SECTION 13000
INSTRUMENTATION AND CONTROLS – GENERAL PROVISIONS

PART 1 - GENERAL

1.01 DOCUMENTS

A. Drawings, specifications and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 13.

B. "Division 11", as used herein, refers to all project Equipment Section Specifications (11XXX).

C. "Division 13", as used herein, refers to all project Special Construction Section Specifications (13XXX).

D. Division 13", as used herein, refers to all project Process Instrumentation and Controls Section Specifications (13XXX).

E. "Division 15", as used herein, refers to all project Mechanical Section Specifications (15XXX).

F. "Division 16", as used herein, refers to all project Electrical Section Specifications (16XXX).

G. The requirements of this Section apply to the entire Scope of Work including that shown on the Drawings, in the Division 13 Section Specifications, and in the General and Supplementary Conditions, and Division 1 Specifications

1.02 DEFINITIONS

A. "Drawings" or "Contract Drawings", as used herein, refer to the project contract drawings.

B. "Specifications" or "Contract Specifications", as used herein, refer to the project contract specifications.

C. "Contractor", as used herein, refers to the General Contractor (including his sub-contractors and his instrument/electrical/etc equipment manufacturers, and suppliers who provide his equipment), who has overall responsibility to furnish and install the "Scope of Work", as described herein and per the Contract Documents.

D. "Instrumentation and Controls (I&C) Subcontractor", as used herein, refers to a sub-contractor to the General Contractor who has primary responsibility to furnish and install the Instrumentation and Controls "Scope of Work", as described herein and per the Contract Documents.

E. "Control Systems Subcontractor", as used herein, refers to a sub-contractor to the General Contractor who has primary responsibility to furnish and install the Process Control System hardware and software (Control System can be Programmable Controller (PLC), Distributed Control System (DCS), and/or Personal Computer (PC) based system as noted in the associated project specifications) associated with the overall Instrumentation and Controls "Scope of Work", as described herein and per the Contract Documents.

F. "Telemetry System Subcontractor", as used herein, refers to a sub-contractor to the General Contractor who has primary responsibility to furnish and install the Telemetry System associated with the overall Instrumentation and Controls "Scope of Work", as described herein and per the Contract Documents.

G. Process and Instrument Diagram (P& ID) or Connections Diagram: A process or flow diagram is a conceptual diagram of the functional interrelationship of subsystems in block or pictorial form. Process equipment such as machinery is shown for proper understanding

H. Schematic Diagram or Elementary Diagram: A schematic or elementary diagram is one that shows all circuits and device elements of a system or piece of equipment and its associated apparatus or any clearly defined functional portion thereof. Such a diagram emphasizes the device elements of a circuit and their functions as distinguished from the physical arrangement of the conductors, devices or elements of a circuit system

I. Wiring Diagram or Connection Diagram: A wiring or connection diagram is one that locates and identifies electrical devices, terminals, and interconnecting wiring in an assembly. This diagram shall be in a form showing interconnecting wiring by lines or indicating interconnecting wiring only be terminal designations

J. Interconnecting Diagram: An interconnection diagram is one that shows only the external connections between controllers, control panels, and associated machinery and equipment

K. Dimension or Outline Drawing: A dimension or outline drawing (base plan, floor plan, and so forth) is one that shows the physical space and mounting requirements of a piece of equipment. It shall be permitted to also indicate ventilation requirements and space provided for connections or the location to which connections are to be made

L. One-Line Diagram (Single-Line): A one-line or single-line diagram is one that shows, by means of single lines and graphic symbols, the course of an electrical circuit or circuits and the component devices or parts used therein. Physical relationships are usually disregarded

M. Logic Diagram: A logic diagram is a particular form of one-line or single-line diagram of a logic circuit using logic symbols

N. Block Diagram: A block diagram is made up of a group of interconnected blocks, each of which represents a device or subsystem

O. Loop Diagram: A loop diagram is a collection of all components of an individual instrumentation system, or loop, showing the field, junction, panel rear and front connection points and all associated equipment

P. Wireless Connection Diagram: The general physical arrangement of devices in control equipment and connections between these devices, terminals, and terminal boards for outgoing connections to external apparatus. Connections are shown in tabular form and not by lines. An elementary (or schematic) diagram may be included in the connection diagram

1.03 SCOPE OF WORK

A. The Instrumentation and Control System work for the project shall consist of new panel work, modification of existing panels (if required), field instrumentation and components, PLC based

Control System at the project site, system communication links, remote telemetry communication equipment (as required), and a remote Distributed Control System (DCS) monitoring link at the existing RM Clayton WRC. A new PLC based Control System for the Liddell Drive Equalization Facility and associated equipment at the project site shall be furnished under the Division 13 Specifications including Programmable Controller Specification 13400. A remote communication and monitoring link to the project site from the RM Clayton WRC will require modifications to the existing Foxboro DCS System at RM Clayton and shall be provided and configured by the DCS system integrator has required by the Division 13 Contract Drawings [P&ID Drawings (I-101, I-102, I-103, I-104, I-106, I-107, and I-108) and Control System Network Drawing (I-002)] and Specifications including the DCS Specification 13500.

B. Instrumentation and Controls required for the Project: The work shall include providing new PLC hardware and configuration for the project site at Liddell Drive Equalization Facility, Local Control Panels per Specification 13200, new DCS Communication Gateway and associated configuration at the RM Clayton WRC, instrumentation and controls equipment, configuration, and startup associated with the process design work for this project. A summary of this work is as follows:

1. New Level Transmitters, low level switches, and other controls at the Diversion Facility Wet Wells associated with the Project.
2. New Local Control Panel including PLC Based Control System for the Diversion Facility located in the associated Electrical Building. New Communication link(s) to Remote Monitoring Sites.
3. New Level Monitoring Panel for each Diversion Wet Well (two) located in the Diversion Facility Electrical Building. New Gas Monitoring Panel located at each Diversion Wet Well (two). New Gas Monitors for the Diversion and Equalization Facility Odor Control Systems. Loss of Ventilation System alarm panels for the Diversion and Equalization Facility.
4. New Magnetic Flow meter on the discharge of each set of Diversion Pumps (one per Wet Well).
5. Monitoring and control of Sluice Gates at each Diversion Structure. Monitoring and control of Sluice Gates at the Inlet of each Diversion Wet Well. Monitoring and control of sludge grinders (two) at each Diversion Wet Well.
6. New Redundant Flow Transmitters at the Flow Metering Manhole associated with Diversion Facility.
7. New remote monitoring of new redundant Level Transmitters at the existing Level Monitoring Manhole located near the Cross Creek Housing Area. (this manhole is also referred to as the Peachtree Creek Trunk Relief Manhole (PCTRM) MH 23180203601).
8. New Local Control Panel including PLC Based Control System for the Equalization Facility located in the associated Electrical Building. New Communication link(s) to Remote Monitoring Sites.
9. New Level transmitter for the Equalization Tank. Monitoring and control of motorized isolation valves at the Equalization Tank. New Capacitance Level Switch for high high Equalization Tank protection and alarming. New discharge high pressure switches for the Jet Mixing Pumps. New level switch for the Cheshire Bridge Junction Box.
10. Monitoring and Control of Motorized Valves at the Equalization Tank and Equalized Flow Return System and Equalized Flow Return Isolation Valve at Diversion Pumps. Monitoring

and Control of Motorized Flushing Water Isolation Valves at the Equalization Tank for the end of Relief Event cleanout flushing sequence.

11. New Magnetic Flow meters on the discharge of each Equalized Flow Return Pump. New thermal low flow switches for monitoring Ventilation air flow from the Diversion Valve Room and EQ Jet Mixing Pump Station.

12. Monitoring and Control of motors associated with the Sludge Grinder Local Control Panels; Diversion Wet Well Drainage and Diversion Pumps; Jet Mixing System Pumps; Equalized Flow Return Pumps; and Equalization Tank Drainage Pumps.

13. New DCS Communication Gateway at the RM Clayton WRC for remote monitoring and control of the PLC based Control System located in the Local Control Panel at the project site.

C. Instrumentation and Controls provided under this contract shall provide a complete and fully functional process control and monitoring system as described in the Contract Drawings and Specifications including functionality shown on the P&ID Drawings (I-101, I-102, I-103, I-104, I-105, I-106, I-107, I-108), Control System Network Drawing(s) (I-102), HVAC Air Flow Diagrams (as required) and per HVAC Control Specification 15950 (as required). Control Logic Descriptions shall be provided under Specification 13150. An Instrument Index for non-vendor furnished instrumentation shall be provided under Specification 13100. A PLC I/O List shall be provided under Specification 13120.

D. Instrumentation and Controls design may include the implementation of Virtual I/O Communication between the project's Control System and various non-Division 13 control packages that may contain other electronic controls like programmable controllers, embedded microprocessor based controllers, or vendor specific proprietary control systems. Required Virtual I/O Communication Links shall be shown on the project's Process and Instrumentation Diagrams (P&ID) and/or described in the project's logic descriptions. Contractor is required to investigate all Virtual I/O Links and provide sufficient hardware, software, and configuration services to fully implement the required virtual communication so as to complete the functionality of the project's control system and to implement the intent of the additional functionality both in terms of monitoring and control that the Owner requires to properly operate his facility as described in the Contract Documents. Contractor is fully responsible to recommend those Virtual I/O points that provides for a fully functional and complete control system. Scope of work may include interfacing with the Engineer and/or Owner to insure that the Contractor proposed list of virtual I/O points is sufficient to provide the functionality required in the Contract documents.

E. Furnish all labor, supervision, services, materials, equipment, documentation, and incidentals required to make ready for use a fully integrated, fully documented, tested, and completely functional instrumentation and control system as shown on the Drawings and as specified herein. Equipment shall be furnished, fabricated, assembled, installed, and placed in proper operating condition in full conformity with the detailed Drawings, Specifications, engineering data, instructions and recommendations of the equipment manufacturer as approved by the Engineer.

F. The Instrumentation and Controls provided under this Division shall be designed and coordinated to ensure complete and fully functional operation of all project (furnished under the current Contract) related equipment and materials as furnished by the Instrumentation and Controls Subcontractor as well as with other equipment and materials provided by others under sections of these Division 13 Specifications, and with other equipment and materials provide by others under related Contract Specifications, and with related existing equipment.

G. To the maximum extent possible, a single Engineer-approved Instrumentation and Controls Subcontractor shall furnish all labor, services, materials, documentations, and equipment as specified in this specification and associated Division 13 specifications.

H. Should the project's Control System (PLC, DCS, SCADA and/or Telemetry control systems) design, configuration, and/or other services be performed by parties other than the Instrumentation and Controls Subcontractor, the Instrumentation and Controls Subcontractor shall be the primary party responsibility to coordinate the design, implementation, and testing with said other parties to ensure a complete and fully functional process instrumentation and control system.

I. The work shall include furnishing, coordinating, installing, and testing the following:

1. All instrumentation and controls, as noted on contract drawings and not furnished by others, including but not limited to those instruments and controls shown on the project's Process &

   Instrumentation Drawings (P&IDs), Instrument List(s), and Control System Architecture Drawing(s) and as specified in all other Sections of the Division 13 Specifications.

2. All Auxiliary devices and accessories, such as signal isolators, transducers or relays, necessary to provide for or to ensure the complete functionality and safe operation of the instrumentation and controls, and to allow interfacing to and/or control of existing equipment and/or equipment provided by other suppliers under other sections of these Contract Specifications, shall be included whether or not said signal isolators, auxiliary devices, or accessories are shown on the Contract Drawings.

3. Instrument mounting pipe stands and brackets, unless expressly supplied by the General Contractor and/or one of his other subcontractors, shall be provided for all instruments not designated as being process or equipment mounted or determined to be located in existing or new control panels. Provide sufficient materials for all instrumentation and controls supplied under this Division; and for all loose vendor-furnished instrumentation and controls as provided by other suppliers under other Sections of these Specifications; and for those existing instrumentation and controls that are determined to have to be relocated or remounted as part of this Contract.

4. Unless otherwise noted, the installation of process-mounted instruments shall be performed by the General Contractor and/or Mechanical Contractor. The Instrumentation and Controls Subcontractor shall provide guidance to the General Contractor and/or Mechanical Contractor to ensure the proper installation and safe operation of the all supplied instrumentation and controls in full conformity with detailed Drawings, Specifications, engineering data, instructions and recommendations of the instrument/equipment manufacturer as approved by the Engineer.

5. Unless otherwise noted, the installation of field-mounted instruments shall be performed by the General Contractor and/or Electrical Contractor. The Process Instrumentation and Controls Subcontractor shall provide guidance to the General Contractor and/or Electrical Contractor to ensure the proper installation and safe operation of the all supplied instrumentation and controls in full conformity with detailed Drawings, Specifications, engineering data, instructions and recommendations of the instrument/equipment manufacturer as approved by the Engineer.

6. Unless otherwise noted, the connection of instrument air and process measurements to all process instrumentation and controls shall be performed by the General Contractor and/or Mechanical Contractor. The Instrumentation and Controls Subcontractor shall provide

guidance to the General Contractor and/or Mechanical Contractor to ensure the proper installation and safe operation of the all supplied instrumentation and controls in full conformity with detailed Drawings, Specifications, engineering data, instructions and recommendations of the equipment manufacturer as approved by the Engineer.

7. Unless otherwise noted, the field wiring (including pulling of specialty cables supplied under Division 13) of all process instrumentation and controls shall be performed by the General Contractor and/or Electrical Contractor as noted in the Contract Specifications. The Instrumentation and Controls Subcontractor shall supply Instrumentation Society of America (ISA) –ISA Standard S5 - style "Loop Sheets" showing detailed wiring terminations to assist the General Contractor and/or Electrical Contractor in the performance of said field wiring and terminations. Field connections to Control System hardware or Telemetry System hardware shall be fully documented by the Instrumentation and Controls Subcontractor (or separate Control System Subcontractor or Telemetry System Subcontractor) utilizing Engineer-approved custom wiring drawings and/or fully annotated mark-ups of standard control system vendor documentation.

8. Termination and testing of Fiber Optic Cables and/or Control System communication cabling shall be performed by the Instrumentation and Controls Subcontractor and/or Control System Subcontractor. Connection and/or termination of Control System hardware interconnecting cabling shall be performed by the Instrumentation and Controls Subcontractor and/or Control System Subcontractor. Connection and/or termination of Telemetry System hardware interconnecting cabling shall be performed by the Instrumentation and Controls Subcontractor and/or Telemetry System Subcontractor.

9. Unless otherwise noted, the installation of all control panels, I/O Cabinets, controllers, etc. furnished under this Division shall be performed by the General Contractor and/or Electrical Contractor. The party responsible for supplying said control panels or cabinets or control devices (i.e. Instrumentation and Controls Subcontractor or Telemetry System Subcontractor) shall be responsible to certify the proper installation and operation of all supplied equipment.

10. The Instrumentation and Controls Subcontractor and/or Control System Subcontractor and/or Telemetry System Subcontractor shall furnish all non-standard specialty instrumentation and control system cables associated with equipment provided under these Division 13 specifications. A composite list and associated cut sheets of all of these cables to be furnished shall be included with the associated Instrumentation and Controls Submittals for Engineer review and Approval. The cable supplier shall coordinate with the General Contractor and/or Electrical Subcontractor to ensure that sufficient cable lengths are provided to properly complete the equipment installation and connections.

11. The Instrumentation and Controls Subcontractor and/or Control System Subcontractor and/or Telemetry System Subcontractor shall coordinate with General Contractor and/or Electrical Subcontractor to ensure that all instrumentation and controls furnished under this Contract are properly grounded and protected against lightning and/or power surges as noted on the Contract Drawings and as noted on the Contract Specifications (including Division 16 and Division 13 specifications).

12. The Instrumentation and Controls Subcontractor and/or Control System Subcontractor and/or Telemetry System Subcontractor shall be responsible for checking out grounding and other safe operation concerns for all supplied control panels, PLC hardware, and other sensitive electrical or electronic control system equipment prior to energization. All Control System and/or Telemetry System I/O should be 100% "real world" simulated from I/O card to/from the panel mounted devices or external terminal blocks. In this regard, all control

panels should have a 100 % point to point wiring checkout prior to being shipped from panel fabricator and should be inspected once placed by Contractor as being ready for construction (no shipping damage, internal wiring okay, grounding applied properly). Grounding of all Control System and/or Telemetry System Cabinets shall be verified by Subcontractor prior to allowing any Contractor or Subcontractor to energize any temporary or permanent power circuits to said Cabinets, power supplies, or programming terminals.

13. The Instrumentation and Controls Subcontractor and/or Control System Subcontractor and/or Telemetry System Subcontractor shall furnish new or rework existing control panels and/or control system cabinets and/or telemetry system cabinets required to complete the instrumentation and controls as shown on the Contract Drawings and Contract Specifications.

14. Unless specified otherwise, the Instrumentation and Controls Subcontractor shall review the shop drawings of all equipment including the shopping drawings of equipment with electrical "field wiring" connections furnished under all divisions of these Contract Specifications. Unless Engineer and Owner approves use of vendor furnished wiring drawings, the Instrumentation and Controls Subcontractor shall provide ISA (ISA Standard S5) style "Loop Sheets" showing detailed "field wiring" terminations of all instrumentation and controls (whether furnished by the Instrumentation and Controls Subcontractor or whether furnished by others) that connect to control panels, control systems (Programmable Controller (PLC), Distributed Control System (DCS), and/or Personal Computer (PC) based systems), and telemetry systems related to the Contract Drawings and Contract Specifications. Where applicable, the Instrumentation and Controls Subcontractor shall design electrical interconnections per manufacturer's requirements. This includes, but is not limited to, devices that are parts of "packages" but which are shipped separately and require field wiring connections.

