? GPM

P/N: BMXFTW308S PREWIRED RTB

* 8 ISOLATED CHANNELS

NOTES:

- * WHEN USING AMI 0810 AI MODULE BE SURE USE TO USE THE 28 PIN TERMINAL BLOCK.
P/N: BMX FTW 308S
- * IF NOTHING IS CONNECTED TO A CHANNEL THAT IS CONFIGURED, THE PLC WILL INDICATE I/O ERROR AS A BROKEN WIRE.

LEGEND:

- ITEMS OR DEVICES LOCATED IN THE FIELD, REMOTE TO A PANEL.
- WIRING INTERNAL TO PANEL
- WIRING EXTERNAL TO PANEL

0			MODIFICATION
0			AS BUILT
0			CONSTRUCTION
A	04.16.16	EJD	SUBMITTAL
REV.	DATE	APVD.	REMARKS

ENGINEER
LIC. #
FIRM LIC. #
MANAGER
SCALE



CURRYCONTROLSCOMPANY

4245 S. Pipkin Road - Lakeland- FL 33811
P.O. Drawer 5408 - Lakeland, FL 33807
(863) 646-5781 - FAX: (863) 646-3899

PLC-2: EAST & WEST
RECYCLE PONDS
PLC:0 SLOT:4
ANALOG INPUT CARD

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA

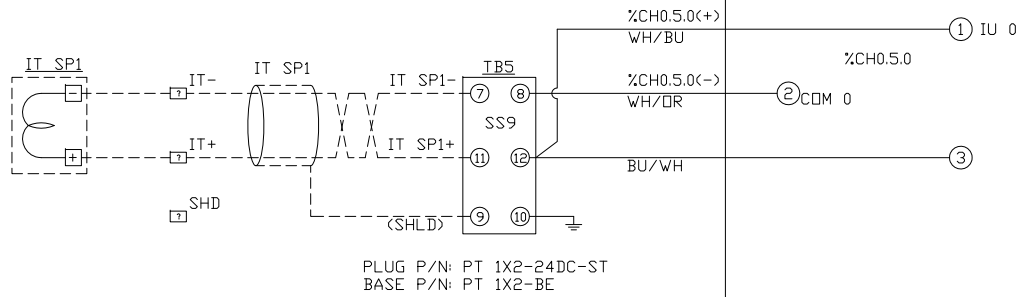
JOB #	J16-8941
DIRECTORY	DRAWINGS
FILE NAME	8941-AI-101
SHEET	OF

RACK: 0 SLOT: 5

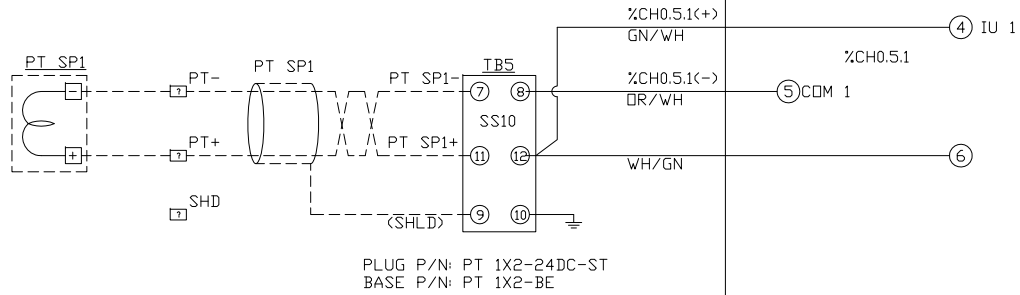
AMI0810H

○ RUN ○ ERR ○ I/O ○

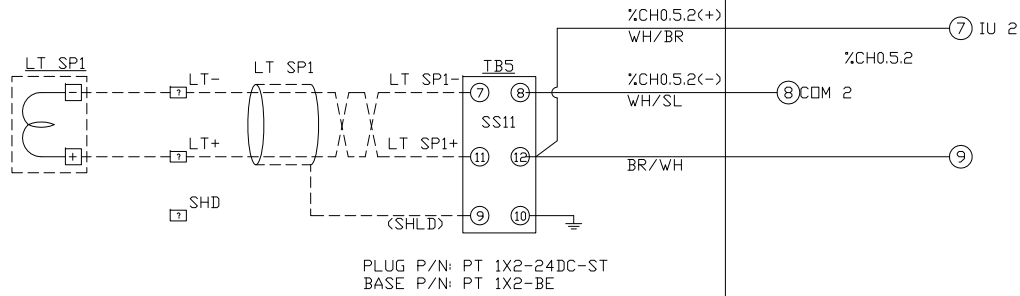
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08 09 10 11 12 13 14 15
16 17 18 19 20 21 22 23
24 25 26 27 28 29 30 31