15. Unless specified otherwise, the Instrumentation and Controls Subcontractor and/or Control System Subcontractor and/or Telemetry System Subcontractor shall identify terminals and prepare custom interconnect drawings or cabling/wiring tables, if necessary, or fully annotate vendor standard drawings to facilitate interconnection of all Control System and/or all Telemetry System components.

16. Unless specified otherwise, the Instrumentation and Controls Subcontractor shall customized training for the maintenance and operations of all instrumentation and controls provided under these Division 13 Specifications.

17. Disconnection and storage prior to turnover to owner of all existing instrumentation and controls that will be taken out of service as part of this Contract, where required.

J. It is the intent of these Specifications that the instrumentation and controls shall be complete and suitable in every way for the service required. All materials and all work which may be reasonably implied as being incidental to the work of this Section or other applicable sections shall be furnished at no extra cost.

K. Substitutions of the functions or type of equipment specified will not be acceptable without written approval of the Engineer. In order to ensure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems, and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained.

L. To facilitate the Owner's future operation and maintenance, all furnished products shall be of the same major instrumentation manufacturer, with control panel mounted devices of the same type

and model as far as possible. For existing facilities, every effort shall be made to supply equipment of the same major manufacturer and model as those predominately found at the Owners facility unless written approval is obtained from the Owner and/or Engineer.

M. All labor, supervision, services, materials, equipment, documentation, and incidentals necessary to achieve the monitoring and control functions described herein shall be provided in a timely manner such that the monitoring and control functions are available when the equipment is ready to be placed into service.

N. Where applicable, the contractor or his authorized representatives shall, before preparing his proposal, visit all areas of the existing site, buildings and structures in which work under this section is to be performed and inspect carefully the present installation. The submission of the proposal by this contractor shall be considered evidence that he or his representative has visited the buildings and noted the locations and conditions under which the work will be performed and that he takes full responsibility for a complete knowledge of all factors governing his work.

O. Where applicable, all process and/or control system operation interruptions affecting existing equipment and plant operations shall be at the Owner's convenience with at least 72 hours (minimum) notice. Each interruption shall have prior approval.

P. Where applicable, the Contractor and his subcontractors shall maintain the existing facility in operation at all times.

Q. The work shall include complete testing of all equipment and wiring at the completion of work and assistance in facilitating minor corrective changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

R. Unless otherwise negotiated with the Owner, Contractor and his subcontractors shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). No existing facility panelboard circuits shall be used. Anything temporarily added, shall be removed at job completion.

S. Complete coordination with other contractors and sub-contractors. The Instrumentation and Controls Subcontractor shall coordinate with all other Contractor's and sub-contractor's equipment submittals and obtain all relevant submittals prior to startup commissioning and testing.

1.04 REFERENCE STANDARDS

A. The instrumentation and controls engineering design, equipment, materials, and installation shall be provided in accordance with the Instrumentation Society of America (ISA) Standards and Recommended Practices, with the National Electrical Code (NEC), and with the latest edition of all codes and standards of the following organizations:

1. American National Standards Institute (ANSI), including (but not limited to):
   a. ANSI B16.5 Pipe Flanges and Flanged Fittings
   b. ANSI C2 - National Electrical Safety Code
   c. ANSI / IEEE C37.90: Guide for Surge Withstand Capability Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
   d. ANSI X3.5 - Flowchart Symbols and Their Usage in Information Processing.

2. American Society of Mechanical Engineers (ASME), including (but not limited to):
   a. ASME / ANSI B16.36 - Orifice Flanges
   b. ASME / ANSI B16.5 - Pipe Flanges and Flanged Fittings
   c. ASME "Fluid Meters Their Theory And Application"
3. American Society for Testing and Materials (ASTM), including (but not limited to): ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
4. American Petroleum Institute (API), including (but not limited to): API Recommended Practice 550 – Instrumentation Installations
5. Building Officials and Code Administrators International, Inc. (BOCA)
6. Electronics Industries Association (EIA)
7. Factory Mutual (FM)
8. Federal Communications Commission (FCC), including (but not limited to): FCC Regulations Part 15 concerning radio frequency transmission and interference
9. Institute of Electrical and Electronics Engineers (IEEE), including (but not limited to):
   a. IEEE Standard 730 - Standard for Software Quality Assurance Plans.
   b. IEEE Standard C62.22- Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems.
   c. IEEE Standard C62.36 - Test Methods for Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits.
   d. IEEE Recommended Practice C62.41- Characteristics of Surges in Low Voltage AC Power Circuits.
   e. IEEE Recommended Practice C62.45- Guide on Surge Testing for Equipment connected to Low Voltage AC Power Circuits.
   f. IEEE Standard C62.64 - Specifications for Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits.
10. Instrument Society of America (ISA), including (but not limited to):
   a. ISA Standard S5.1 - Instrumentation Symbols and Identification
   b. ISA Standard S5.2 - Binary Logic Diagrams for Process Operations
   c. ISA Standard S5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
   d. ISA Standard S5.4 - Instrument Loop Diagrams
   e. ISA Standard S5.5 – Graphic Symbols for Process Displays
   f. ISA Standard 18.1 – Annunicator Sequences and Specifications
   g. ISA Standard S20 - Instrument Spec Sheets
   h. ANSI / ISA–S12.1.01–1999 - Definitions and Information Pertaining to Electrical Instruments in Hazardous (Classified) Locations
   i. ISA RP7.3 – Quality Standard for Instrument Air
   j. ISA RP12.4- Pressurized Enclosures
   k. ANSI / ISA 12.06.01 – Wiring Practices for Hazardous (Classified) Locations – Instrumentation Part 1: Intrinsic Safety.
   l. ANSI / ISA TR12.06.01 – Electrical Equipment in a Class I, Division 2/Zone 2Hazardous Location.

m. ANSI/ISA–S12.12–1994 - Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations

11. International Conference of Building Officials (ICBO)

12. National Electrical Manufacturers Association (NEMA), including (but not limited to):
    a. AB-3 – Molded Case Circuit Breakers and their Applications
    b. ICS 1 - Industrial Control and Systems: General Requirements.
    c. ICS 2 - Industrial Control and Systems: Controllers, Contactors and Overload Relays, Rated Not More than 2,000 Volts AC or 750 Volts DC.
    d. ICS 3 - Industrial Control and Systems: Factory Built Assemblies
    e. ICS 4 - Industrial Control and Systems: Terminal Blocks.
    f. ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
    g. ICS 6 - Industrial Control and Systems: Enclosures.
    h. ICS 19 - Industrial Control and Systems: Diagrams, Device Designations, and Symbols.
    i. LS-1 - Low Voltage Surge Protection Devices.
    j. NEMA Standard 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

13. National Fire Protection Association (NFPA), including (but not limited to):
    a. NFPA 70 - National Electrical Code (NEC)
    b. NFPA 72 - National Fire Alarm Code
    c. NFPA 79 - Electrical Standard for Industrial Machinery
    d. NFPA 101 - Life Safety Code
    e. NFPA 110 - Emergency and Standby Power Systems
    f. NFPA 496 - Purged and Pressurized Enclosures for Electrical Equipment
    g. NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

14. Occupational Safety and Health Act (OSHA)

15. Scientific Apparatus Makers Association (SAMA)

16. Southern Building Code Congress International (SBCCI): Standard Building Code (SBC)

17. Underwriter's Laboratories (UL), including (but not limited to):
    a. UL 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
    b. UL 489 – (NEMA AB-1) – Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures.
    c. UL 497 – Standard for Protectors for Paired Conductor Communications Circuits.
    d. UL 497B – Safety Protectors for Data Communications and Fire Alarm Circuits.
    e. UL 508 – Industrial Control Equipment.
    f. UL 698 – Industrial Control Equipment for use in hazardous areas.
    g. UL 943 – Ground Fault Circuit Interrupters.
    h. UL 1077 – Standard for Supplementary Protectors for Use in Electrical Equipment.
    i. UL 1283 - Standard for Electromagnetic Interference Filters.
    j. UL 1363 – Standard for Relocatable Power Taps.

k. UL 1449 – Standard for Transient Voltage Surge Suppressors.

l. UL 1604 -Standard for Electrical Equipment for Use in Class I and II, Division 2, and Class III Hazardous (Classified) Locations.

18. Uniform Building Code (UBC)

19. All applicable state and local codes, amendments, regulations and practices.

20. Appropriate Authorities Having Jurisdiction.

B. Where codes and/or standards conflict, the most conservative document shall be followed.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. The Instrumentation and Controls Subcontractor shall perform all work necessary to complete his portion of the "Scope of Work" specified in this Division. The Instrumentation and Controls Subcontractor does not have to be the same supplier as the Control System Subcontractor nor Telemetry System Subcontractor as specified in separate sections of this contract. For this project, the providing of the Remote Communication and Monitoring Gateway at the existing RM Clayton WRC will be provided by DCS Configuration Subcontractor as defined under Specification 13500.

B. The Instrumentation and Controls Subcontractor shall maintain a fully equipped office/production facility with full-time employees capable of fabricating, configuring, installing, calibrating, troubleshooting, and testing the instrumentation and control system specified herein. Qualified repair personnel shall be available and capable of reaching the facility within a 24 hour period.

C. Actual installation of the equipment and materials specified by this Division need not be performed by employees of the Instrumentation and Controls Subcontractor; however, the Instrumentation and Controls Subcontractor shall be responsible for the on-site technical supervision of the installation.

D. The Instrumentation and Controls Subcontractor shall furnish equipment and materials, which shall be the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

E. The General Contractor must name his/her proposed Instrumentation and Controls Subcontractor and Control System Subcontractor(s) and Telemetry System Subcontractors in the bid documents. These subcontractors shall be experienced and fully qualified to perform their individual scopes of work as specified in the Contract. Resumes, including description of previous related project experience, of all proposed qualified individuals with each Subcontractor that are actually available to perform work associated with their scopes of work shall be included with the bid documents. Substitution of subcontractor personnel during the Contract period without written approval of the Engineer is not permitted. Failure to document sufficient personnel with appropriate experience and qualifications to perform the work proposed is sufficient grounds to disqualify the Contractor and/or Subcontractors from performing or completing the "Scope of Work" associated with this Division.

F. Subcontractor Qualifications:

1. General
   a. The specified control system and instrumentation integration including panel building, instrument calibration, testing, start-up, operational testing, and training shall be performed by a Systems Integrator staffed with qualified personnel, possessing necessary equipment and experience in performing similar project installations.
   b. The control system components shall, as far as practical, be of one manufacturer.
   c. The components, modules, devices, and control system equipment shall be recognized industrial quality products. Recognized commercial or office grade products are prohibited.
   d. The overall system performance shall be demonstrated to and accepted by Owner.
   e. The application software packages shall be latest versions available, or compatible with existing software currently in use.

2. Systems Integrator Qualifications:
   a. The following Systems Integrators are pre-qualified to perform the work specified in Division 17 without the need to provide Evidence of Experience:
      i) Control Instruments Incorporated (C2I), Atlanta, GA
      ii) Transdyn, Duluth, GA
      iii) MR Systems, Norcross, GA
      iv) Revere Controls, Birmingham, AL
      v) Turbitrol
      vi) As approved per requirements of this Section or as modified by any Addendums.
   b. Contractor-proposed Systems Integrator shall be evaluated based on submittal of the following Evidence of Experience:
      i) Submit evidence of experience in performing three similar successful projects in the last five years with one project currently in progress or competed within the last two years.
      ii) Submit project descriptions with contact names, addresses, and telephone numbers from the project Owner, General Contractor, and Principal Design Firm.
      iii) Submit organization chart and resumes for proposed project personnel.
      iv) Submit Training and Certification information. Completion of the following training courses or appropriate portions thereof or possession of the following certifications included with the Systems Integrator's personnel experience requirements described above:
         a) Project manager: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.
         b) Systems engineer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Engineering Skills Training program.
         c) Programmer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.
         d) Field instrument technician: Certified Control Systems Technician (CCST) registration or completion of the relevant core courses in the Technical Skills Training program.
         e) Certified training programs, as offered by ISA.

v) Submit financial data for Systems Integrator division when subsidiary to a parent corporation. Include two years of financial data.

a) Financial Statement.

b) Balance Sheet.

c) Dun & Bradstreet Report.

vi) This submittal is due no later than two (2) weeks prior to Bid Date. Bidders will be advised of approval or rejection in writing no later than fourteen (14) days prior to Bid Date. Rejected submittals may be supplemented with additional information and resubmitted no later than one (1) week prior to the Bid Date. Bidders making supplementary submittals will be advised of approval or rejection in writing no later than three (3) days prior to Bid Date. Approval of a completed Evidence of Experience by the Engineer is dependent on his determination that the proposed system integrator has sufficient company experience, company expertise, and experienced qualified personnel in new and remodeling work on municipal instrumentation and control systems, has the ability to understand and perform the Work specified, has sufficient financial resources and has not had a detrimental impact to the scope, schedule and budget of work they performed or work performed by others on prior construction projects.

1.06 INTERPRETATION OF DRAWINGS

A. The Drawings are not intended to show exact locations of instrumentation, control panels, or other pieces of equipment. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of the instrumentation and controls work, and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

B. Verify with the Engineer the exact locations and mounting heights of any instrumentation, control panels or other furnished devices that requires regular maintenance or operator access for the safe operation of the process and associated equipment.

C. Any work installed contrary to or without approval by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

D. Surface mounted instrumentation, control panels, junction boxes, and other devices provided under this division shall be supported by spacers (minimum 1, inch) to provide a clearance between wall and equipment.

E. Floor mounted instrumentation mounting stands, analyzer cabinets, control panels, and other devices provided under this division shall be anchored to and placed on top of housekeeping pads to prevent incidental damage to said equipment during normal operation and housekeeping of the facility.

F. All process, pneumatic, and electrical connections to furnished instrumentation and other controls shall be made as required, and in accordance with the approved shop drawings.

G. Redesign of instrumentation, electrical, or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment, and/or layout other than specified herein, shall be done by the Contractor at his own expense. Redesign and detailed plans

shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his own or others, caused by such redesign.

H. The Contractor shall coordinate his work with the work of the different trades so that interferences between instrumentation, control panels, conduits, piping, equipment, and architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the Contractor without additional expense to the Owner. In case interference develops, the Engineer is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.

1.07 PRIORITY OF THE CONTRACT DOCUMENTS

A. If during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and Drawings, furnish the higher performance requirements. The higher performance requirements shall be considered the equipment, material, device or installation method that represents the most stringent option, the highest quality, or the largest quantity.

B. In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the Engineer and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.

C. Detailed Drawings shall govern over General Drawings, larger scale drawings take precedence over smaller scale drawings and Change Order Drawings shall govern over Contract Drawings. Contract Drawings shall govern over Shop Drawings until Shop Drawings have been approved by the Engineer.

D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provision of the Contract Documents will take precedence if they are more stringent or cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between laws and regulations, the higher performance requirements shall be binding on the Contractor, unless otherwise directed by the Engineer.

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

1.08 SUBMITTALS

A. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for

determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. In accordance with the General Conditions and the Special Conditions of the Contract, submit to the Engineering the following documentation to demonstration compliance with submittal requirements of the Contract:

C. Shop drawings including copies of all drawings, parts lists, product data, and other materials shall be submitted and shall include:

1. Project Execution Plan. The project execution plan shall be submitted and approved before any further submittals will be accepted.
2. Process Instrumentation and Controls Submittal including complete Instrumentation List. For all instruments and control devices, provide a complete Instrument Spec Sheet; vendor product information including Model Number breakdown; Product Data Cut sheets; Instruction Manuals; and sizing calculations where applicable.
3. Process Instrumentation and Controls Specialty Cable list signed off by Contractor and/or Electrical Subcontractor as to required cable lengths.
4. Control Panels including all components and devices per Specification 13200.
5. Control System Project Execution Plan, if Control System Subcontractor is different from Instrumentation and Controls Subcontractor. The Control Systems project execution plan shall be submitted and approved by Engineer and Instrumentation and Controls Subcontractor before any further Control Systems submittals will be accepted.
6. Control System Hardware Submittal including Bill of Materials and Instruction Manuals.
7. Control System Software Submittal including description of software packages, graphic printouts, and operating instructions.
8. Documentation of Foreign Device Interfaces and Implementation of Virtual I/O communication design relative to required interfaces to non-division 13 control systems.
9. Telemetry System Project Execution Plan, if Telemetry System Subcontractor is different from Instrumentation and Controls Subcontractor. The Telemetry Systems project execution plan shall be submitted and approved by Engineer and Instrumentation and Controls Subcontractor before any further Control Systems submittals will be accepted.
10. Telemetry System Hardware and Software Submittal, if applicable.
11. ISA S5 Style Wiring Drawings (Loop Sheets).
12. Control System Interconnection drawings and/or fully annotated mark-ups of standard control system vendor documentation.
13. Telemetry System (if applicable) Interconnection drawings and/or fully annotated mark-ups of standard telemetry system vendor documentation.
14. "Signed Off" Instrumentation and Controls Calibration Reports.
15. "Signed Off" Functional Testing Reports.

16. Training Plans.

17. Spare Parts, Expendables, and Test Equipment.

D. Prior to submittal, all shop drawings shall be checked for accuracy and Contract requirements. Shop drawings shall bear the date checked. Shop drawings shall include any additional deviations from the Contract not noted in the associated project execution plan submittal (see Paragraph 1.08). If deviations from the Contract Specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Each submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections along with justifications for any requested deviations to the specification requirements with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

E. The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specification and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings, which may not be indicated on the shop drawings, is included under the work of this Section.

F. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.

G. No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.

H. After Installation and Testing is complete and approved, submit Record Documents per Paragraph 1.09 "Record Drawings".

I. After Record Drawings have been approved, submit Operation and Maintenance Manuals per Paragraph 1.10 "Operation and Maintenance Manuals".

1.09 PROJECT EXECUTION PLANS

A. Each Project Execution plan shall included the approach to work, proposed control system architecture diagrams, the proposed work schedule including milestones and potential meetings, proposed project personnel and organization, details of factory and field testing, details of training programs, and a paragraph by paragraph review of the specifications indicating any proposed deviations. The schedule shall illustrate all major project milestones including the following:

1. All major project activities including duration.
2. Schedule for all subsequent project submittals.
3. Tentative dates for all project design review meetings.
4. Schedule for manufacturing and staging of all process instrumentation and controls system equipment (or telemetry system equipment as applicable).
5. Schedule for all factory and/or panel shop testing.

6. Schedule for shipment of all process instrumentation and control systems equipment (and/or telemetry system equipment) including all peripheral devices.
7. Schedule for all field testing.
8. Schedule for all training.

B. The Project Execution Plan shall be submitted and approved before any further work or submittals are generated by that Subcontractor. The Subcontractor will continue to update his schedule after approval by the Engineer and provide periodic updates to the Engineer and Owner to allow monitoring of his progress. Notice of difficulties in design or procurement or delivery or installation, decisions to be made, and requests for information shall be performed in a timely manner in writing to the Engineer and Owner. Under no circumstances should failure to notify the Engineer or Owner of these conditions constitute a delay in project schedule or an increase in the project cost or scope.

C. Control System and/or Telemetry System project execution plan shall be reviewed with the Instrumentation and Controls Subcontractor prior to submittal to the Engineer. The Instrumentation and Controls Subcontractor shall be the primary party responsibility to coordinate the design, implementation, and testing with all other parties providing labor, supervision, services, materials, equipment, documentation, and incidentals associated with the "Scope of Work" under this Contract Division. Disagreements, Failure to resolve conflicts, and unresolved issues between all parties shall be noted in each preliminary project execution plan and in each subsequent project schedule update or coordination/review meeting with the Engineer or Owner. Under no circumstances should failure to notify the Engineer or Owner of these conditions constitute a delay in project schedule or an increase in the project cost or scope.

D. Each Project Execution Plan submitted for approval shall include a copy of the applicable contract specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Each Project Execution Plan submitted for approval shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justifications for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire Project Execution Plan with no further consideration.

E. Each Project Execution Plan shall include a personnel staffing plan. This staffing plan shall include the project manager, project engineers and all field technicians/staff that are anticipated to be used on this project. The staffing plan shall include up to date resumes for all personnel identified. Substitution of personnel during the course of the project shall require written approved by the Engineer.

1.10 RECORD DOCUMENTS

A. Prepare and submit record documents indicating installed conditions for:

1. A complete list of the instruments and other equipment supplied, including serial numbers, calibration ranges, and other pertinent data (can be submitted as part of the associated final O&M Manual).
2. Instrument Spec Sheets corrected to reflect the "as-constructed" condition of each instrument or control device.
3. Process Instrumentation and Controls Specialty Cable list with installed cable lengths.
4. A complete "As Constructed" set of approved shop Drawings including the following drawings:
   a. Control Panel general arrangement and wiring drawings plus complete identified parts lists.
   b. ISA S5.4 Style Wiring Drawings (Loop Sheets).
   c. Control System Interconnection drawings and/or fully annotated mark-ups of standard control system vendor documentation.
   d. Telemetry System (if applicable) Interconnection drawings and/or fully annotated mark-ups of standard telemetry system vendor documentation.

B. Subcontractors under this Division shall assist the "installers" of equipment provided under these Division 13 Specifications in providing record documents showing the dimensioned locations of control panels and other enclosures containing instrumentation and controls equipments.

1.11 OPERATION AND MAINTENANCE MANUALS

A. Prepare operation and maintenance manuals include the following information for all process instrumentation and controls provided:

1. O&M Manual Title Page including Project Title, Owners Name and Address, Equipment Name, Equipment Tag Numbers (or reference detail index of materials enclosed), related Contract Specification number, Models Numbers (or reference detailed list of model numbers enclosed), and Purchase Order Number.
2. Comprehensive Table of Contents including Section and Page numbering.
3. Composite List of Manufacturer and Model Number information for all equipment and components furnished. Serial Numbers of each component shall be included when available.
4. Statement of Warranty provided along with vendor and service contact information. Provide name, address, and telephone number of the local supplier.
5. Summary of recommended inspection and maintenance schedule. Provide list of test equipment and tools required and spare parts provided with contract.
6. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
7. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

8. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
9. Connection and Wiring drawings including electrical and instrumentation schematics.
10. Servicing instructions and lubrication charts and schedules.

B. Operation and Maintenance Data

1. Submit complete operations and maintenance data for all equipment furnished under this Division. The manuals shall be prepared specifically for the installation and shall include all required cuts, drawings, equipment lists, descriptions, complete parts list, etc, that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
2. Submitted data should be fully annotated for specific equipment actually being supplied. Optional components and/or instructions should be "crossed out" to facilitate safe operation and to allow for accurate and complete maintenance.
3. In addition to printed documentation provide at least two (2) sets of CDs containing electronic copies of all CAD drawings, spreadsheets, electronic PC, PLC, or DCS programs, and other calculations, programs, or documentation generated used to perform work under this Division.

1.12 CODES, INSPECTIONS AND FEES

A. All equipment, materials, and installation shall be in accordance with the requirements of the local authority having jurisdiction.

B. Contractor shall obtain all necessary permits, inspections, certificates of acceptance, certificates of occupancy, etc. Contractor shall pay all fees related to these items. Contractor shall submit to the Authority Having Jurisdiction the necessary Drawings in the size and quantity as required by the Authority Having Jurisdiction. These permits, inspections, and certificates shall cover all aspects of the process instrumentation and controls. The permits, inspections and certificates shall be obtained by Contractor from the appropriate Authority Having Jurisdiction including, but not limited to, building departments, inspection authorities, plan review examiners, fire marshals, insurers, etc.

C. Obtain required inspection stickers indicating installation suitability from the local authority having jurisdiction. Install as directed by authority having jurisdiction.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Instrumentation, materials, and controls furnished under this division shall meet the following Shipping Requirements:

1. Prior to shipment of all factory and/or panel shop assembled equipment or control panels, The Engineer and/or Owner shall have the option to witness the testing of said equipment in accordance with the Testing Sections of these Specifications. Additionally, the Engineer and/or Owner may wish to inspect the condition and packaging of said equipment prior to its shipment. Provide at least two weeks written notice of all testing and shipments to the Engineer and Owner.
2. After completion of shop assembly, factory test, and approvals; all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty

polyethylene envelopes or secured sheeting to provide complete protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at job site.

3. Special instructions for proper field handling, storage and installation required by the manufacturer for proper protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in re-sealable plastic bags or other acceptable means of protection.

4. None of the control equipment shall be shipped to the site until the room(s) are environmentally suitable.

5. All sensitive electronic or computer equipment and control panels/cabinets for the Control System or Telemetry Systems supplied under this Division shall be shipped to the job site via dedicated air ride van.

B. Instrumentation, materials, and controls furnished under this division shall meet the following Identification Requirements:

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

2. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the Drawings, shall be provided on each piece of instrumentation or controls supplied.

3. All instruments, controls, and other equipment delivered to the jobsite shall be properly identified with tag or equipment name, manufacturer, model number and description. Provide inspection stickers, testing certificates, compliance labels, and other information needed as specified and required for each piece of equipment.

C. Instrumentation, materials, and controls furnished under this division shall meet the following Delivery Requirements:

1. Each delivery shall be accompanied by a complete Bill of Lading including a detailed description (type of container, size, and weight) of each package or shipping container included in the shipment. Inspect each item for completeness against Bill of Lading; if it is to be stored, reseal for protection; unpack and handle equipment in accordance with manufacturer's recommendations.

2. Supplier shall provide "signed off" Bill of Lading for each shipment. Bills of Lading shall be provided with monthly status reports required by paragraph 1.09, Project Execution Plans.

3. Receiver of all shipments shall retain records of all shipments and shall keep records of storage locations. Shipments shall be available for inspection by Engineer and/or Owner prior to installation.

4. Receiver of all shipments shall inspect each shipment for delivery condition. Provide timely notification to shipper and Engineer and Owner of any damage discovered during receipt, storage, and installation of all equipment.

D. Instrumentation, materials, and controls furnished under this division shall meet the following Storage Requirements:

1. Control Panels, I/O Cabinets, Analyzers, sensitive electronic or computer equipment and/or controls or other materials not sealed and/or suitable for continuous outdoors storage shall not be stored out-of-doors. Such Instrumentation and Controls shall be stored in dry permanent shelters and shall be adequately protected against mechanical injury. If any equipment has been damaged, such damage shall be replaced by the Contractor at his own cost and expense.

2. Equipment and materials stored outdoors shall be covered to keep clean and to protect from dust and dirt. Store on pallets or shelves so that there is no exposure to rain or standing water. Storage environment shall be compatible with the enclosure provided for the instrument or control device and shall prevent exterior or internal damage from rain, dirt, dust or corrosion. Keep equipment clean by covering or by other measures as necessary.

3. If any instrumentation or control component has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner, the damaged units or systems shall remain on site and returned to the manufacturer after the replacement units or systems have been delivered to the site. Under no circumstances will instrumentation or controls damaged by water be rehabilitated or repaired, new equipment shall be supplied, and all costs associated with replacement shall be borne by the Contractor.

4. Control panels and I/O Cabinets shall be stored on level surfaces to prevent damage or warping.

5. Control Panels and I/O Cabinets shall not be stored out-of-doors even if designed for outdoor installation until temporary or permanent sun and rain shields have been erected at the installation or storage location (assuming the enclosure is rating for outdoor installation).

   Instrumentation and Controls equipment are often extremely sensitive to static electricity and extremes of humidity and temperature. Consult manufacturer guidelines for limits of environmental exposure to provide adequate Heating and Ventilation means where normal storage conditions would violate said manufacturer guidelines or warranties. Should materials or equipment be damaged by improper storage, the Contractor at his own cost and expense shall replace such equipment or materials.

6. Project delay costs associated with improper storage or replacement delays shall be the sole responsibility of the supplier and/or Contractor.

1.14 SIZE OF EQUIPMENT

A. Investigate each space in the structure through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the structure.

B. The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passing through such restricted areas during transportation, the manufacturer shall be required to brace the equipment suitably, to ensure that the tilting does not impair the functional integrity of the equipment.

1.15 Y2K DATE COMPATIBILITY

A. All furnished instrumentation and controls shall utilize time and date keeping functions that are compatible with the use of time and date information for dates beyond December 31, 1999. This time and date functional compatibility is also known as Year 2000 (Y2K) date compatibility. All furnished components shall inheritably provide for (or be upgradeable to provide for) Y2K compatibility unless specifically exempted in writing by the Owner and Engineer.

B. The requirement for time and date functions to be compatible with dates beyond December 31, 1999 shall be implemented with the following minimum provisions:

1. No value for current date will cause any loss of functionality or result in any improper operation.
2. Real time clocks, and time and date calculations shall provide consistent results for dates before; during; and after the start of the Year 2000 Julian calendar year.
3. In all displays and data storage, the "century" associated with any date must be determined either explicitly (i.e. by stored/entered numeric value) or by unambiguous algorithms or by unambiguous interfering rules.
4. Real time clocks or the database entry of time and date information shall utilize date information whereas the associated "year" is entered/stored as a four digit (or larger) numeric value or as a two digit "year" numeric value followed by at least two numeric digits for the "century". Time and date calculations utilizing the amount of time (seconds, etc) from a fixed date (like birth of Unix – 1/1/1970 or birth of IBM compatible PCs (MS-DOS) – 1/1/1980) shall be avoided (i.e. the use of unambiguous algorithms should be avoided). The use of interfering rules to determine the century of the associated year shall be avoided (i.e. the year is stored only as a two digit numeric number with the century determined by whether the year is above or below a certain value – say year at or below 50 meaning the century is "19" or if the year is say 51 then the century is "20").
5. Year 2000 must be recognized as a leap year (Leap Years are defined as those years that are divisible by 4 except for the start of centuries which must also be divisible by 400; i.e. 1900 is not a leap year but 2000 is a leap year).

1.16 PROJECT/SITE REQUIREMENTS

A. Site Elevation. Equipment shall be designed to operate at a ground elevation of approximately 820 feet above mean sea level. Equipment located below grade shall be NEMA Type 4X rated.

B. Temperature. Indoor field equipment shall be suitable for normal operation from 40 to 105 F degrees ambient. Outdoor field equipment shall be suitable for normal operation from -20 to 120 F degrees ambient. Storage temperatures will range from 32 to 140 F degrees ambient. Additional cooling or heating shall be furnished if required by the equipment furnished. Equipment in air-conditioned areas should be suitable for normal operation from 60 to 80 degrees Fahrenheit with short-term excursions to the temperature limits specified for indoor equipment.

C. Relative Humidity. Air-conditioned area equipment shall be suitable for 20 to 80 percent relative, non-condensing humidity. All other equipment shall be suitable for 10 to 100 percent relative, condensing humidity.

D. Availability of AC Power Supplies

1. 120 volts, 60 Hertz, Single Phase AC sources of electrical power will be provided unregulated industrial panel boards.
2. 480 volts, 60 Hz, Single Phase AC sources of electric power will be provided from unregulated 480VAC industrial panel boards, as required.
3. 480 volts, 60 Hz, Three Phase AC sources of electric power will be provided from contactors located in low voltage MCC's or from three phase 480VAC industrial panel boards as noted in the Division 16 Drawings.

E. Availability of compressed air or High Quality Instrument air:

1. Standard quality compressed air is unavailable unless a new plant air compressor is provided under the Division 11 specifications.
2. High Quality Instrument air is unavailable unless provided by others.

1.17 WARRANTY

A. Provide a warranty for all instrumentation and controls in accordance with the general requirements of the Contract Specifications. Unless specified more stringently elsewhere in the general requirements, the components of the instrumentation and controls system shall be warranted against defective materials, design, and workmanship for a period of one (1) year from the date of final acceptance.

B. During the warranty period, Subcontractor shall furnish personnel to inspect, test, and take corrective action to correct all deficiencies in his "Scope of Work" such that the corrective action is consistent with the quality of materials and work of the original construction and is in conformance with the Contract Specifications, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials of the same type shall be the product of one (1) manufacturer.

B. The materials used shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or manufacturers product specifications shall be submitted for approval as required by the Engineer.

C. All current carrying cables, wires, buses, terminals, windings, parts, etc. shall be copper. Exception shall be made to this section is for circuits involving thermocouple circuits where the wiring, terminals and/or other current carrying parts shall be made from the same materials as that of the thermocouple.

D. Materials and equipment furnished shall be suitable in all ways for the intended application. Ratings shall match or exceed the requirements of the indicated Reference Standards, Drawings and Specifications.

2.02 ENCLOSURE TYPES

A. Unless otherwise specified herein or shown on the Drawings, instrumentation and control system enclosures shall have the following ratings.

1. NEMA 1 for dry, non-process indoor locations.
2. NEMA 12 for "DUST" locations.
3. NEMA 4X for outdoor locations, rooms below grade (including basements and buried vaults), "DAMP" and "WET" locations. Enclosure material shall be carbon steel with baked or electrostatically applied enamel finish, or stainless steel.
4. NEMA 4X for "CORROSIVE" locations. Enclosure material shall be stainless steel or fiberglass reinforced polyester (FRP). All FRP panels located in direct sunlight shall be provided with a protective coating to prevent discoloration and cracking.
5. NEMA 7 (and listed for use in the area classifications shown) for "Class I, Division 1"; "Class I, Division 2" and "Hazardous Locations". Enclosure material shall be cast malleable iron.
6. Refer to Division 16 Drawings for hazardous area classifications.
7. Installations in Outdoor areas require sun shields.

2.03 REQUIREMENTS FOR HAZARDOUS AREAS

A. All equipment, materials, and installation techniques used in areas designated as hazardous in the Specification Sections, or on the Contract Drawings shall be in strict accordance with National Electrical Code Articles 500, 501, 502, 503, and 504.

B. Unless auxiliary protective means as noted below are utilized, all equipment and materials that are supplied shall be labeled and approved for safe operation and inheritable designed for used in hazardous areas. Such equipment and materials shall be UL listed for the appropriate hazardous area classification.

C. Unless otherwise noted on the Contract Drawings, the Engineer intends that instrumentation and controls located in Electrically "Hazardous Locations" be inherently suitable (i.e. use of explosion proof NEMA 7 or NEMA 9 enclosures) to meet the electrical area classifications. Should the Contractor or Subcontractors provide instrumentation, auxiliary devices, or other control equipment that is not inherently suitable for intended environment; the design, implementation, or use of Intrinsic Safety barriers or other mechanical or electrical means of guaranteeing the suitability of the said instrumentation, auxiliary devices or other control equipment to safely operating in its intended environment shall only be implemented at the expense of the installer or supplier of said equipment. The supplier has the responsibility to coordinate with all other Contractors and Subcontractors affected to notify them of the impact and negotiate the sharing of the costs and other impact associated with the use of alternate designs.

D. The common engineering practice of the use of float level switches for monitoring the levels in sumps and other areas, which are often considered electrical hazardous, is an example of the implied intent of the Engineer in his design documents that the Contractor and/or his suppliers and/or subcontractors can be reasonably expected and required to provide additional materials and methods to make use of the specified device in what may well be a electrically "hazardous location". The Contractor and/or his suppliers and/or subcontractors may choose to use a more

expensive device (that is inherently suitable for the intended location) in implementing the engineering design if he or she so chooses but at no time shall there be any additional cost or schedule impact to the Owner.