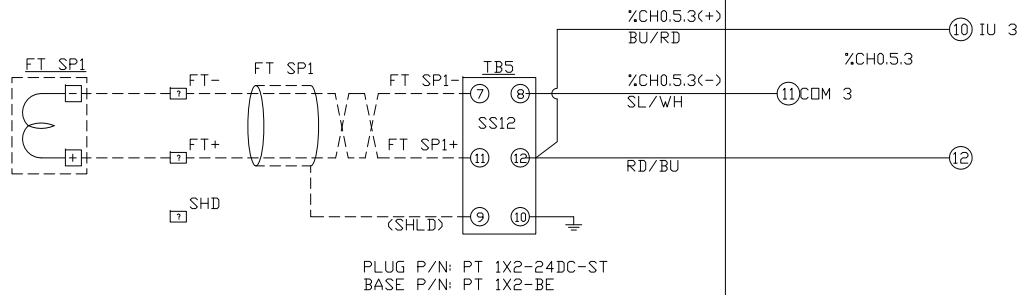
WEST RECYCLE POND
PUMP #1 MOTOR AMPS
(4-20mA)
0-???? AMPs



WEST RECYCLE POND
PUMP #1 PRESSURE
(4-20mA)
0-???? PSI



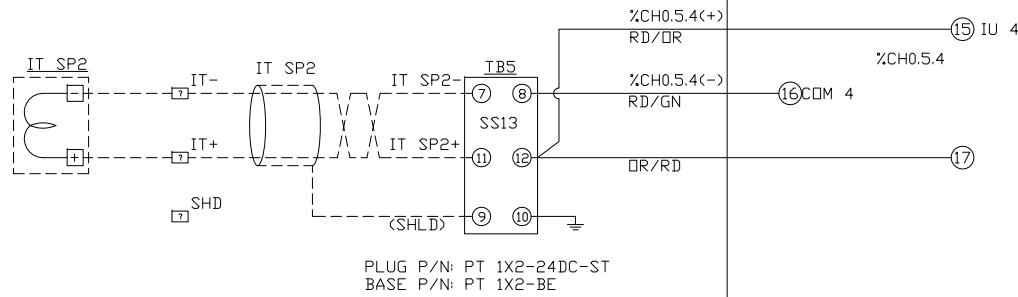
WEST RECYCLE POND
PUMP #1 LEVEL
(4-20mA)
0-???? FEET



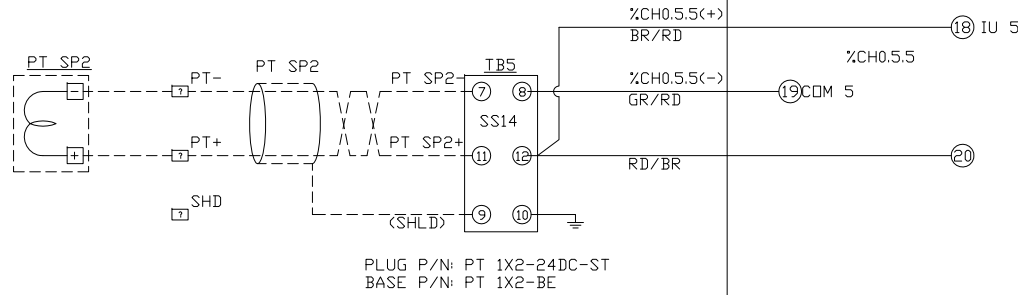
WEST RECYCLE POND
PUMP #1 FLOW
(4-20mA)
0-???? GPM

⑬ (NC)

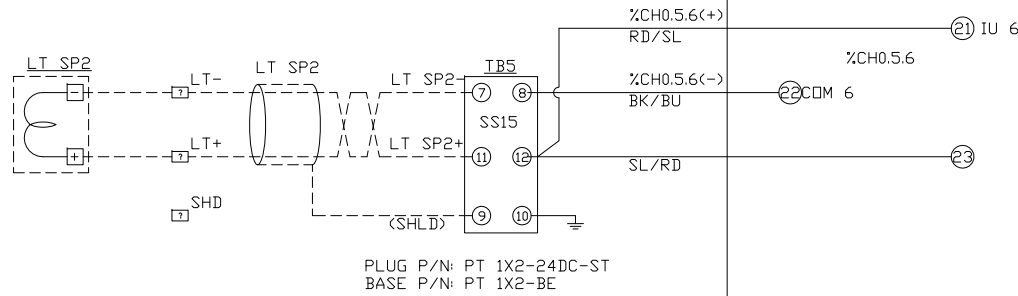
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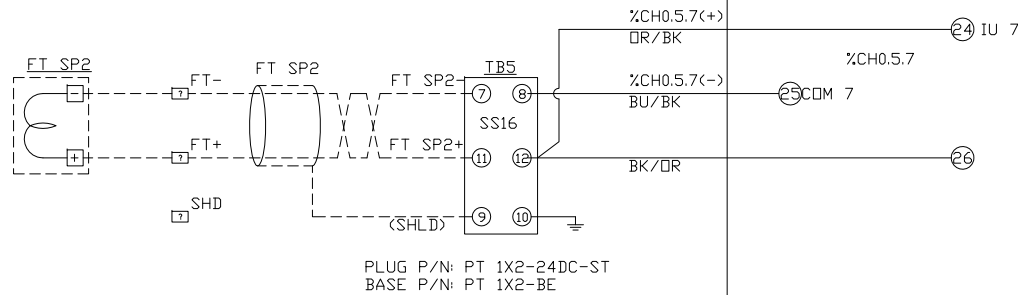
WEST RECYCLE POND
PUMP #2 MOTOR AMPS
(4-20mA)
0-???? AMPs



WEST RECYCLE POND
PUMP #2 PRESSURE
(4-20mA)
0-???? PSI



WEST RECYCLE POND
PUMP #2 LEVEL
(4-20mA)
0-???? FEET



WEST RECYCLE POND
PUMP #2 FLOW
(4-20mA)
0-???? GPM

㉗ (NC)

㉘ (NC)

* 8 ISOLATED CHANNELS

P/N: BMXFTW308S PREWIRED RTB

NOTES:

- * WHEN USING AMI 0810 AI MODULE BE SURE USE TO USE THE 28 PIN TERMINAL BLOCK.
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LEGEND:

- ITEMS OR DEVICES LOCATED IN THE FIELD, REMOTE TO A PANEL.
- WIRING INTERNAL TO PANEL
- WIRING EXTERNAL TO PANEL

0			MODIFICATION
0			AS BUILT
0			CONSTRUCTION
A	04.16.16	EJD	SUBMITTAL
REV.	DATE	APVD.	REMARKS

ENGINEER
LIC. #
FIRM LIC. #
MANAGER
SCALE



CURRYCONTROLSCOMPANY

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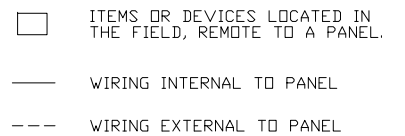
PLC-2: EAST & WEST
RECYCLE PONDS
PLC:0 SLOT:5
ANALOG INPUT CARD

ORLANDO UTILITIES COMMISSION
STANTON ENERGY CENTER
LINED PONDS DEWATERING PROJECT
ORANGE COUNTY, FLORIDA

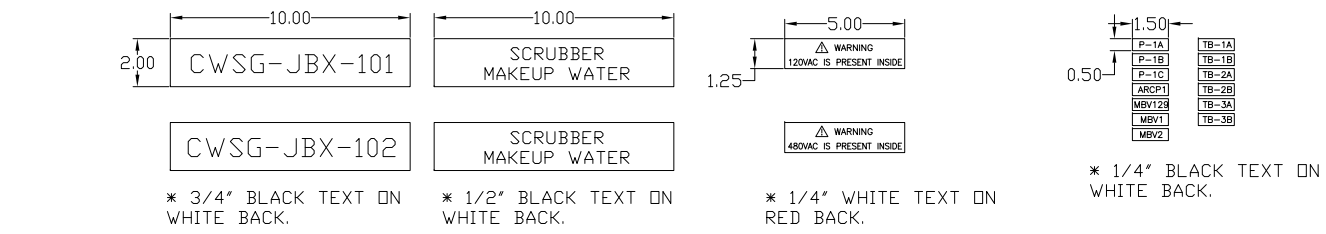
JOB #	J16-8941
DIRECTORY	DRAWINGS
FILE NAME	8941-AI-102
SHEET	OF



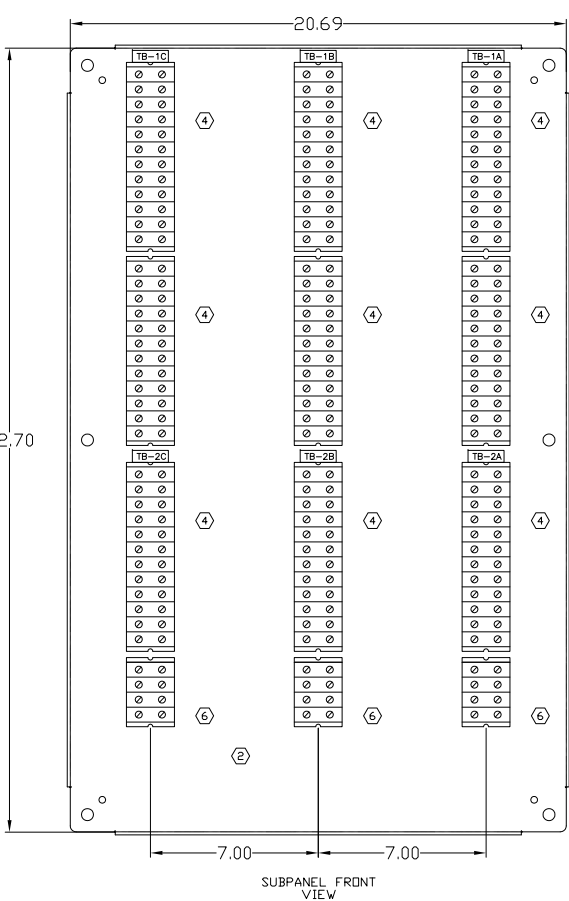
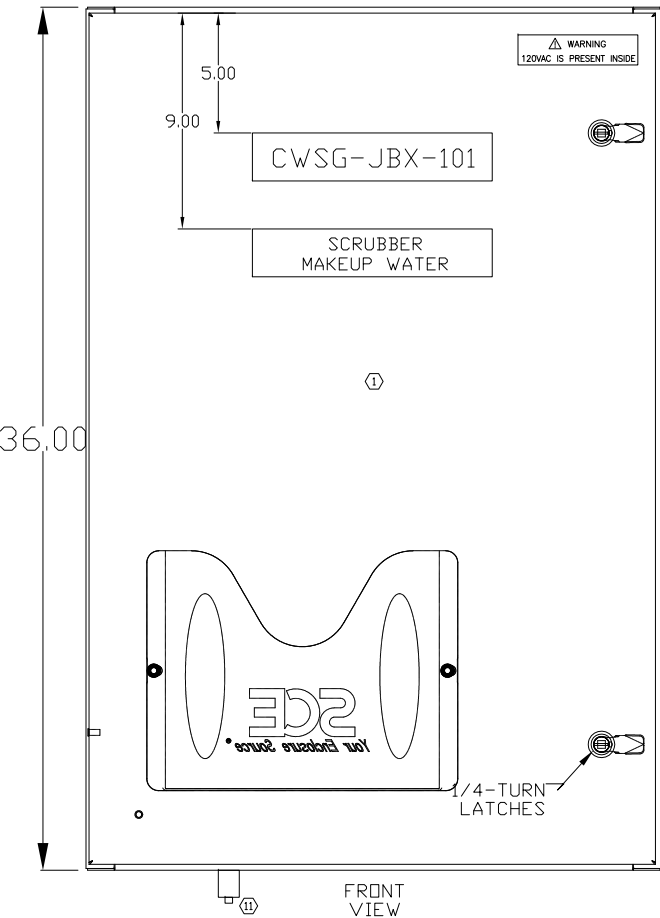
- LEGEND:



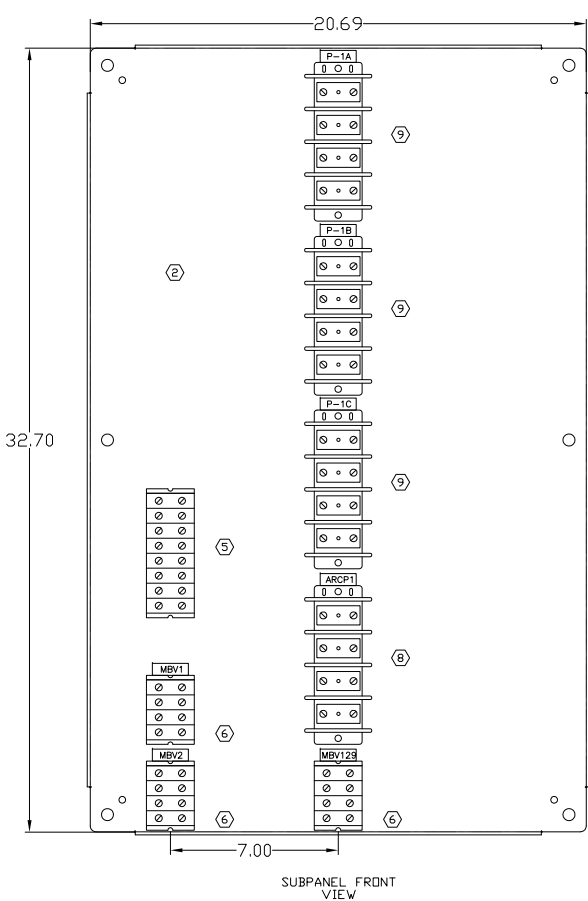
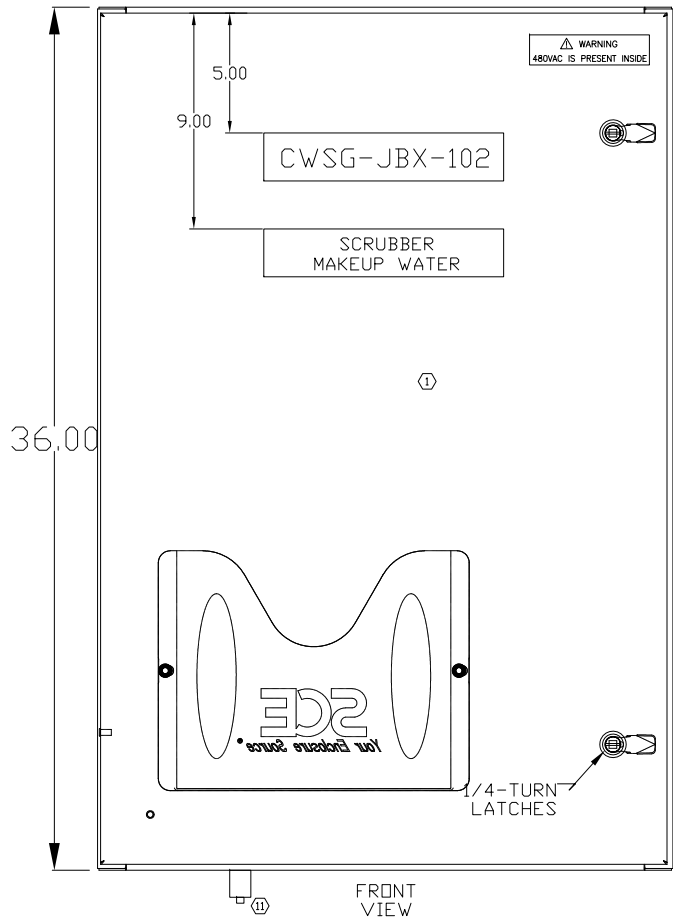
0			MODIFICATION	ENGINEER	 CURRYCONTROLSCOMPANY 4245 S. PIPKIN Road - Lakeland- FL 33811 P.O. Drawer 5408 - Lakeland, FL 33807 (863) 646-5781 - FAX: (863) 646-3899	PLC-2: EAST & WEST RECYCLE PONDS PLC:0 SLOT:6 ANALOG INPUT CARD	ORLANDO UTILITIES COMMISSION STANTON ENERGY CENTER LINED PONDS DEWATERING PROJECT ORANGE COUNTY, FLORIDA	JOB #	J16-8941
0			AS_BUILT	LIC. #				DIRECTORY	DRAWINGS
0			CONSTRUCTION	FIRM LIC. #				FILE NAME	8941-AI-103
A	04.16.16	EJD	SUBMITTAL	MANAGER				SHEET	OF
REV.	DATE	APVD.	REMARKS	SCALE					