E. The use of Intrinsic Safety (IS) as an auxiliary protection means shall be designed, installed, and testing in compliance with the National Electrical Code Articles 500, 501, 502, 503, and 504. Additionally, the Intrinsic Safety design, installation, and testing shall comply with the following:

1. Devices utilized in Intrinsically Safe (IS) applications must be certified and stamped as being suitable for use in the intended area classification. Certifications of all IS devices shall be submitted along with the associated instrumentation and controls. Failure to submit proper certifications and/or IS Design calculations shall not constitute approval of the auxiliary protection means by the Engineer.
2. Zener Diode style IS Barriers must be grounded in compliance with National Electrical Code Article 504 and ANSI/ISA Recommended Practice 12.06.01. Provide at least AWG # 6 insulated Green Wire to a dedicated ground rod or grounding triad as necessary to get less than 1 ohm to ground resistance. Dedicated IS grounding system shall (and must) only be connected at one point to the plant ground grid (if grounding triad used, Connection to IS Barriers at one leg of triad and connection to plant ground grid from another leg of the triad should be used to guarantee a good and high quality path to earth ground).
3. Simple Apparatus (Switches, etc.) can be provided with Switch Amplifier type IS Barriers that do not require a dedicated IS Grounding connection to the IS Barrier.
4. Energy storing devices (i.e. transmitters, etc) have Entity parameters that must be utilized in developing the IS Barrier design to ensure that installation will be suitable for the intended electrically "hazardous location". Vendor furnished Entity parameters and IS Barrier design calculations shall be submitted for approval in these applications.
5. IS Barriers should be located in an electrically non-hazardous area such that the incoming hazardous ISS wiring from field devices is electrical isolated at the IS barrier from the regular non-hazardous wiring leaving the IS Barrier.
6. IS wiring inside control panels shall be separated by 2 inches of air space from all regular non-hazardous wiring. All IS wiring inside enclosures shall be secured so that any conductor that might come loose from a terminal cannot come in contact with another terminal. Grounded Metal or Isolated Partitions are permitted by NEC Code Article 504-30 with lesser distance requirements.
7. Wiring ducts in Control Panels containing IS circuits shall be colored light blue or identified with labels containing the wording "Intrinsic Safe Wiring" or the equivalent.
8. IS wiring shall be located in dedicated conduits separated from any non-hazardous wiring.
9. Conduits where above ground containing IS wiring shall be identified with labels containing the wording "Intrinsic Safe Wiring" or the equivalent per NEC Article 504-80.b. Spacing between labels shall be no less than every 25 feet.
10. IS wiring shall be color coded light blue where no other conductors colored light blue are used per NEC Article 504-80.c.
11. Conduits containing IS wiring where entering enclosures containing regular non-IS wiring shall be sealed to prevent possible transmission of gases from hazardous areas.

2.04 INSTRUMENTATION – GENERAL REQUIREMENTS

A. To facilitate the Owner's future operation and maintenance, all furnished products shall be of the same major instrumentation manufacturer, with control panel mounted devices of the same type and model as far as possible. For existing facilities, every effort shall be made to supply equipment of the same major manufacturer and model as those predominately found at the Owners facility unless written approval is obtained from the Owner and/or Engineer.

B. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals, which are established standards for the water and wastewater industries.

C. All pneumatic instrumentation shall be furnished with coalescing filters and/or filter regulators and shall utilize high quality instrument air to generate linear transmission signals of 3 to 15 PSIG.

D. All electronic instrumentation shall be of the solid-state type and shall utilize linear transmission signals of 4 to 20 mA DC (milliampere direct current), however, signals between instruments within the same panel or cabinet may be 1-5V DC (volts direct current), or the like.

E. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.

F. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.

G. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Electrical Drawings, to comply with the National Electrical Code.

H. All indicators and recorder read-outs shall be linear in process units, unless otherwise noted.

I. All transmitters shall be provided with either integral indicators or junction box mounted indicators that display all measurements in process units, accurate to two percent.

J. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

K. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, in-so-far as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

L. The field mounted digital system equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

M. All electronic/digital equipment shall be provided with radio frequency interference protection and shall be FCC approved. Instrumentation should be able to operate normally (causing no more

than 0.75% change in accuracy) when exposed to Electromagnetic Radiation of approximately 10 Volts/meter at frequencies from 27 to 500 Mhz.

N. All electrically operated equipment shall be designed to operate on an alternating current power source [Voltage and Frequency as noted in Site Conditions, Paragraph 1.20], plus or minus 10 percent, except where specifically noted. All regulators and power supplied required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

O. All electrical operated equipment furnished shall be U.L. approved wherever such approved equipment is available.

P. All electrically operated equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

2.05 TRANSIENT SURGE AND LIGHTNING PROTECTION

A. General Requirements – Transient Surge and Lightning and protection shall be provided to protect all instrumentation and controls from induced voltages and power surges propagating along the analog or discrete signal and/or power supply lines or digital communication connection to the Control system and/or Telemetry system. The protection systems shall be such that the surge protective device shall not interfere with normal operation, but shall lower the induced voltage level or transient surge level to be less than the instrument's (or control device's) surge withstanding level, and shall be maintenance free and self-restoring, if possible. All connection points to be copper with nickel plating. The surge protective device should meet IEEE C-62-41 Standards.

B. Additional Requirements shall be as required in Division 13 Contract Specification 13270 – Surge and Lightning Protection.

C. The supplier of instrumentation and controls associated with this Division shall provide the appropriate surge protective device as required by this Division. Instrumentation and Controls Subcontractor shall provide any additional surge protective devices, materials, supervision, installation, and testing if the supplier of any instrumentation and controls under the Contract Specifications does not satisfy the intent of the Division 13 Contract Specification 13270 – Surge and Lightning Protection.

2.06 INSTRUMENTATION TUBING AND FITTINGS

A. All instrument air header takeoffs and branch connections less than 2-in shall be 316 stainless steel or copper as noted in the mechanical (piping) specifications.

B. All instrument shut-off valves and associated fittings shall be supplied in accordance with the Mechanical (piping) specifications and all instrument installation details. Instrument fittings and valves shall be match the predominant standard at the existing facility unless other specified in the mechanical (piping) specifications.

C. Unless otherwise specified in the mechanical (piping) specifications, all instrument tubing shall be fully annealed ASTM A269 Seamless 316 grade free of O.D. scratches having the following dimensional characteristics as required to fit the specific installation:

1. 1/4-in to 1/2-in O.D. x 0.035 wall thickness.
2. 5/8-in to 1-in O.D. x 0.049 wall thickness.
3. 1-in O.D. x 0.065 wall thickness.
4. 1-1/4-in O.D. x 0.065 wall thickness.
5. 1-1/2-in O.D. x 0.083 wall thickness.
6. 2-in O.D. x 0.095 wall thickness.

D. All process connections to instruments shall be annealed 1/2-in O.D. stainless steel tubing, Type 316.

E. All tube track shall be supported by stainless steel and installed as per manufacturer's installation instructions.

2.07 MAINTENANCE REQUIREMENTS

A. Spare Parts

1. Spare parts shall be as defined in the related specification sections. All spare parts shall be new and unused.
2. All spare parts shall be individually packaged and labeled.
3. Materials shall be delivered in the manufacturer's original containers labeled to completely describe contents and equipment for which it is furnished.
4. Provide one gallon of touch-up paint, in one-quart containers, for each type and color used for all cabinets, panels, consoles, etc., supplied under the related specification sections.
5. The spares listed above shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of instrumentation and controls work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

B. The P&IDs and Contract Drawings indicate the intent of the interconnection between the individual instruments. Any exceptions should be noted. Two complete sets of approved shop drawings shall be kept at the job site during all on-site construction. Both sets shall be identically

marked up to reflect any modifications made during field installation or start-up. All markings shall be verified and initialed by the Engineer or his designated representative.

C. Following completion of installation and the operational readiness testing, one set of the marked up drawings shall be provided to the Engineer, the other retained by the Supplier for incorporation of the mark-ups into final as-built documentation.

D. Instrumentation and Controls furnished under this Division shall be factory and/or "bench" calibrated prior to installation and testing.

E. The instrumentation installation details on the Contract Drawings indicate the designed installation for the instruments specified. Where specific installation details are not specified or shown on the Drawings, the American Petroleum Institute (API) Recommended Practice 550 shall be followed as applicable.

F. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Contractor shall bear full responsibility for such violations and assume all costs arising there from.

G. All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the Electrical Drawings for the locations. All work shall be in strict accordance with codes and local rulings, should any work be performed contrary to said rulings, ordinances and regulations, the Supplier shall bear full responsibility for such violations and assume all costs arising there from.

H. Unless specifically shown in the Contract Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or pipe stands. All instrumentation process and instrument air connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing, and blow down service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

I. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adaptors, and shut-off valves.

J. Field instruments requiring AC power supply shall be provided with local electrical shutoffs, and fuses as required.

K. Brackets and hangers required for mounting of equipment shall be provided. They shall be installed in a workmanlike manner and not interfere with any other equipment.

L. The Instrumentation and Controls Subcontractors hall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the Instrumentation and Controls Subcontractor shall be required to ship his material in sections sized to permit passing through restricted areas in the building. The ISS shall also investigate, and make any field modifications to the allocated space for each cabinet, enclosure and panel to assure proper space and access (front, rear, side).

M. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground point be employed for each shield.

N. Lifting rings from cabinets/assemblies shall be removed. Hole plugs shall be provided for the holes of the same color as the cabinet.

O. The Instrumentation and Controls Subcontractor, acting through the Contractor, shall coordinate the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. He shall be responsible to ensure that all field wiring for power and signal circuits are correctly done in accordance with best industry practice and provide for all necessary system grounding to ensure a satisfactory functioning installation. The Instrumentation and Controls Subcontractor hereunder shall schedule and coordinate his work under this section with that of the electrical work specified under applicable Sections of Division 16.

P. Installation of Fiber Optic Cable. Refer to cable manufacturer's specifications for bend radius. Use cable breakout assembly as recommended by the cable manufacturer. Provide wire basket, strain relief as required to meet manufacturer's strain requirements.

Q. Instrumentation and Controls shall at all times during construction be adequately protected against mechanical injury, water damage, corrosion, dirt, dust and foreign material. Equipment equipped with internal electrical heaters shall have them energized to keep the equipment dry. Doors to control panels and cabinets shall be kept closed at all times when work on them is not being done. Control Panels, Analyzers, sensitive electronic or computer equipment and/or controls or other materials not sealed and/or suitable for continuous outdoors storage shall not be stored out-of-doors. Such Instrumentation and Controls shall be stored in dry permanent shelters. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner, the damaged units or systems shall remain on site and returned to the manufacturer after the replacement units or systems have been delivered to the site. Under no circumstances will instrumentation or controls equipment damaged by water be rehabilitated or repaired, new equipment shall be supplied, and all costs associated with replacement shall be borne by the Contractor.

R. Any damage to factory applied paint finish shall be repaired using touch-up paint furnished by the instrument or equipment manufacturer. The entire damaged enclosure panel or section shall be repainted per manufacturers recommendations to restore the original finish, at no additional cost to the Owner.

3.02 INSPECTION AND TESTING

A. Test all instrumentation and control system components furnished under this Division and repair or replace all defective equipment or work. Comprehensive testing and demonstration of proper operation of all equipment shall be required as part of this Contract. Operation and testing shall be demonstrated to the Owner's satisfaction as a requirement for final acceptance of the equipment being supplied. All inspection and testing furnishing for the project shall also conform to the Contract Requirements including those included in the General Conditions Specification 01650 "Facility Startup". The Subcontractor shall schedule and coordinate all inspections and testing with General Contractor and any other applicable subcontractors. The General Contractor shall notify the Engineer and Owner at least two weeks prior to all factory and field tests. The Engineer and/or Owner shall have the option to inspect all tests at the factory and in the field.

B. Contractor to submit written Test Procedures at least 30 days prior to the start of the contractual required shop tests, field performance tests, and final acceptance tests as specified in the Contract Specifications and Drawings.

C. Pre-Operational Testing: Perform the following minimum tests and checks prior to attempting to test the Instrumentation and Controls for plant operation on a system-by-system basis.

1. Inspection and Calibration: Perform pre-operational visual and mechanical inspection, calibration (calibration of new/existing instrumentation or verification of vendor pre-calibrated instruments), and verification of proper operation for all instrumentation and controls provided under this Division. For analog instruments, instrument calibration check shall list at least five points where the calibration was verified (0, 25%, 50%, 75% and 100% of span). For discrete instruments, verify switch operation at set point and note the reset setting. Submit an individual calibration sheet for each piece of instrumentation and controls. Calibration sheet shall be legibly signed off by person(s) performing this test and shall list all conditions found and all corrective actions taken. Complete step-by-step filled-in calibration settings sheets shall be provided for each transmitter that requires application specific settings beyond simple zero and span settings. These calibration settings sheets shall be complete enough to allow the maintenance personnel to restore the "as-constructed" settings to an instrument that has to be replaced in the future.

2. Factory Power and Grounding Tests: Test grounding and verify any other safe operation concerns associated with all supplied control panels, PLC hardware, intrinsic safety equipment, and other sensitive electrical or electronic control system equipment prior to energization. Supplier shall certify that the grounding and installation is in conformance with the manufacturer's warranty requirements prior to providing temporary or permanent power to any supplied equipment.

3. Electronic Burn-in Testing: All electronic or solid-state components include Personal computers, PC peripherals, Computer Network equipment, and PLC/DCS/Telemetry System Hardware shall be operated continuous without failure for at least 48 hours prior to factory or field operational testing (and preferably before field installation). Instrumentation and Controls inside control panels and I/O Cabinets shall be tested before shipment to jobsite. Submit for approval copies of certified test reports including actual test data, observations and certification that the electronic burn-in tests have been completed.

4. Unwitnessed Factory Testing: All vendor furnished fabricated control panels or factory assembled systems shall be completely interconnected and tested for full operation and functionality prior to be ready to be shipped for field installation and testing. The vendor and/or fabricator shall perform a complete unwitness factory test on all equipment prior to informing the Engineer and/or Owner that it is ready to ship and offering for either to come to the factory for a full or partial witnessed factory test to confirm the unwitness testing already conducted.actory Panel Testing: All Control System and/or Telemetry System I/O shall be 100% "real world" simulated from I/O card to/from the panel mounted devices or external terminal blocks. In this regard, all control panels and I/O Cabinets shall have a 100 % point to point wiring checkout prior to being shipped from vendor or panel fabricator. Engineer and/or Owner shall have to opportunity to witness all testing. Repair and correct before shipping any deficiencies discovered in the work during the factory panel testing. Submit for approval copies of certified test reports including actual test data, observations, corrective actions taken, and certification that the factory panel tests have been completed and all corrections have been implemented.

5. Field Power and Grounding Tests: Test grounding and verify any other safe operation concerns associated with all supplied control panels, PLC hardware, intrinsic safety equipment, and other sensitive electrical or electronic control system equipment prior to energization. Supplier shall certify that the grounding and installation is in conformance with the manufacturer's warranty requirements prior to providing temporary or permanent

power to any supplied equipment. Submit copies of certified installation and grounding test reports.

6. Field Installation Inspection and Supervision: Unless otherwise noted, Instrumentation and Controls provided under this division shall remain the responsibility of the supplier till turned over to the Engineer and/or Owner (or his assigned Operations Company) for normal plant operation. Instrumentation and Controls shall be inspected for shipping or construction damage and for proper installation before being tested or placed into service. The Control System or Telemetry Subcontractor whom supplied the associated instrumentation and controls shall inspect, calibrate, adjust settings, and ready for operation each component supplied. Subcontractor shall certify that each component is installed per the manufacturer requirements and applicable industry standards and therefore is ready for testing and operation. Repair or replace all defective equipment or work. The supplier shall coordinate with the General Contractor and/or other affected subcontractors to resolve any deficiencies, improper installation, or improper component operation discovered. Repairs to malfunctioning components shall require approval by the Engineer. All costs associated with installation, inspection, testing, calibration, adjustments, repairs, or replacement including expedited shipping charges to meet project deadlines shall be born by the General Contractor or his subcontractors.

7. Field Wiring and Interlock Checkout: Prior to plant operation, inspect and test all instrumentation, controls, and interlocks to verify that the instrumentation and control systems will function properly and as indicated by the Contract Drawings and as noted in the approved shop drawings. The Instrumentation and Controls Supplier shall perform the following checks to certify that the instrumentation and controls are ready for pre-operational testing:
   a. Verify field wiring installation against approved loop sheets and interconnect wiring drawings.
   b. Simulate each instrumentation signal to and from each control panel or field device. Verify that all signals are sent, processed, or received properly. Check controller operation including controller action (direct or reverse) and valve position. Check display ranges against calibration sheets.
   c. Verify that Control System has configured and connected per the approved shop drawings. Verify proper operation of alternate power sources and fault-tolerant hardware (Processors, Network connections, I/O cards – where applicable, etc.).
   d. Verify that all Processors and Operator Consoles have been loaded with the latest software configuration. Verify software I/O addressing and configuration against approved detailed software engineering documents.
   e. Simulate each I/O point to verify that all signals are sent, processed or received properly. Verify the I/O address, display range, and graphic displays associated with each signals.

8. Submit for approval copies of all pre-operational certified test reports including actual test data, observations and certification that each individual test has been completed.