Item #	Description	Manufacturer	Manufacturer Part No.	CWSG JBX 101	CWSG JBX 102	Total Quantities
1	Saginaw 36x24x08 316SS enclosure	Saginaw	SCE-36EL2408SS6LP	1	1	2
2	Saginaw subpanel	Saginaw	SCE-36P24	1	1	2
3						
4	Terminal Block Barrier 12 Position	Marathon	1512 STD	9	0	9
5	Terminal Block Barrier 8 Position	Marathon	1508 STD	0	1	1
6	Terminal Block Barrier 4 Position	Marathon	1504 STD	3	3	6
7						
8	Power Distribution & Terminal Blocks	Bussman	16000-4	0	1	1
9	Power Distribution & Terminal Blocks	Bussman	16005-4	0	3	3
10						
11	Drains and Breathers	Crouse-Hinds	ECD384	1	1	2
12						
13						
14						
15						
16						
17						



CWSG-JBX-101
CONTROL JB PANEL VIEW



CWSG-JBX-102
POWER JB PANEL VIEW

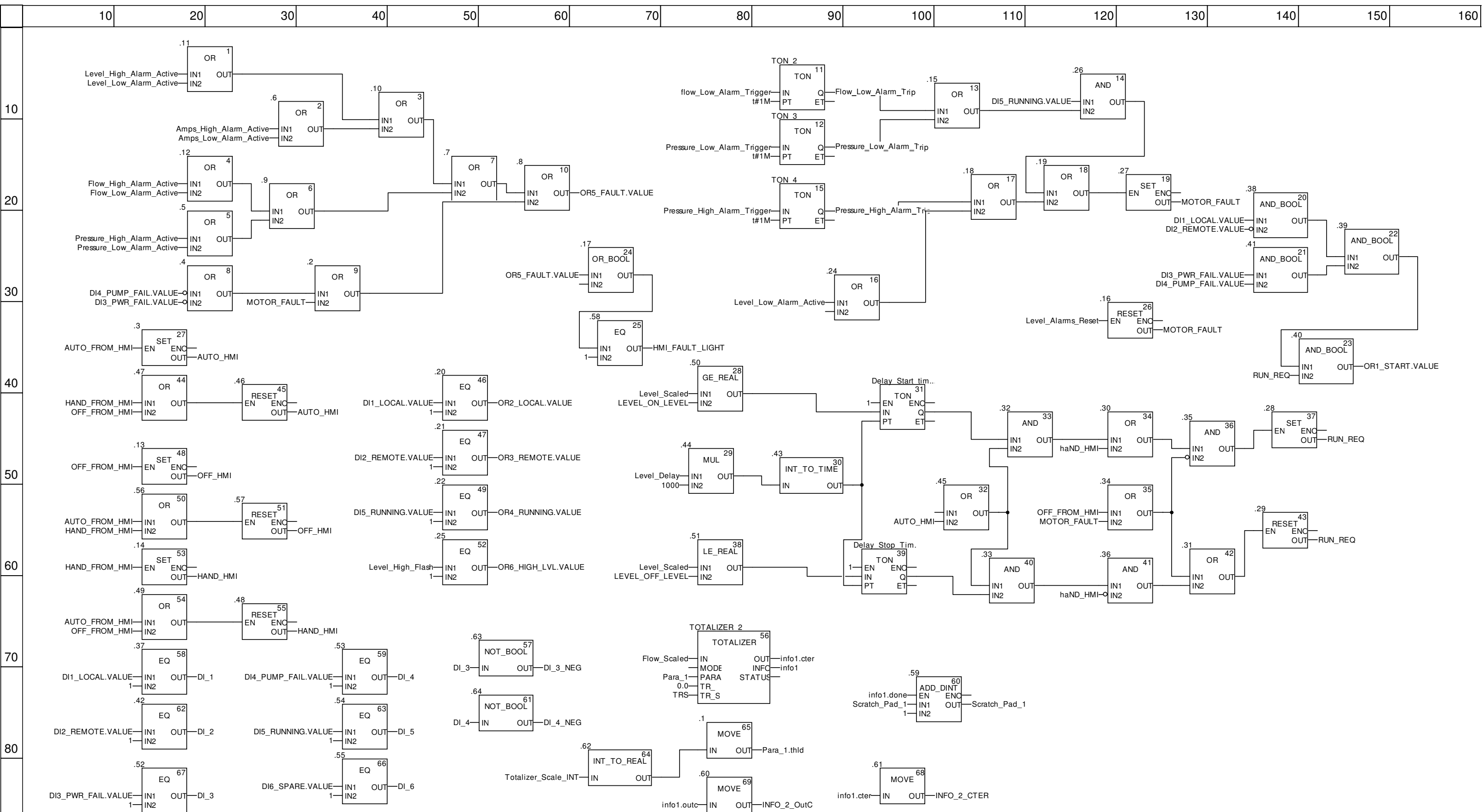


APPENDIX

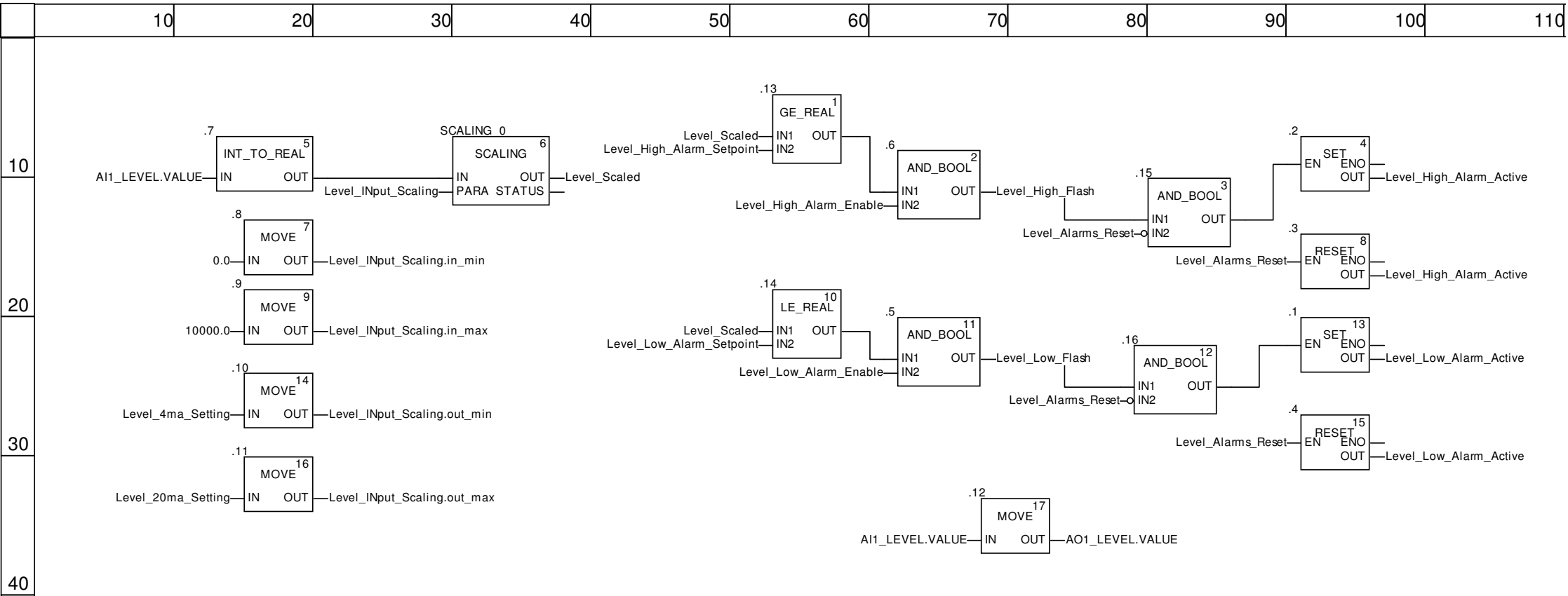
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Existing Coal Ponds and **Recycle Basins Control** **Panel Logic**

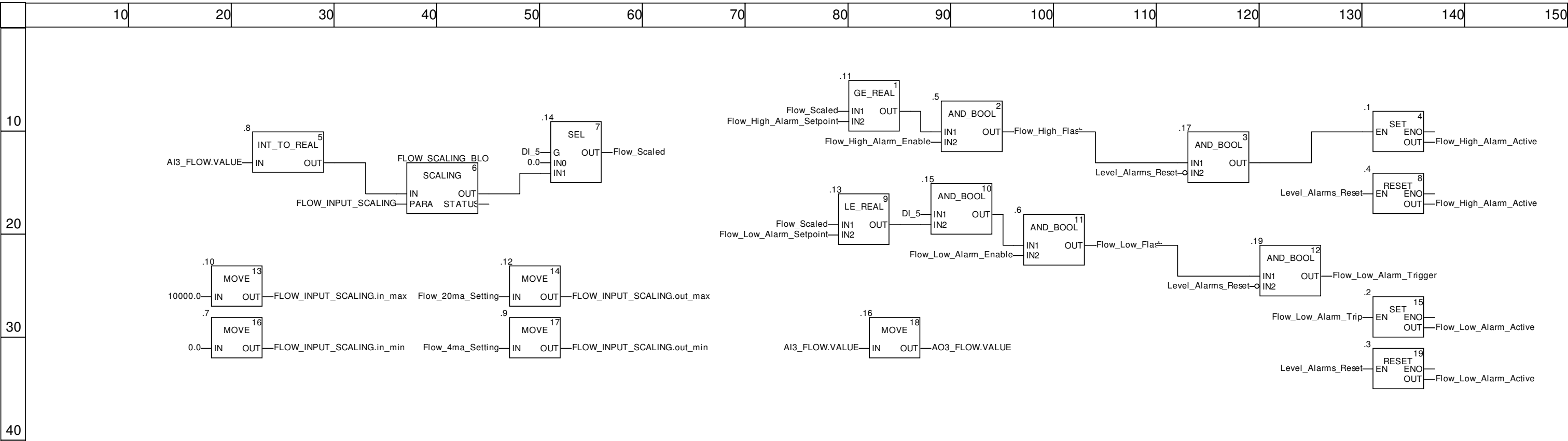
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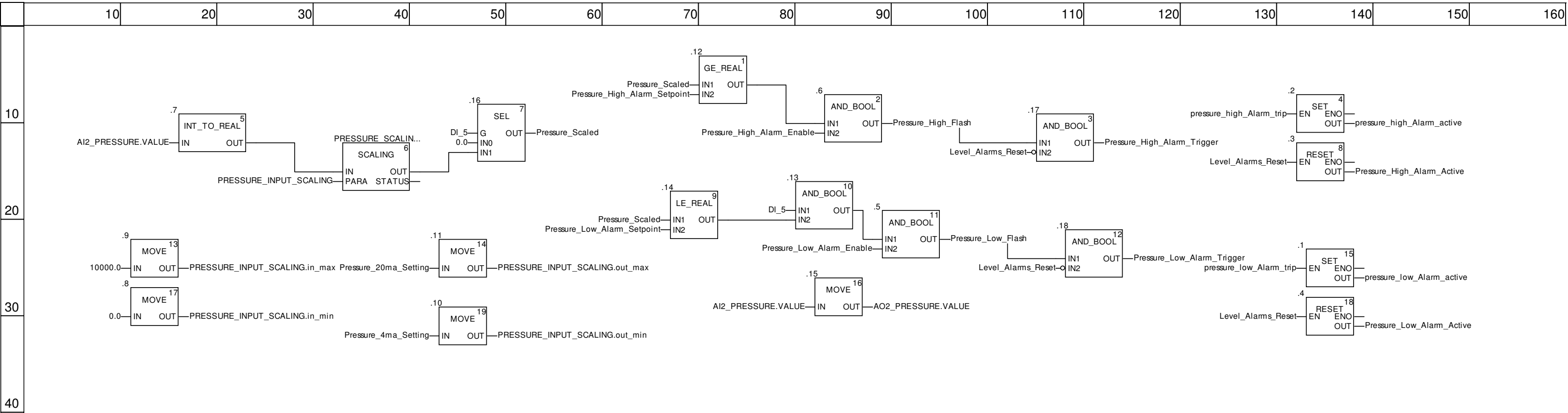
Level_Ect



Flow



Pressure



AMPERAGE

	10	20	30	40	50	60	70	80	90	100	110	120	130	140
10														
20														
30														
40														

Variables

Name	Type	Address	Value	Comment	Time stamp	R/W Rights	Exchange On	Task	Retain	
Amps_4ma_Setting	REAL	%MW42	0.0			NO	1	MAST	1	
Amps_20ma_Setting	REAL	%MW44	10.0			NO	1	MAST	1	
Amps_High_Alarm_Active	BOOL	%MW300.0			None	NO	1	MAST	1	
Amps_High_Alarm_Enable	BOOL	%MW40.0			None	NO	1	MAST	1	
Amps_High_Alarm_Setpoint	REAL	%MW46	9.0			NO	1	MAST	1	
Amps_High_Flash	BOOL	%MW40.2			None	NO	1	MAST	1	
Amps_Low_Alarm_Active	BOOL	%MW300.1			None	NO	1	MAST	1	
Amps_Low_Alarm_Enable	BOOL	%MW40.1			None	NO	1	MAST	1	
Amps_Low_Alarm_Setpoint	REAL	%MW48	1.5			NO	1	MAST	1	
Amps_Low_Flash	BOOL	%MW40.3			None	NO	1	MAST	1	
Amps_Scaled	REAL	%MW50				NO	1	MAST	1	
Analog_Test	INT					NO	1	MAST	1	
AUTO_FROTH_MI	BOOL	%MW200.0			None	NO	1	MAST	1	
AUTO_HMI	BOOL	%MW200.1			None	NO	1	MAST	1	
DI_1	BOOL	%MW320.1		Door_Sw_Local	None	NO	1	MAST	1	
DI_2	BOOL	%MW320.2		Door_Sw_Remote	None	NO	1	MAST	1	
DI_3	BOOL	%MW300.3		UPS_Fail	None	NO	1	MAST	1	
DI_3_NG	BOOL	%MW300.7			None	NO	1	MAST	1	
DI_4	BOOL	%MW300.4		777_Motor_OL	None	NO	1	MAST	1	
DI_4_NG	BOOL	%MW300.8			None	NO	1	MAST	1	
DI_5	BOOL	%MW300.5		Pump_Running	None	NO	1	MAST	1	
DI_6	BOOL	%MW300.6		Spare	None	NO	1	MAST	1	
Flow_4ma_Setting	REAL	%MW62	0.0			NO	1	MAST	1	
Flow_20ma_Setting	REAL	%MW64	200.0			NO	1	MAST	1	
Flow_High_Alarm_Active	BOOL	%MW310.0			None	NO	1	MAST	1	