9. Provide all instruments, personnel and equipment required for the tests specified in this Division.

D. Operational Testing: Once all instrumentation and controls have been testing per the Pre-Operational Testing requirements listed above, the Instrumentation and Controls shall be tested along with the associated Mechanical and Electrical equipment provided on this Contract in a

systematic - system-by-system basis. Perform the following minimum tests and checks prior to turning over the Contract supplied equipment for the owner's use:

1. At least 30 days prior to start of Operational Testing, the Contractor shall submit written composite operational testing plan include schedule and procedures. Contractor shall seek input from and approval by with Engineer and/or Owner on his Operational Testing plan before any testing shall commence.
2. Certify that the mechanical equipment (Divisions 11 and 13 equipment including required HVAC equipment provided under Division 15) have been inspected, operated, tested, and adjusted of proper operation by the manufacturer's field technicians in accordance with the Contractual Requirements prior to startup.
3. Certify that associated piping, valves, and other equipment supplied under Division 15 have been inspected, operated, tested, and adjusted of proper operation by the manufacturer's field technicians in accordance with the Contractual Requirements prior to startup.
4. Certify that associated Electrical equipment supplied under Division 16 has been inspected, operated, tested, and adjusted of proper operation by the manufacturer's field technicians in accordance with the Contractual Requirements prior to startup.
5. Certify that associated Instrumentation and Controls supplied under Division 13 has been inspected, operated, tested, and adjusted of proper operation by the manufacturer's field technicians in accordance with the Contractual Requirements prior to startup.

E. Demonstrate that all Control System and Telemetry System Hardware and Software have be installed and configured per Contractual Requirements, including resumption of operation after full Utility Power Failure, verification of failure modes of controls during loss of all power sources or switchover to and from primary power to backup power sources, and verification of continued operation in the event of loss of redundant network or I/O communication links. Virtual I/O communication links shall be tested and verified for fully functionality per approved PLC or DCS Software Submittals.

1. Perform complete operational testing for every piece of equipment, every instrument, and all controls provided under the Contract. All modes of equipment operation shall be demonstrated and all interlocks shall be tested under as realistic process conditions as possible (note where simulation of signals was required).
2. Each test shall be witnessed by the Engineer and/or Owner and shall require signoff by the General Contractor, Person performing the test, and by the Engineer and/or Owner that the Contractual testing requirements have been satisfied. Written testing sign-off forms shall be broken down by each piece of equipment or instrument loop being tested.
3. Two copies of "As-Constructed" approved shop drawings including O&M Manuals shall be available during the testing and all discrepancies and corrections shall be noted completely and legibly on both sets. After testing has been successfully completed – one set of drawings shall be made available to the owner for his use in operating and maintaining the facility. The other set shall be used by the Contractor to generate record drawings.

F. Operational Testing: After individual system operational testing, all equipment performance shall be demonstrated in continuous operation for at least a five (5) day (24 hours a day) period of time as specified required in the General Conditions and Section 01650 - Facility Startup before final acceptance testing can be initiated. The Contractor shall provide for on-site operation and maintenance during this operational demonstration test. If any component of the Control Systems

fails to continuously perform, the performance demonstration testing period must be repeated. The Owner and/or Engineer reserves the right to inspect any rejected component prior to replacement or repair. If corrective measures are to be taken, such measures shall be done on-site at such times as convenient to the Owner and within 90 days of the unsuccessful test. The Owner shall be allowed to use the Instrumentation and Control System supplied immediately following installation and testing whether or not the complete system meets the testing conditions specified.

G. Continuous Field Acceptance Testing: Once all the equipment furnished has been tested to demonstrate Operational performance (Operational Testing requirement) of each component, Contractor shall demonstrate continuous full time operation of all equipment furnished together as a complete and fully functional system. As required under the General Conditions and Section 01650 - Facility Startup, this continous field acceptance testing shall be demonstrated for up to six (6) months of twenty four hours a day operation without interruption or failure except as allowed in the General Conditons.

G. All inspection and testing shall be performed by personnel who are competent and experienced in the use of instrumentation and controls for industrial process control. Personnel shall have complete knowledge in the proper installation, operation, and maintenance of the instrumentation and controls being provided.

H. Manufacturer Representatives: Whereas, the supplier does not have the personnel that are sufficiently experienced and trained to perform all inspections, testing, and training required by the Contract Specifications, the supplier shall provide manufacturer certified representatives to assist his field personnel in performing these requirements at no additional cost to the Owner. The use of manufacturer representatives shall be clearly noted in the approval submittals.

I. All testing shall be scheduled and coordinated by the General Contractor. The Contractor or Subcontractors under this Division shall have qualified personnel present during all testing.

J. All test data and procedures followed during testing shall be logged, and certified copies of the logs shall be provided to the Engineer and Owner.

K. Acceptance of shop tests by Owner or Engineer shall not constitute a waiver of requirements to meet the field tests under specified operating conditions, nor does inspection relieve the manufacturer or supplier of his responsibility in any way.

3.03 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner or clean lint-free rags. Do not use compressed air.

3.04 TRAINING

A. The Instrumentation and Controls Subcontractor and/or Control System Subcontractor and/or Telemetry System Subcontractor shall be responsible to fully familiarize and train all Technicians, Operators, Engineers, and Managers associated with the Owner's facility on the maintenance, troubleshooting, and operation of the equipment being supplied. Training shall familiarize the Owner with the all equipment furnished including location and application of each type of instrumentation and controls. Additionally, training shall cover all aspects of the calibration, programming, maintenance, troubleshooting, and operation of the Instrumentation

and Controls System. All training for the project shall also conform to the Contract Requirements including those included in the General Conditions Specification 01664 "Training". All costs involving in fulfilling the training requirements including the preparation of training plans and course materials, duplication of training materials, use of audio/visual presentation equipment, post-training individualized testing, and the use of rental equipment to facilitate individualized training shall be included in the contract price.

B. Contractor provided Operations and Maintenance manuals shall be the basis of all provided training. Supplemental information utilized in the course of the training provided shall be turned over to the Owner for his use in performing refresher training or training of new personnel at a later date.

C. Training shall be conducted by professional, full time instructors familiar with the specifics of the Instrumentation and Control System furnished. Training shall be customized to reflect the specific instrumentation and controls furnished and shall additionally be customized to reflect the understanding of the Owner's personnel. Training shall utilize samples of actual applications, teaching aids, excerpts of the O&M Manuals, slide/video presentations, etc. to facilitate learning and retention of the training provided. Training time shall be divided between classroom and "hands-on" instruction. After the training has been successfully completed, all training materials shall be delivered to Owner for his use.

D. Training shall be performed at the Owner's facility utilizing the actual equipment furnished under the Contract. Contractor can supply (at no cost to the Owner) additional similar equipment to facilitate individualized training or to allow training during the simultaneous operation and testing of Instrumentation and Control system.

E. Initial training may be performed before all construction activities are complete. Final operation and maintenance training shall only be performed after all equipment is fully operational and tested.

F. Instrumentation and Control System Training shall be furnished as follows:

1. Overview and Familiarization of the Instrumentation and Controls System
   a. Length of Class: at least 2 hours
   b. Who shall attend: All Technicians, Operators, Engineers, and Managers
   c. Location: Owner's Plant site
   d. Purpose: To provide a general overview of the Instrumentation and Controls being provided and to familiarize the Owner with the types of equipment being provided. This course can be held before all construction activities have been completed.
2. Control System (and/or Telemetry System) Maintenance Training
   a. Length of Class: at least 4 hours
   b. Who shall attend: Maintenance technicians and supervisors
   c. Location: Owner's Plant Site
   d. Purpose: To make the maintenance personnel familiar with the maintenance requirements of the Instrumentation and Control System. Teach the maintenance personnel how to troubleshoot problems with the equipment provided.

3. Control System (and/or Telemetry System) Configuration and Programming Training
   a. Length of Class: at least 4 hours
   b. Who shall attend: Engineering staff
   c. Location: Owner's Plant Site
   d. Purpose: To make the Owner's engineering staff familiar with the specific software applications provided for the Control Systems (and/or Telemetry System). The supplier shall review the Software Documentation provided so that the Owner's engineering staff is familiar with the Control System Architecture and I/O configuration. The supplier shall assume some basic familiarity with the software provided but shall demonstrate how to add and delete I/O points, modify control logic (both analog and discrete), and modify operator graphics and trends.
4. Use and Operation of the Installed Control System
   a. Length of Class: at least 4 hours
   b. Who shall attend: All Technicians, Operators, Engineers, and Managers
   c. Location: Owner's Plant Site
   d. Purpose: To demonstrate the use and functionality of the Instrumentation and Control System provided. Review the operational functions that must be performed at local or vendor furnished control panels. Familiarize the owner with the basic operation of any graphical based Operator Workstations. Provide a complete review of all graphic and trend displays provided.

G. All training schedules shall be coordinated with and at the convenience of the Owner. Training shall be scheduled with the Owner at least two weeks prior to the actual training date. Training may have to be repeated several times to accommodate the owner's work schedule and personnel availability. Training Class size shall to limited to no more than fifteen (15) individuals for each session.

I. Training lesson plans and certifications for all trainers shall be submitted for approval prior to any performed training sessions. Submittal of Training lesson plans and trainer certificates shall be at least three (3) weeks prior to scheduled training. Copies of training lesson plans, training manuals and handout, visual aids, and reference material shall be provided to the Owner at least one week prior to the start of each training session.

H. The Owner reserves the right to videotape all training sessions. All such tapes shall become the sole property of the Owner.

REFERENCE FORMS

The forms listed below and included in this section are referenced from other sections of the specifications:

Form No.	Title
13000-A	Loop Wiring and Insulation Resistance Test Data Form
13000-B	Control Circuit Piping Leak Test Form
13000-C	Controller Calibration Test Data Form
13000-D	Panel Indicator Calibration Test Data Form
13000-E	Recorder Calibration Test Data Form
13000-F	Signal Trip Calibration Test Data Form
13000-G	Field Switch Calibration Test Data Form
13000-H	Transmitter Calibration Test Data Form
13000-I	Miscellaneous Instrument Calibration Test Data Form
13000-J	Individual Loop Test Data Form
13000-K	Loop Commissioning Test Data Form

13000-A. LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM:

Loop No.:_____

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

			Continuity Resistance [a]		Insulation Resistance [b]			
Wire No.	Panel Tie	Field TB	Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A			--	(A/SH)				
B			(A/B)	--				
C			(A/C)	--				
D			(A/D)	--				
etc.								

a. Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of ±2 ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.

b. Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED_____ Date_____
Contractor's Representative

WITNESSED_____ Date_____
City's Representative

13000-B. CONTROL CIRCUIT PIPING LEAK TEST FORM:

Loop No.:_____

List tubing associated with loop in table below. Make applicable measurements after isolating any air consuming pilots from circuit.

Tube No.	Tubing Equivalent Length of 1/4-Inch Copper[a]	Test Period (seconds)	Permitted Pressure Drop (psi)[b]	Measured Pressure Drop (psi)
A				
B				
C				
D				
etc.				

a. Convert actual tubing and air motor volume to equivalent 1/4-inch copper tubing.

b. Pressure drop shall not exceed 1 psi per hundred feet 1/4-inch tubing per 5 seconds.

CERTIFIED_____ Date_____
Contractor's Representative

WITNESSED_____ Date_____
City's Representative

13000-C. CONTROLLER CALIBRATION TEST DATA FORM:

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input: _____ Process Variable (PV) Scale: _____

Output: _____ Output Scale: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				

% Deviation Allowed: _____

Connect output to PV for following tests:

	Set Point (SP) Indicator Accuracy			Output Meter Accuracy		Controller Accuracy		
SP	PV Reading	Expected % Dev.	Actual Reading	Expected Reading	% Dev.	Actual Output	Output	% Dev.
(0%)		0%						
(50%)		50%						
(100%)		100%						

% Dev. Allowed:_____ % Dev. Allowed:_____ % Dev. Allowed:_____

CERTIFIED_____ Date_____
Contractor's Representative

WITNESSED_____ Date_____
City's Representative

13000-D. PANEL INDICATOR CALIBRATION TEST DATA FORM:

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input:

Scale: _____ Range: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				

% Deviation Allowed: _____

CERTIFIED_____ Date_____
Contractor's Representative

WITNESSED_____ Date_____
City's Representative

13000-E. RECORDER CALIBRATION TEST DATA FORM:

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input: _____ Chart: _____

Scale: _____ Range: _____

% of Range	Input	Expected Scale Reading	Actual Scale Reading	% Deviation
0				
50				
100				

% Deviation Allowed: _____

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

13000-F. SIGNAL TRIP CALIBRATION TEST DATA FORM:

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input:

Scale: _____ Range: _____

Set Point(s): _____

After setting set point(s), run signal input through entire range and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED_____ Date_____
Contractor's Representative

WITNESSED_____ Date_____
City's Representative

13000-G. FIELD SWITCH CALIBRATION TEST DATA FORM:

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input: _____

Range: _____

Set Point(s): _____

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED_____ Date_____
Contractor's Representative

WITNESSED_____ Date_____
City's Representative

13000-H. TRANSMITTER CALIBRATION TEST DATA FORM:

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input: _____

Output: _____

Range: _____ Scale: _____

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

% of Range	Input	Expected Output	Actual Output	% Deviation
0				
50				
100				

% Deviation Allowed: _____

CERTIFIED_____ Date_____
Contractor's Representative

WITNESSED_____ Date_____
City's Representative

13000-I. MISCELLANEOUS INSTRUMENT CALIBRATION TEST DATA FORM:

(For instruments not covered by any of the preceding test forms, the Contractor shall create a form containing all necessary information and calibration procedures.)

CERTIFIED_____ Date_____
Contractor's Representative

WITNESSED_____ Date_____
City's Representative

13000-J. INDIVIDUAL LOOP TEST DATA FORM:

Loop No.:

Description: (Give complete description of loop's function using) tag numbers where appropriate.)

P&ID No.: (Attach copy of P&ID.)

a. Wiring tested:
(Attach test form 13000-A)

b. Instrumentation tubing/piping tested:
(Attach test form 13000-B)

c. Instruments calibrated:
(Attach test forms 13000-C through I)

d. List step-by-step procedures for testing loop parameters. Test loop with instruments, including transmitters and control valves, connected and functioning. If it is not possible to produce a real process variable, then a simulated signal may be used with the Engineer's approval.

CERTIFIED _____ Date_____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

13000-K. LOOP COMMISSIONING TEST DATA FORM:

Loop No.: _____

a. Loop tested:
(Attach test form 13000-J)

b. Controlled or connected equipment tests confirmed:

c. Give complete description of loop's interface with process.

d. With associated equipment and process in operation, provide annotated chart trace of loop response to changes in set points for verification of performance. This chart should demonstrate 1/4-amplitude damping as output adjusts to set point change. Show set points, starting and finishing times on chart, as well as any other pertinent data.

Connect 2-pen recorder to process variable (PV) and to controller output. Use 1 inch/second chart speed.

Pen 1 - PV - Connections:

Pen 2 - Output - Connections:

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
City's Representative

END OF SECTION 13000

Liddell Drive Equalization Facility - Instrument list - Non-Vendor Furnished

I&C Specification: 13100

Last Revised:	5/30/2012	6/24/2012	7/20/2012	8/27/2012	9/28/2012
Last Revision #:	Preliminary	90% Update	Additional Changes	Revised EQ Tank Desig	Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	As Description	Manufacturer	Model No.	Connection Type	Connection Size	Calibration Low Range	Calibration High Range	Calibration Units	Calibration Notes	Supplier	Device Type	Spec Reference	Physical Location	Power Supply	Notes
	FE	110	A	FE110A	I-101	South Fork Flow Metering Manhole Flow	FloDar Surface Radar Flow Sensor FloDar Surface			L-Bracket off Wall							Field	13300	Flow Metering Structure	N	Marsh McBirney FloDar
	FIT	110	A	FIT110A	I-101	South Fork Flow Metering Manhole Flow	Radar Flow Transmitter			N/A		0	100	MGD			Field	13300	Flow Metering Structure	Y	Mount 4'-6" above ground
	FE	110	B	FE110B	I-101	South Fork Flow Metering Manhole Flow	FloDar Surface Radar Flow Sensor FloDar Surface			L-Bracket off Wall							Field	13300	Flow Metering Structure	N	Marsh McBirney FloDar
	FIT	110	B	FIT110B	I-101	South Fork Flow Metering Manhole Flow	Radar Flow Transmitter			N/A		0	100	MGD			Field	13300	Flow Metering Structure	Y	Mount 4'-6" above ground
	LE	120	A	LE120A	I-101	Existing Peachtree Creek Trunk Sewer Level Monitoring Manhole Sanitary Sewer Level	Ultrasonic Level Transducer			Suspended Transducer							Field	13300	Remote Level Monitoring Manhole	N	Suspend into manhole via 1" CVPC Pipe - narrow beam angle required (about 6 degrees) to allow both transmitters to function in the same manhole
	LIT	120	A	LIT120A	I-101	Existing Peachtree Creek Trunk Sewer Level Monitoring Manhole Sanitary Sewer Level	Ultrasonic Level Transmitter			N/A		0	90	Inches			Field	13300	Remote Level Monitoring Manhole	Y	Mount 4'-6" above ground
	LE	120	B	LE120B	I-101	Existing Peachtree Creek Trunk Sewer Level Monitoring Manhole Sanitary Sewer Level	Ultrasonic Level Transducer			Suspended Transducer							Field	13300	Remote Level Monitoring Manhole	N	Suspend into manhole via 1" CVPC Pipe - narrow beam angle required (about 6 degrees) to allow both transmitters to function in the same manhole
	LIT	120	B	LIT120B	I-101	Existing Peachtree Creek Trunk Sewer Level Monitoring Manhole Sanitary Sewer Level	Ultrasonic Level Transmitter			N/A		0	90	Inches			Field	13300	Remote Level Monitoring Manhole	Y	Mount 4'-6" above ground
	LE	201		LE201	I-102	Diversion Wet Well # 1 Level	Radar Level Transducer			Flanged	3 inch						Field	13300	Diversion Wet Well # 1	N	Flange mount on top of Diversion Wet Well
	LIT	201		LIT201	I-102	Diversion Wet Well # 1 Level	Radar Level Transmitter			N/A		0	39	Feet	Bottom EL 785 to top of concrete at 824 feet El.		Field	13300	Diversion Wet Well # 1	Y	Mount 4'-6" above ground
	LE	202		LE202	I-102	Diversion Wet Well # 1 Level	Radar Level Transducer			Flanged	3 inch						Field	13300	Diversion Wet Well # 1	N	Flange mount on top of Diversion Wet Well
	LIT	202		LIT202	I-102	Diversion Wet Well # 1 Level	Radar Level Transmitter			N/A		0	39	Feet	Bottom EL 785 to top of concrete at 824 feet El.		Field	13300	Diversion Wet Well # 1	Y	Mount 4'-6" above ground
	LSLL	203		LSLL203	I-102	Diversion Wet Well # 1 LowLow Level	Float Level Switch			Tie-Wrap to Support Pipe			788.33	Feet Elev.	Open on Falling Level		Field	13300	Diversion Wet Well # 1	N	Requires Intrinsic Safety Wiring
	LSLL	204		LSLL204	I-102	Diversion Wet Well # 1 LowLow Level	Float Level Switch			Tie-Wrap to Support Pipe			785.8	Feet Elev.	Open on Falling Level		Field	13300	Diversion Wet Well # 1	N	Requires Intrinsic Safety Wiring
	LSHH	205		LSHH205	I-102	Diverison Valve Room Sump High High Level	Float Level Switch			Tie-Wrap to Support Pipe			807.8 approx	Feet Elev.	Open on Rising Level		Field	13300	Diversion Valve Room Sump	N	Requires Intrinsic Safety Wiring
	FE	210		FE210	I-102	Diversion Wet Well # 1 Discharge Flow	Magneter Flow Transducer			Flanged	36 Inches						Field	13300	Diversion Valve Room	N	Flow Meter Vault ?
	FIT	210		FIT210	I-102	Diversion Wet Well # 1 Discharge Flow	Magneter Flow Transmitter			N/A		0	45	MGD			Field	13300	Diversion Valve Room	Y	Mount 4'-6" above ground
	AE	210		AE210	I-102	Combustible Gas Detection - Methane - Diversion Wet Well #1	Combustible Gas Sensor - Infrared Absorption			Pipe Stand							Field	13300	Diversion Wet Well # 1	N	Pipe Stand Bracket about 4 ft off Wet Well cover
	AIT	210		AIT210	I-102	Combustible Gas Detection - Methane - Diversion Wet Well #1	Combustible Gas Transmiter			N/A		0	100	% LEL	10% LEL - Methane		Panel	13300	Diversion Wet Well # 1	Y	located in Gas Monitoring Panel
	AY	210		AY210	I-102	Combustible Gas Detection - Methane - Diversion Wet Well #1	Combustible Gas Detector - Sample Pump			N/A							Panel	13300	Diversion Wet Well # 1	N	located in Gas Monitoring Panel
	XA	210	A	XA210A	I-102	Combustible Gas Detection - Diversion Wet Well #1	Audible Horn			N/A							Panel	13300	Diversion Wet Well # 1	N	located in Gas Monitoring Panel
	XL	210	A	XL210A	I-102	Combustible Gas Detection - Diversion Wet Well #1	Strobe Light			N/A							Panel	13300	Diversion Wet Well # 1	N	located in Gas Monitoring Panel

Liddell Drive Equalization Facility - Instrument list - Non-Vendor Furnished

I&C Specification: 13100 | Last Revised: 5/30/2012 | 6/24/2012 | 7/20/2012 | 8/27/2012 | 9/28/2012
Last Revision #: Preliminary | 90% Update | Additional Changes | Revised EQ Tank Desig Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	As Description	Manufacturer	Model No.	Connection Type	Connection Size	Calibration Low Range	Calibration High Range	Calibration Units	Calibration Notes	Supplier	Device Type	Spec Reference	Physical Location	Power Supply	Notes
	AE	211		AE211	I-102	Hydrogen Sulfide Gas Detection - Diversion Wet Well #1	H2S Gas Detector Sensor			Pipe Stand							Field	13300	Diversion Wet Well # 1	N	Pipe Stand Bracket about 4 ft off Wet Well cover
	AIT	211		AIT211	I-102	Hydrogen Sulfide Gas Detection - Diversion Wet Well #1	H2S Gas Detector Transmitter			N/A		0	30	PPM			Field	13300	Diversion Wet Well # 1	Y	located in Gas Monitoring Panel
	AY	211		AY211	I-102	Hydrogen Sulfide Gas Detection - Diversion Wet Well #1	H2S Gas Detector - Sample Pump			N/A							Field	13300	Diversion Wet Well # 1	N	located in Gas Monitoring Panel
	AE	212		AE212	I-102	Combustible Gas Detection - Petroleum - Diversion Wet Well #1	Combustible Gas Sensor - Infrared Absorption			Pipe Stand							Field	13300	Diversion Wet Well # 1	N	Pipe Stand Bracket about 4 ft off Wet Well cover
	AIT	212		AIT212	I-102	Combustible Gas Detection - Petroleum - Diversion Wet Well #1	Combustible Gas Transmitter			N/A		0	100	% LEL	10% LEL - Petroleum		Panel	13300	Diversion Wet Well # 1	Y	located in Gas Monitoring Panel
	AY	212		AY212	I-102	Combustible Gas Detection - Petroleum - Diversion Wet Well #1	Combustible Gas Detector - Sample Pump			N/A							Panel	13300	Diversion Wet Well # 1	N	located in Gas Monitoring Panel
	LE	301		LE301	I-103	Diversion Wet Well # 2 Level	Radar Level Transducer			Flanged	3 inch						Field	13300	Diversion Wet Well # 2	N	Flange mount on top of Diversion Wet Well
	LIT	301		LIT301	I-103	Diversion Wet Well # 2 Level	Radar Level Transmitter			N/A		*0*	*39*	*Feet*	*Bottom EL 785 to top of concrete at 824 feet EL*		Field	13300	Diversion Wet Well # 2	Y	Mount 4'-6" above ground
	LE	302		LE302	I-103	Diversion Wet Well # 2 Level	Radar Level Transducer			Flanged	3 inch						Field	13300	Diversion Wet Well # 2	N	Flange mount on top of Diversion Wet Well
	LIT	302		LIT302	I-103	Diversion Wet Well # 2 Level	Radar Level Transmitter			N/A		*0*	*39*	*Feet*	*Bottom EL 785 to top of concrete at 824 feet EL*		Field	13300	Diversion Wet Well # 2	Y	Mount 4'-6" above ground
	LSLL	303		LSLL303	I-103	Diversion Wet Well # 2 LowLow Level	Float Level Switch			Tie-Wrap to Support Pipe			788.33	Feet Elev.	Open on Falling Level		Field	13300	Diversion Wet Well # 2	N	Requires Intrinsic Safety Wiring
	LSLL	304		LSLL304	I-103	Diversion Wet Well # 2 LowLow Level	Float Level Switch			Tie-Wrap to Support Pipe			785.8	Feet Elev.	Open on Falling Level		Field	13300	Diversion Wet Well # 2	N	Requires Intrinsic Safety Wiring
	FE	**310**		**FE310**	I-103	Diversion Wet Well # 2 Discharge Flow	Magneter Flow Transducer			**Flanged**	**36 Inches**						Field	13300	**Diversion Facility**	N	Flow Meter Vault ?
	FIT	**310**		**FIT310**	I-103	Diversion Wet Well # 2 Discharge Flow	Magneter Flow Transmitter			N/A		**0**	**45**	**MGD**			Field	13300	**Diversion Facility**	Y	Mount 4'-6" above ground
	AE	310		AE310	I-103	Combustible Gas Detection - Methane - Diversion Wet Well # 2	Combustible Gas Sensor - Infrared Absorption			Pipe Stand							Field	13300	Diversion Wet Well # 2	N	Pipe Stand Bracket about 4 ft off Wet Well cover
	AIT	310		AIT310	I-103	Combustible Gas Detection - Methane - Diversion Wet Well # 2	Combustible Gas Transmitter			N/A		0	100	% LEL	10% LEL - Methane		Panel	13300	Diversion Wet Well # 2	Y	located in Gas Monitoring Panel
	AY	310		AY310	I-103	Combustible Gas Detection - Methane - Diversion Wet Well # 2	Combustible Gas Detector - Sample Pump			N/A							Panel	13300	Diversion Wet Well # 2	N	located in Gas Monitoring Panel
	XA	310	A	XA310A	I-103	Combustible Gas Detection - Diversion Wet Well # 2	Audible Horn			N/A							Panel	13300	Diversion Wet Well # 2	N	located in Gas Monitoring Panel
	XL	310	A	XL310A	I-103	Combustible Gas Detection - Diversion Wet Well # 2	Strobe Light			N/A							Panel	13300	Diversion Wet Well # 2	N	located in Gas Monitoring Panel
	AE	311		AE311	I-103	Hydrogen Sulfide Gas Detection - Diversion Wet Well # 2	H2S Gas Detector Sensor			Pipe Stand							Field	13300	Diversion Wet Well # 2	N	Pipe Stand Bracket about 4 ft off Wet Well cover
	AIT	311		AIT311	I-103	Hydrogen Sulfide Gas Detection - Diversion Wet Well # 2	H2S Gas Detector Transmitter			N/A		0	30	PPM			Field	13300	Diversion Wet Well # 2	Y	located in Gas Monitoring Panel
	AY	311		AY311	I-103	Hydrogen Sulfide Gas Detection - Diversion Wet Well # 2	H2S Gas Detector - Sample Pump			N/A							Field	13300	Diversion Wet Well # 2	N	located in Gas Monitoring Panel
	AE	312		AE312	I-103	Combustible Gas Detection - Petroleum - Diversion Wet Well # 2	Combustible Gas Sensor - Infrared Absorption			Pipe Stand							Field	13300	Diversion Wet Well # 2	N	Pipe Stand Bracket about 4 ft off Wet Well cover
	AIT	312		AIT312	I-103	Combustible Gas Detection - Petroleum - Diversion Wet Well # 2	Combustible Gas Transmitter			N/A		0	100	% LEL	10% LEL - Petroleum		Panel	13300	Diversion Wet Well # 2	Y	located in Gas Monitoring Panel
	AY	312		AY312	I-103	Combustible Gas Detection - Petroleum - Diversion Wet Well # 2	Combustible Gas Detector - Sample Pump			N/A							Panel	13300	Diversion Wet Well # 2	N	located in Gas Monitoring Panel

Liddell Drive Equalization Facility - Instrument list - Non-Vendor Furnished

I&C Specification: 13100

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Desig Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	As Description	Manufacturer	Model No.	Connection Type	Connection Size	Calibration Low Range	Calibration High Range	Calibration Units	Calibration Notes	Supplier	Device Type	Spec Reference	Physical Location	Power Supply	Notes
	LE	501		LE501	I-104	Equalization Tank Level	Radar Level Transducer			Flanged	3 inch						Field	13300	Equalization Tank Top	N	Flange mount on top of Equalization Tank
	LIT	501		LIT501	I-104	Equalization Tank Level	Radar Level Transmitter			N/A		0	61	Feet	Bottom EL 796.5 to 1 foot above overflow 856 Ft EL		Field	13300	Equalization Tank	Y	Mount 4'-6" above ground
	LSH	501		LSH501	I-104	Equalization Tank High Level	Capacitance High Level Switch			Threaded	1" NPT		855	Feet Elev.	Open on Rising Level		Field	13300	Equalization Tank Top	Y	Explosion proof or Intrinsic Safety
	LSHH	501		LSHH501	I-104	Equalization Tank High High Level	Capacitance High High Level Switch			Threaded	1" NPT		855.5	Feet Elev.	Open on Falling Level		Field	13300	Equalization Tank Top	Y	Explosion proof or Intrinsic Safety
	LSHH	502		LSHH502	I-104	Equalization Pipeline Junction Box High High Level	Float Level Switch			Tie-Wrap to Support Pipe			867	Feet Elev.	Open on Rising Level		Field	13300	Flow Return Junction Box	N	Requires Intrinsic Safety Wiring
	PSH	501		PSH501	I-104	Jet Mix Pump #1 Discharge High Pressure	Diaphragm Actuated Pressure Switch w/Diaphragm Seal			Threaded	1" NPT		15	PSIG	Open on Rising Pressure		Field	13300	Jet Mixing Pump Station	N	
	PSH	502		PSH502	I-104	Jet Mix Pump #2 Discharge High Pressure	Diaphragm Actuated Pressure Switch w/Diaphragm Seal			Threaded	1" NPT		15	PSIG	Open on Rising Pressure		Field	13300	Jet Mixing Pump Station	N	
	LSHH	503		LSHH503	I-104	Jet Mix Pump Station Washdown Sump High High Level	Float Level Switch			Tie-Wrap to Support Pipe			787.8 approx	Feet Elev.	Open on Rising Level		Field	13300	Jet Mixing Pump Station	N	Requires Intrinsic Safety Wiring
	~~LSHH~~	~~504~~		~~LSHH504~~	~~I-104~~	~~Equalization Facility Valve Vault Sump High High Level~~	~~Float Level Switch~~			~~Tie-Wrap to Support Pipe~~			~~XXX~~	~~Feet Elev.~~	~~Open on Rising Level~~		~~Field~~	~~13300~~	~~Equalization Valve Vault~~	~~N~~	~~Requires Intrinsic Safety Wiring~~
	~~FE~~	~~503~~		~~FE503~~	~~I-105~~	~~Equalization Tank Discharge Flow~~	~~Magneter Flow Transducer~~			~~Flanged~~	~~48 Inches~~						~~Field~~	~~13300~~	~~Equalization Valve Vault~~	~~N~~	~~Flow Meter Vault 2~~
	~~FIT~~	~~503~~		~~FIT503~~	~~I-105~~	~~Equalization Tank Discharge Flow~~	~~Magneter Flow Transmitter~~			~~N/A~~		~~0~~	~~40~~	~~MGD~~			~~Field~~	~~13300~~	~~Equalization Valve Vault~~	~~Y~~	~~Mount 4'-6" above ground~~
	FE	531		FE531	I-105	Equalized Flow Return Pump # 1 Discharge Flow	Magneter Flow Transducer			Flanged	16 Inches						Field	13300	Equlization Flow Return Pump Station	N	
	FIT	531		FIT531	I-105	Equalized Flow Return Pump # 1 Discharge Flow	Magneter Flow Transmitter			N/A		0	7,000	GPM			Field	13300	Equalization Flow Return Pump Station	Y	Mount 4'-6" above ground
	FE	532		FE532	I-105	Equalized Flow Return Pump # 2 Discharge Flow	Magneter Flow Transducer			Flanged	16 Inches						Field	13300	Equalization Flow Return Pump Station	N	
	FIT	532		FIT532	I-105	Equalized Flow Return Pump # 2 Discharge Flow	Magneter Flow Transmitter			N/A		0	7,000	GPM			Field	13300	Equlization Flow Return Pump Station	Y	Mount 4'-6" above ground
	FE	533		FE533	I-105	Equalized Flow Return Pump # 3 Discharge Flow	Magneter Flow Transducer			Flanged	16 Inches						Field	13300	Equalization Flow Return Pump Station	N	
	FIT	533		FIT533	I-105	Equalized Flow Return Pump # 3 Discharge Flow	Magneter Flow Transmitter			N/A		0	7,000	GPM			Field	13300	Equalization Flow Return Pump Station	Y	Mount 4'-6" above ground
	AE	410		AE410	I-106	Hydrogen Sulfide Gas Detection - Diversion Facility Odor Control Scrubber Inlet	H2S Gas Detector Sensor			Control Panel							Field	13300	Diversion Facility Odor Control Scrubber OC-401	N	located in Gas Monitoring Panel