Variables

Name	Type	Address	Value	Comment	Time stampi	R/W Rights	Exchange On	Task	Retain	
Flow_High_Alarm_Enable	BOOL	%MW60.0			None	NO	1	MAST	1	
Flow_High_Alarm_Setpoint	REAL	%MW66	150.0			NO	1	MAST	1	
Flow_High_Flash	BOOL	%MW60.2			None	NO	1	MAST	1	
Flow_Low_Alarm_Active	BOOL	%MW310.1			None	NO	1	MAST	1	
Flow_Low_Alarm_Enable	BOOL	%MW60.1			None	NO	1	MAST	1	
Flow_Low_Alarm_Setpoint	REAL	%MW68	25.0			NO	1	MAST	1	
Flow_Low_Alarm_Trip	BOOL	%MW310.2			None	NO	1	MAST	1	
Flow_Low_Alarm_Trip	BOOL	%MW310.3			None	NO	1	MAST	1	
Flow_Low_Flash	BOOL	%MW60.3			None	NO	1	MAST	1	
Flow_Scaled	REAL	%MW70				NO	1	MAST	1	
HAND_FROTH_MI	BOOL	%MW200.2			None	NO	1	MAST	1	
HAND_HMI	BOOL	%MW200.3			None	NO	1	MAST	1	
HMI_FAULT_LIGHT	BOOL	%MW200.4			None	NO	1	MAST	1	
INFO_2_CTR	UINT	%MW502				NO	1	MAST	1	
INFO_2_OutC	REAL	%MW500				NO	1	MAST	1	
Level_4ma_Setting	REAL	%MW82	0.0			NO	1	MAST	1	
Level_20ma_Setting	REAL	%MW84	139.0			NO	1	MAST	1	
Level_Alarms_Reset	BOOL	%MW200.6			None	NO	1	MAST	1	
Level_Delay	INT	%MW30	2			NO	1	MAST	1	
Level_High_Alarm_Active	BOOL	%MW80.1			None	NO	1	MAST	1	
Level_High_Alarm_Enable	BOOL	%MW80.0			None	NO	1	MAST	1	
Level_High_Alarm_Setpoint	REAL	%MW86	24.0			NO	1	MAST	1	
Level_High_Flash	BOOL	%MW80.4			None	NO	1	MAST	1	

Variables

Name	Type	Address	Value	Comment	Time stampi	R/W Rights	Exchange On	Task	Retain	
Level_Low_Alarm_Active	BOOL	%MW80.3			None	NO	1	MAST	1	
Level_Low_Alarm_Enable	BOOL	%MW80.2			None	NO	1	MAST	1	
Level_Low_Alarm_Setpoint	REAL	%MW88	5.0			NO	1	MAST	1	
Level_Low_Flash	BOOL	%MW80.5			None	NO	1	MAST	1	
LEVEL_OFF_LEVEL	REAL	%MW90	8.0			NO	1	MAST	1	
LEVEL_ON_LEVEL	REAL	%MW92	20.0			NO	1	MAST	1	
Level_Scaled	REAL	%MW98				NO	1	MAST	1	
MOTOR_FAULT	BOOL	%MW20.0			None	NO	1	MAST	1	
OFF_FROM_HMI	BOOL	%MW200.5			None	NO	1	MAST	1	
OFF_HMI	BOOL	%MW200.7			None	NO	1	MAST	1	
Pressure_4ma_Setting	REAL	%MW112	0.0			NO	1	MAST	1	
Pressure_20ma_Setting	REAL	%MW114	50.0			NO	1	MAST	1	
Pressure_High_Alarm_Active	BOOL	%MW100.1			None	NO	1	MAST	1	
Pressure_High_Alarm_Enable	BOOL	%MW100.0			None	NO	1	MAST	1	
Pressure_High_Alarm_Setpoint	REAL	%MW116	30.0			NO	1	MAST	1	
Pressure_High_Alarm_Trigger	BOOL	%MW100.2			None	NO	1	MAST	1	
Pressure_High_Alarm_Trip	BOOL	%MW100.3			None	NO	1	MAST	1	
Pressure_High_Flash	BOOL	%MW100.8			None	NO	1	MAST	1	
Pressure_Low_Alarm_Active	BOOL	%MW100.4			None	NO	1	MAST	1	
Pressure_Low_Alarm_Enable	BOOL	%MW100.5			None	NO	1	MAST	1	
Pressure_Low_Alarm_Setpoint	REAL	%MW118	10.0			NO	1	MAST	1	

Variables

Name	Type	Address	Value	Comment	Time stampi	R/W Rights	Exchange On	Task	Retain	
Pressure_Low_Alarm_Trigger	BOOL	%MW100.6			None	NO	1	MAST	1	
Pressure_Low_Alarm_Trip	BOOL	%MW100.7			None	NO	1	MAST	1	
Pressure_Low_Flash	BOOL	%MW100.9			None	NO	1	MAST	1	
Pressure_Scaled	REAL	%MW120				NO	1	MAST	1	
RUN_REQ	BOOL	%MW20.1			None	NO	1	MAST	1	
Scratch_Pad_1	DINT	%MW700				NO	1	MAST	1	
Totalizer_Scale_INT	INT	%MW600	6000			NO	1	MAST	1	
TRS	BOOL	%MW20.2			None	NO	1	MAST	1	