Liddell Drive Equalization Facility - Instrument list - Non-Vendor Furnished

I&C Specification: 13100

Last Revised:	5/30/2012	6/24/2012	7/20/2012	8/27/2012	9/28/2012
Last Revision #:	Preliminary	90% Update	Additional Changes	Revised EQ Tank Desig	Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	As Description	Manufacturer	Model No.	Connection Type	Connection Size	Calibration Low Range	Calibration High Range	Calibration Units	Calibration Notes	Supplier	Device Type	Spec Reference	Physical Location	Power Supply	Notes
	AIT	410		AIT410	I-106	Hydrogen Sulfide Gas Detection - Diversion Facility Odor Control Scrubber Inlet	H2S Gas Transmiiter			N/A		0	30	PPM	H2S		Panel	13300	Diversion Facility Odor Control Scrubber OC-401	Y	
	AY	410		AY410	I-106	Hydrogen Sulfide Gas Detection - Diversion Facility Odor Control Scrubber Inlet	H2S Gas Detector - Sample Pump			N/A							Panel	13300	Diversion Facility Odor Control Scrubber OC-401	N	located in Gas Monitoring Panel
	AE	411		AE411	I-106	Combustible Gas Detection - Methane - Diversion Facility Odor Control Scrubber	Combustible Gas Sensor - Infrared Absorption			Pipe Stand							Field	13300	Diversion Facility Odor Control Scrubber OC-401	N	Mount 4'-6" above ground
	AIT	411		AIT411	I-106	Combustible Gas Detection - Methane - Diversion Facility Odor Control Scrubber	Combustible Gas Transmiiter			N/A		0	100	% LEL	10% LEL - Methane		Panel	13300	Diversion Facility Odor Control Scrubber OC-401	Y	
	AE	412		AE412	I-106	Combustible Gas Detection - Methane - Diversion Facility Odor Control Scrubber after Filter Bed	H2S Gas Detector Sensor			Control Panel							Field	13300	Diversion Facility Odor Control Scrubber OC-401	N	located in Gas Monitoring Panel
	AIT	412		AIT412	I-106	Combustible Gas Detection - Methane - Diversion Facility Odor Control Scrubber after Filter Bed	H2S Gas Transmiiter			N/A		0	30	PPM	H2S		Panel	13300	Diversion Facility Odor Control Scrubber OC-401	Y	
	AY	412		AY412	I-106	Combustible Gas Detection - Methane - Diversion Facility Odor Control Scrubber after Filter Bed	H2S Gas Detector - Sample Pump			N/A							Panel	13300	Diversion Facility Odor Control Scrubber OC-401	N	located in Gas Monitoring Panel
	AE	413		AE413	I-106	Combustible Gas Detection - Methane - Diversion Facility Odor Control Scrubber Outlet	H2S Gas Detector Sensor			Control Panel							Field	13300	Diversion Facility Odor Control Scrubber OC-401	N	located in Gas Monitoring Panel
	AIT	413		AIT413	I-106	Combustible Gas Detection - Methane - Diversion Facility Odor Control Scrubber Outlet	H2S Gas Transmiiter			N/A		0	30	PPM	H2S		Panel	13300	Diversion Facility Odor Control Scrubber OC-401	Y	
	AY	413		AY413	I-106	Combustible Gas Detection - Methane - Diversion Facility Odor Control Scrubber Outlet	H2S Gas Detector - Sample Pump			N/A							Panel	13300	Diversion Facility Odor Control Scrubber OC-401	N	located in Gas Monitoring Panel
	FSL	415		FSL415	I-106	Diversion Facility Valve Room Low Ventillation Air Flow	Thermal Air Flow Switch			Threaded	1" NPT		2,000	SCFM	Open on falling flow		Field	13300	Discharge of Exhaust Fans EF-301 and 302 (H3-102)	Y	Hardwire to Loss of Ventilation Alarm System
	AE	510		AE510	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber Inlet	H2S Gas Detector Sensor			Control Panel							Field	13300	Equalization Facility Odor Control Scrubber OC-501	N	located in Gas Monitoring Panel

Liddell Drive Equalization Facility - Instrument list - Non-Vendor Furnished

1&C Specification: 13100

Last Revised:	5/30/2012	6/24/2012	7/20/2012	8/27/2012	9/28/2012
Last Revision #:	Preliminary	90% Update	Additional Changes	Revised EQ Tank Desig	Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	As Description	Manufacturer	Model No.	Connection Type	Connection Size	Calibration Low Range	Calibration High Range	Calibration Units	Calibration Notes	Supplier	Device Type	Spec Reference	Physical Location	Power Supply	Notes
	AIT	510		AIT510	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber Inlet	H2S Gas Transmiiter			N/A		0	30	PPM	H2S		Panel	13300	Equalization Facility Odor Control Scrubber OC-501	Y	
	AY	510		AY510	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber Inlet	H2S Gas Detector - Sample Pump			N/A							Panel	13300	Equalization Facility Odor Control Scrubber OC-501	N	located in Gas Monitoring Panel
	AE	511		AE511	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber	Combustible Gas Sensor - Infrared Absorption			Pipe Stand							Field	13300	Equalization Facility Odor Control Scrubber OC-501	N	Mount 4'-6" above ground
	AIT	511		AIT511	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber	Combustible Gas Transmiiter			N/A		0	100	% LEL	10% LEL - Methane		Panel	13300	Equalization Facility Odor Control Scrubber OC-501	Y	
	AE	512		AE512	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber after Filter Bed	H2S Gas Detector Sensor			Control Panel							Field	13300	Equalization Facility Odor Control Scrubber OC-501	N	located in Gas Monitoring Panel
	AIT	512		AIT512	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber after Filter Bed	H2S Gas Transmiiter			N/A		0	30	PPM	H2S		Panel	13300	Equalization Facility Odor Control Scrubber OC-501	Y	
	AY	512		AY512	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber after Filter Bed	H2S Gas Detector - Sample Pump			N/A							Panel	13300	Equalization Facility Odor Control Scrubber OC-501	N	located in Gas Monitoring Panel
	AE	513		AE513	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber Outlet	H2S Gas Detector Sensor			Control Panel							Field	13300	Equalization Facility Odor Control Scrubber OC-501	N	located in Gas Monitoring Panel
	AIT	513		AIT513	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber Outlet	H2S Gas Transmiiter			N/A		0	30	PPM	H2S		Panel	13300	Equalization Facility Odor Control Scrubber OC-501	Y	
	AY	513		AY513	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber Outlet	H2S Gas Detector - Sample Pump			N/A							Panel	13300	Equalization Facility Odor Control Scrubber OC-501	N	located in Gas Monitoring Panel
	FSL	515	A	FSL515A	I-107	Equalization Facility Jet Mix Pump Room Low Ventillation Air Flow	Thermal Air Flow Switch			Threaded	1" NPT		11,000	SCFM	Open on falling flow		Field	13300	Discharge of Exhaust Fans EF-701 and 702 (H7-101)	Y	Hardwire to Loss of Ventilation Alarm Panel LCP-515
	FSL	515	B	FSL515B	I-107	Equalization Facility Jet Mix Pump Room Low Ventillation Air Flow	Thermal Air Flow Switch			Threaded	1" NPT		11,000	SCFM	Open on falling flow		Field	13300	Discharge of Exhaust Fans EF-701 and 702 (H7-101)	Y	Hardwire to Loss of Ventilation Alarm Panel LCP-515
	FE	510		FE510	I-108	Equalization Tank Flushing Water Flow	Magneter Flow Transducer			Flanged	8 Inches						Field	13300	Jet Mixing Pump Station	N	Flow Meter Vault ?

Liddell Drive Equalization Facility - Instrument list - Non-Vendor Furnished

I&C Specification: 13100

Last Revised:	5/30/2012	6/24/2012	7/20/2012	8/27/2012	9/28/2012
Last Revision #:	Preliminary	90% Update	Additional Changes	Revised EQ Tank Desig	Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	As Description	Manufacturer	Model No.	Connection Type	Connection Size	Calibration Low Range	Calibration High Range	Calibration Units	Calibration Notes	Supplier	Device Type	Spec Reference	Physical Location	Power Supply	Notes
	FIT	510		FIT510	I-108	Equalization Tank Flushing Water Flow	Magneter Flow Transmitter			N/A		0	2000	GPM			Field	13300	Jet Mixing Pump Station	Y	Mount 4'-6" above ground

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display			Alarms			Trend Record	Notes
																	Low Range	High Range	Units	Type	Low	High		
	HSO	102	C	HSO102C	I-101	Diversion Structure # 2 Diversion Gate # 3 Open Command	Motorized Actuntor Open Command	Diversion Structure #2	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	102	C	HSC102C	I-101	Diversion Structure # 2 Diversion Gate # 3 Closed Command	Motorized Actuntor Close Command	Diversion Structure #2	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	102	C	ZIO102C	I-101	Diversion Structure # 2 Diversion Gate # 3 Open Position	Open Limit Switch	Diversion Structure #2	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	102	C	ZIC102C	I-101	Diversion Structure #1 Diversion Gate # 3 Closed Position	Closed Limit Switch	Diversion Structure #2	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	102	C	YN102C	I-101	Diversion Structure #2 Diversion Gate # 3 Local/Remote Status	Local/Remote Switch Status	Diversion Structure #2	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	FI	110	A	FI110A	I-101	South Fork Flow Metering Manhole Flow	FloDar Surface Radar Flow Transmitter	Flow Metering Manhole	AI	24V DC	SCADA	Y	No	SCADA			0	100	MGD	Absolute			Y	
	FI	110	B	FI110B	I-101	South Fork Flow Metering Manhole Flow	FloDar Surface Radar Flow Transmitter	Flow Metering Manhole	AI	24V DC	SCADA	Y	No	SCADA			0	100	MGD	Absolute			Y	
	LI	120	A	LI120A	I-101	Existing Peachtree Creek Trunk Sewer Level Monitoring Manhole Sanitary Sewer Level	Ultrasonic Level Transmitter	Remote Level Monitoring Manhole	AI	24V DC	RTU Panel	Y	No	SCADA			0	90	Inches	Absolute			Y	via Telemetry RTU at existing Site- Monitored by both Diversion Facility and Equalization Facility PLC's
	LI	120	B	LI120B	I-101	Existing Peachtree Creek Trunk Sewer Level Monitoring Manhole Sanitary Sewer Level	Ultrasonic Level Transmitter	Remote Level Monitoring Manhole	AI	24V DC	RTU Panel	Y	No	SCADA			0	90	Inches	Absolute			Y	via Telemetry RTU at existing Site- Monitored by both Diversion Facility and Equalization Facility PLC's
	UA	199		UA199	I-101	Diversion Facility Electrical Building Fire Alarm System Common Trouble Status	Common Trouble Status Contact	Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	from Fire Alarm Panel
	HSO	201		HSO201	I-102	Diversion Wet Well # 1 Isolation Gate # 1 Open Command	Motorized Actuator Open Command	Diversion Wet Well #1	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	201		HSC201	I-102	Diversion Wet Well # 1 Isolation Gate # 1 Closed Command	Motorized Actuator Close Command	Diversion Wet Well #1	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	201		ZIO201	I-102	Diversion Wet Well #1 Isolation Gate # 1 Open Position	Open Limit Switch	Diversion Wet Well #1	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	201		ZIC201	I-102	Diversion Wet Well #1 Isolation Gate # 1 Closed Position	Closed Limit Switch	Diversion Wet Well #1	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	201		YN201	I-102	Diversion Wet Well #1 Isolation Gate # 1 Local/Remote Status	Local/Remote Switch Status	Diversion Wet Well #1	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	202		HSO202	I-102	Diversion Wet Well # 1 Isolation Gate # 2 Open Command	Motorized Actuator Open Command	Diversion Wet Well #1	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	202		HSC202	I-102	Diversion Wet Well # 1 Isolation Gate # 2 Closed Command	Motorized Actuator Close Command	Diversion Wet Well #1	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	202		ZIO202	I-102	Diversion Wet Well #1 Isolation Gate # 2 Open Position	Open Limit Switch	Diversion Wet Well #1	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	202		ZIC202	I-102	Diversion Wet Well #1 Isolation Gate # 2 Closed Position	Closed Limit Switch	Diversion Wet Well #1	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	202		YN202	I-102	Diversion Wet Well #1 Isolation Gate # 2 Local/Remote Status	Local/Remote Switch Status	Diversion Wet Well #1	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	203		HSO203	I-102	Diversion Wet Well Interconnection Sluice Gate Open Command	Motorized Actuntor Open Command	Diversion Wet Well #1	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	203		HSC203	I-102	Diversion Wet Well Interconnection Sluice Gate Closed Command	Motorized Actuntor Close Command	Diversion Wet Well #1	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	203		ZIO203	I-102	Diversion Wet Well Interconnection Sluice Gate Open Position	Open Limit Switch	Diversion Wet Well #1	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend / Record	Notes
	HSO	101	A	HSO101A	I-101	Diversion Structure # 1 Diversion Gate # 1 Open Command	Motorized Actuator Open Command	Diversion Structure #1	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	101	A	HSC101A	I-101	Diversion Structure # 1 Diversion Gate # 1 Closed Command	Motorized Actuator Close Command	Diversion Structure #1	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	101	A	ZIO101A	I-101	Diversion Structure #1 Diversion Gate # 1 Open Position	Open Limit Switch	Diversion Structure #1	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	101	A	ZIC101A	I-101	Diversion Structure #1 Diversion Gate # 1 Closed Position	Closed Limit Switch	Diversion Structure #1	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	101	A	YN101A	I-101	**Diversion Structure #1 Diversion Gate # 1 Local/Remote Status**	**Local/Remote Switch Status**	**Diversion Structure #1**	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	101	B	HSO101B	I-101	Diversion Structure # 1 Diversion Gate # 2 Open Command	Motorized Actuator Open Command	Diversion Structure #1	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	101	B	HSC101B	I-101	Diversion Structure # 1 Diversion Gate # 2 Closed Command	Motorized Actuator Close Command	Diversion Structure #1	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	101	B	ZIO101B	I-101	Diversion Structure # 1 Diversion Gate # 2 Open Position	Open Limit Switch	Diversion Structure #1	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	101	B	ZIC101B	I-101	Diversion Structure # 1 Diversion Gate # 2 Closed Position	Closed Limit Switch	Diversion Structure #1	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	101	B	YN101B	I-101	**Diversion Structure #1 Diversion Gate # 2 Local/Remote Status**	**Local/Remote Switch Status**	**Diversion Structure #1**	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	101	C	HSO101C	I-101	**Diversion Structure # 1 Diversion Gate # 3 Open Command**	**Motorized Actuator Open Command**	**Diversion Structure #1**	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	101	C	HSC101C	I-101	**Diversion Structure # 1 Diversion Gate # 3 Closed Command**	**Motorized Actuator Close Command**	**Diversion Structure #1**	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	101	C	ZIO101C	I-101	**Diversion Structure #1 Diversion Gate # 3 Open Position**	**Open Limit Switch**	**Diversion Structure #1**	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	101	C	ZIC101C	I-101	**Diversion Structure #1 Diversion Gate # 3 Closed Position**	**Closed Limit Switch**	**Diversion Structure #1**	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	101	A	YN101C	I-101	**Diversion Structure #1 Diversion Gate # 3 Local/Remote Status**	**Local/Remote Switch Status**	**Diversion Structure #1**	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	102	A	HSO102A	I-101	Diversion Structure # 2 Diversion Gate # 1 Open Command	Motorized Actuator Open Command	Diversion Structure #2	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	102	A	HSC102A	I-101	Diversion Structure # 2 Diversion Gate # 1 Closed Command	Motorized Actuator Close Command	Diversion Structure #2	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	102	A	ZIO102A	I-101	Diversion Structure # 2 Diversion Gate # 1 Open Position	Open Limit Switch	Diversion Structure #2	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	102	A	ZIC102A	I-101	Diversion Structure #1 Diversion Gate # 1 Closed Position	Closed Limit Switch	Diversion Structure #2	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	102	A	YN102A	I-101	**Diversion Structure #2 Diversion Gate # 1 Local/Remote Status**	**Local/Remote Switch Status**	**Diversion Structure #2**	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	102	B	HSO102B	I-101	Diversion Structure # 2 Diversion Gate # 2 Open Command	Motorized Actuator Open Command	Diversion Structure #2	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	102	B	HSC102B	I-101	Diversion Structure # 2 Diversion Gate # 2 Closed Command	Motorized Actuator Close Command	Diversion Structure #2	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	102	B	ZIO102B	I-101	Diversion Structure # 2 Diversion Gate # 2 Open Position	Open Limit Switch	Diversion Structure #2	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	102	B	ZIC102B	I-101	Diversion Structure # 2 Diversion Gate # 2 Closed Position	Closed Limit Switch	Diversion Structure #2	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	102	B	YN102B	I-101	**Diversion Structure #2 Diversion Gate # 2 Local/Remote Status**	**Local/Remote Switch Status**	**Diversion Structure #2**	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend / Record	Notes
	ZIC	203		ZIC203	I-102	Diversion Wet Well Interconnection Sluice Gate Closed Position	Closed Limit Switch	Diversion Wet Well #1	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	203		YN203	I-102	Diversion Wet Well Interconnection Sluice Gate Local/Remote Status	Local/Remote Switch Status	Diversion Wet Well #1	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	MN	201	A	MN201A	I-102	Diversion Wet Well #1 Sludge Grinder # 1	"M" Contact	Diversion Wet Well # 1	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	Vendor Furnished Local Control Panel
	XA	201	A	XA201A	I-102	Diversion Wet Well #1 Sludge Grinder # 1	Common Trouble Status Contact	Diversion Wet Well # 1	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Vendor Furnished Local Control Panel
	MC	201	A	MC201A	I-102	Diversion Wet Well #1 Sludge Grinder # 1	Motor Start/Stop	Diversion Wet Well # 1	DO	120 VAC	LCP	N	No	SCADA	Start	Stop							N	Vendor Furnished Local Control Panel
	YN	201	AA	YN201AA	I-102	Diversion Wet Well #1 Sludge Grinder # 1	HOR Remote Status	Diversion Wet Well # 1	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	Vendor Furnished Local Control Panel
	MN	202	A	MN202A	I-102	Diversion Wet Well #1 Sludge Grinder # 2	"M" Contact	Diversion Wet Well # 1	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	Vendor Furnished Local Control Panel
	XA	202	A	XA202A	I-102	Diversion Wet Well #1 Sludge Grinder # 2	Common Trouble Status Contact	Diversion Wet Well # 1	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Vendor Furnished Local Control Panel
	MC	202	A	MC202A	I-102	Diversion Wet Well #1 Sludge Grinder # 2	Motor Start/Stop	Diversion Wet Well # 1	DO	120 VAC	LCP	N	No	SCADA	Start	Stop							N	Vendor Furnished Local Control Panel
	YN	202	AA	YN202AA	I-102	Diversion Wet Well #1 Sludge Grinder # 2	HOR Remote Status	Diversion Wet Well # 1	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							Y	Vendor Furnished Local Control Panel
	LI	201		LI201	I-102	Diversion Wet Well # 1 Level	Radar Level Transmitter	Facility Electrical Building	AI	24V DC	SCADA	Y	No	SCADA			785	824	Feet EL	Absolute			Y	from Level Monitoring Panel
	LI	202		LI202	I-102	Diversion Wet Well # 1 Level	Radar Level Transmitter	Facility Electrical Building	AI	24V DC	SCADA	Y	No	SCADA			785	824	Feet EL	Absolute			Y	from Level Monitoring Panel
	LALL	203		LALL203	I-102	Diversion Wet Well # 1 LowLow Level	Float Level Switch	Facility Electrical Building	DI	120 VAC	SCADA	N	Yes	SCADA	Normal	LowLow							Y	from Level Monitoring Panel
	LALL	204		LALL204	I-102	Diversion Wet Well # 1 LowLow Level	Float Level Switch	Facility Electrical Building	DI	120 VAC	SCADA	N	Yes	SCADA	Normal	LowLow							Y	from Level Monitoring Panel
	LAHH	205		LAHH205	I-102	Diverison Valve Room Sump High High Level	Float Level Switch	Diversion Valve Room Sump	DI	120 VAC	SCADA	N	Y	SCADA	Normal	HHH							Y	
	MN	201		MN201	I-102	Diversion Wet Well #1 Diversion Pump # 1 Running Status	"M" Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	201		XA201	I-102	Diversion Wet Well #1 Diversion Pump # 1 Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	201		MC201	I-102	Diversion Wet Well #1 Diversion Pump # 1 Start/Stop Command	Motor Start/Stop	Diversion Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	201	A	YN201A	I-102	Diversion Wet Well #1 Diversion Pump # 1 VFD HOR in Remote Status	HOR Remote Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	YN	201	B	YN201B	I-102	Diversion Wet Well #1 Diversion Pump # 1 Local E-STOP Status	Local E-STOP Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	E-STOP							N	
	SI	201		SI201	I-102	Diversion Wet Well #1 Diversion Pump # 1 Speed Feedback	VFD Speed Feedback	Diversion Facility Electrical Building	AI	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	SC	201		SC201	I-102	Diversion Wet Well #1 Diversion Pump # 1 Speed Control	VFD Speed Control	Diversion Facility Electrical Building	AO	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	UA	201		UA201	I-102	Diversion Wet Well #1 Diversion Pump # 1 Surge Control Panel Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	From Local Surge Control Panel PIC-201
	MN	202		MN202	I-102	Diversion Wet Well #1 Diversion Pump # 2 Running Status	"M" Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

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Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display			Alarms			Trend Record	Notes
																	Low Range	High Range	Units	Type	Low	High		
	XA	202		XA202	I-102	Diversion Wet Well #1 Diversion Pump # 2 Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	202		MC202	I-102	Diversion Wet Well #1 Diversion Pump # 2 Start/Stop Command	Motor Start/Stop	Diversion Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	202	A	YN202A	I-102	Diversion Wet Well #1 Diversion Pump # 2 VFD HOR in Remote Status	HOR Remote Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	YN	202	B	YN202B	I-102	Diversion Wet Well #1 Diversion Pump # 2 Local E-STOP Status	Local E-STOP Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	E-STOP							N	
	SI	202		SI202	I-102	Diversion Wet Well #1 Diversion Pump # 2 Speed Feedback	VFD Speed Feedback	Diversion Facility Electrical Building	AI	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	SC	202		SC202	I-102	Diversion Wet Well #1 Diversion Pump # 2 Speed Control	VFD Speed Control	Diversion Facility Electrical Building	AO	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	UA	202		UA202	I-102	Diversion Wet Well #1 Diversion Pump # 2 Surge Control Panel Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	From Local Surge Control Panel PIC-202
	MN	203		MN203	I-102	Diversion Wet Well #1 Diversion Pump # 3 Running Status	"M" Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	203		XA203	I-102	Diversion Wet Well #1 Diversion Pump # 3 Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	203		MC203	I-102	Diversion Wet Well #1 Diversion Pump # 3 Start/Stop Command	Motor Start/Stop	Diversion Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	203	A	YN203A	I-102	Diversion Wet Well #1 Diversion Pump # 3 VFD HOR in Remote Status	Local E-STOP Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	E-STOP							N	
	YN	203	B	YN203B	I-102	Diversion Wet Well #1 Diversion Pump # 3 Local E-STOP Status	Local E-STOP Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	E-STOP							N	
	SI	203		SI203	I-102	Diversion Wet Well #1 Diversion Pump # 3 Speed Feedback	VFD Speed Feedback	Diversion Facility Electrical Building	AI	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	SC	203		SC203	I-102	Diversion Wet Well #1 Diversion Pump # 3 Speed Control	VFD Speed Control	Diversion Facility Electrical Building	AO	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	UA	203		UA203	I-102	Diversion Wet Well #1 Diversion Pump # 3 Surge Control Panel Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	From Local Surge Control Panel PIC-203
	MN	204		MN204	I-102	Diversion Wet Well #1 Drainage Pump Running Status	"M" Contnet	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	204		XA204	I-102	Diversion Wet Well #1 Drainage Pump Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	204		MC204	I-102	Diversion Wet Well #1 Drainage Pump Start/Stop Command	Motor Start/Stop	Diversion Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	204	A	YN204A	I-102	Diversion Wet Well #1 Drainage Pump RVSS HOR in Remote Status	HOR Remote Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	YN	204	B	YN204B	I-102	Diversion Wet Well #1 Drainage Pump Local E-STOP Status	Local E-STOP Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	E-STOP							N	

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend / Record	Notes
	HSO	203	A	HSO203A	I-102	Return Flow to South Forks Sanitary Sewer Motorized Isolation Valve - Open Command	Motorized Valve Actuator Open Command	Diversion Facility	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	203	A	HSC203A	I-102	Return Flow to South Forks Sanitary Sewer Motorized Isolation Valve - Closed Command	Motorized Valve Actuator Close Command	Diversion Facility	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	203	A	ZIO203A	I-102	Return Flow to South Forks Sanitary Sewer Motorized Isolation Valve - Open Position	Open Limit Switch	Diversion Facility	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	203	A	ZIC203A	I-102	Return Flow to South Forks Sanitary Sewer Motorized Isolation Valve - Closed Position	Closed Limit Switch	Diversion Facility	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	203	A	YN203A	I-102	Return Flow to South Forks Sanitary Sewer Motorized Isolation Valve Local/Remote Status	Local/Remote Switch Status	Diversion Facility	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	FI	210		FI1210	I-102	Diversion Wet Well # 1 Discharge Flow	Magneter Flow Transmitter	Diversion Valve Room	AI	24V DC	SCADA	Y	No	SCADA			0	45	MGD	Absolute			Y	flow metering vault ?
	AI	210		AI210	I-102	Combustible Gas Detection - Methane - Diversion Wet Well #1	Combustible Gas Transmitter	Diversion Wet Well # 1	AI	24V DC	SCADA	Y	No	SCADA			0	100	% LEL				Y	Gas Monitoring Panel
	XA	210		XA210	I-102	Combustible Gas Detection - Methane - Diversion Wet Well #1	Common Trouble Status Contact	Diversion Wet Well # 1	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Gas Monitoring Panel
	AI	211		AI211	I-102	Hydrogen Sulfide Gas Detection - Diversion Wet Well #1	H2S Gas Detector Transmitter	Diversion Wet Well # 1	AI	24V DC	SCADA	Y	No	SCADA			0	30	PPM				Y	Gas Monitoring Panel
	XA	211		XA211	I-102	Hydrogen Sulfide Gas Detection - Diversion Wet Well #1	Common Trouble Status Contact	Diversion Wet Well # 1	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Gas Monitoring Panel
	AI	212		AI212	I-102	Combustible Gas Detection - Petroleum - Diversion Wet Well #1	Combustible Gas Transmitter	Diversion Wet Well # 1	AI	24V DC	SCADA	Y	No	SCADA			0	100	% LEL				Y	Gas Monitoring Panel
	XA	212		XA212	I-102	Combustible Gas Detection - Petroleum - Diversion Wet Well #1	Common Trouble Status Contact	Diversion Wet Well # 1	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Gas Monitoring Panel
	HSO	301		HSO301	I-103	Diversion Wet Well # 2 Isolation Gate # 1 Open Command	Motorized Actuator Open Command	Diversion Wet Well #2	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	301		HSC301	I-103	Diversion Wet Well # 2 Isolation Gate # 1 Closed Command	Motorized Actuator Close Command	Diversion Wet Well #2	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	301		ZIO301	I-103	Diversion Wet Well # 2 Isolation Gate # 1 Open Position	Open Limit Switch	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	301		ZIC301	I-103	Diversion Wet Well # 2 Isolation Gate # 1 Closed Position	Closed Limit Switch	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	301		YN301	I-103	Diversion Wet Well #2 Isolation Gate # 1 Local/Remote Status	Local/Remote Switch Status	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	302		HSO302	I-103	Diversion Wet Well # 2 Isolation Gate # 2 Open Command	Motorized Actuator Open Command	Diversion Wet Well #2	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	302		HSC302	I-103	Diversion Wet Well # 2 Isolation Gate # 2 Closed Command	Motorized Actuator Close Command	Diversion Wet Well #2	DO	120 VAC	GATE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	302		ZIO302	I-103	Diversion Wet Well # 2 Isolation Gate # 2 Open Position	Open Limit Switch	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	302		ZIC302	I-103	Diversion Wet Well # 2 Isolation Gate # 2 Closed Position	Closed Limit Switch	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	302		YN302	I-103	Diversion Wet Well #2 Isolation Gate # 2 Local/Remote Status	Local/Remote Switch Status	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	MN	301	A	MN301A	I-103	Diversion Wet Well # 2 Sludge Grinder # 1	"M" Contact	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	Vender Furnished Local Control Panel
	XA	301	A	XA301A	I-103	Diversion Wet Well # 2 Sludge Grinder # 1	Common Trouble Status Contact	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Vender Furnished Local Control Panel

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display			Alarms			Trend / Record	Notes
																	Low Range	High Range	Units	Type	Low	High		
	MC	301	A	MC301A	I-103	Diversion Wet Well # 2 Sludge Grinder # 1	Motor Start/Stop	Diversion Wet Well #2	DO	120 VAC	LCP	N	No	SCADA	Start	Stop							N	Vendor Furnished Local Control Panel
	YN	301	AA	YN301AA	I-103	Diversion Wet Well # 2 Sludge Grinder # 1	HOR Remote Status	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	Vendor Furnished Local Control Panel
	MN	302	A	MN302A	I-103	Diversion Wet Well # 2 Sludge Grinder # 2	"M" Contact	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	Vendor Furnished Local Control Panel
	XA	302	A	XA302A	I-103	Diversion Wet Well # 2 Sludge Grinder # 2	Common Trouble Status Contact	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Vendor Furnished Local Control Panel
	MC	302	A	MC302A	I-103	Diversion Wet Well # 2 Sludge Grinder # 2	Motor Start/Stop	Diversion Wet Well #2	DO	120 VAC	LCP	N	No	SCADA	Start	Stop							N	Vendor Furnished Local Control Panel
	YN	302	AA	YN302AA	I-103	Diversion Wet Well # 2 Sludge Grinder # 2	HOR Remote Status	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	Vendor Furnished Local Control Panel
	LI	301		LI301	I-103	Diversion Wet Well # 2 Level	Radar Level Transmitter	Facility Electrical Building	AI	24V DC	SCADA	Y	No	SCADA			785	824	Feet EL	Absolute			Y	from Level Monitoring Panel
	LI	302		LI302	I-103	Diversion Wet Well # 2 Level	Radar Level Transmitter	Facility Electrical Building	AI	24V DC	SCADA	Y	No	SCADA			785	824	Feet EL	Absolute			Y	from Level Monitoring Panel
	LALL	303		LALL303	I-103	Diversion Wet Well # 2 LowLow Level	Float Level Switch	Facility Electrical Building	DI	120 VAC	SCADA	N	Yes	SCADA	Normal	LowLow							Y	from Level Monitoring Panel
	LALL	304		LALL304	I-103	Diversion Wet Well # 2 LowLow Level	Float Level Switch	Facility Electrical Building	DI	120 VAC	SCADA	N	Yes	SCADA	Normal	LowLow							Y	from Level Monitoring Panel
	MN	301		MN301	I-103	Diversion Wet Well #2 Diversion Pump # 1 Running Status	"M" Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	301		XA301	I-103	Diversion Wet Well #2 Diversion Pump # 1 Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	301		MC301	I-103	Diversion Wet Well #2 Diversion Pump # 1 Start/Stop Command	Motor Start/Stop	Diversion Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	301	A	YN301A	I-103	Diversion Wet Well #2 Diversion Pump # 1 VFD HOR in Remote Status	HOR Remote Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	YN	301	B	YN301B	I-103	Diversion Wet Well #2 Diversion Pump # 1 Local E-STOP Status	Local E-STOP Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	E-STOP							N	
	SI	301		SI301	I-103	Diversion Wet Well #2 Diversion Pump # 1 Speed Feedback	VFD Speed Feedback	Diversion Facility Electrical Building	AI	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	SC	301		SC301	I-103	Diversion Wet Well #2 Diversion Pump # 1 Speed Control	VFD Speed Control	Diversion Facility Electrical Building	AO	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	UA	301		UA301	I-103	Diversion Wet Well #2 Diversion Pump # 1 Surge Control Panel Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	From Local Surge Control Panel PIC-301
	MN	302		MN302	I-103	Diversion Wet Well #2 Diversion Pump # 2 Running Status	"M" Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	302		XA302	I-103	Diversion Wet Well #2 Diversion Pump # 2 Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	302		MC302	I-103	Diversion Wet Well #2 Diversion Pump # 2 Start/Stop Command	Motor Start/Stop	Diversion Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	302	A	YN302A	I-103	Diversion Wet Well #2 Diversion Pump # 2 VFD HOR in Remote Status	HOR Remote Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	YN	302	B	YN302B	I-103	Diversion Wet Well #2 Diversion Pump # 2 Local E-STOP Status	Local E-STOP Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	E-STOP							N	

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend / Record	Notes
	SI	302		SI302	I-103	Diversion Wet Well #2 Diversion Pump # 2 Speed Feedback	VFD Speed Feedback	Diversion Facility Electrical Building	AI	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	SC	302		SC302	I-103	Diversion Wet Well #2 Diversion Pump # 2 Speed Control	VFD Speed Control	Diversion Facility Electrical Building	AO	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	UA	302		UA302	I-103	Diversion Wet Well #2 Diversion Pump # 2 Surge Control Panel Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	From Local Surge Control Panel PIC-302
	MN	303		MN303	I-103	Diversion Wet Well #2 Diversion Pump # 3 Running Status	"M" Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	303		XA303	I-103	Diversion Wet Well #2 Diversion Pump # 3 Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	303		MC303	I-103	Diversion Wet Well #2 Diversion Pump # 3 Start/Stop Command	Motor Start/Stop	Diversion Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	303	A	YN303A	I-103	Diversion Wet Well #2 Diversion Pump # 1 VFD HOR In Remote Status	HOR Remote Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	YN	303	B	YN303B	I-103	Diversion Wet Well #2 Diversion Pump # 3 Local E-STOP Status	Local E-STOP Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	E-STOP							N	
	SI	303		SI303	I-103	Diversion Wet Well #2 Diversion Pump # 3 Speed Feedback	VFD Speed Feedback	Diversion Facility Electrical Building	AI	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	SC	303		SC303	I-103	Diversion Wet Well #2 Diversion Pump # 3 Speed Control	VFD Speed Control	Diversion Facility Electrical Building	AO	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	UA	303		UA303	I-103	Diversion Wet Well #2 Diversion Pump # 3 Surge Control Panel Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	From Local Surge Control Panel PIC-303
	MN	304		MN304	I-103	Diversion Wet Well #2 Drainage Pump Running Status	"M" Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	304		XA304	I-103	Diversion Wet Well #2 Drainage Pump Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	304		MC304	I-103	Diversion Wet Well #2 Drainage Pump Start/Stop Command	Motor Start/Stop	Diversion Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	304	A	YN304A	I-103	Diversion Wet Well #2 Drainage Pump VFD HOR in Remote Status	HOR Remote Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	YN	304	B	YN304B	I-103	Diversion Wet Well #2 Drainage Pump Local E-STOP Status	Local E-STOP Status	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	E-STOP							N	
	FI	310		FI310	I-103	Diversion Wet Well # 2 Discharge Flow	Magneter Flow Transmitter	Diversion Facility	AI	24V DC	SCADA	Y	No	SCADA			0	45	MGD	Absolute			Y	flow metering vault ?
	AI	310		AI310	I-103	Combustible Gas Detection - Methane - Diversion Wet Well #2	Combustible Gas Transmitter	Diversion Wet Well #2	AI	24V DC	SCADA	Y	No	SCADA			0	100	% LEL				Y	Gas Monitoring Panel
	XA	310		XA310	I-103	Combustible Gas Detection - Methane - Diversion Wet Well #2	Common Trouble Status Contact	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Gas Monitoring Panel
	AI	311		AI311	I-103	Hydrogen Sulfide Gas Detection - Diversion Wet Well #2	H2S Gas Detector Transmitter	Diversion Wet Well #2	AI	24V DC	SCADA	Y	No	SCADA			0	30	PPM				Y	Gas Monitoring Panel
	XA	311		XA311	I-103	Hydrogen Sulfide Gas Detection - Diversion Wet Well #2	Common Trouble Status Contact	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Gas Monitoring Panel

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend Record	Notes
	AI	312		AI312	I-103	Combustible Gas Detection - Petroleum - Diversion Wet Well #2	Combustible Gas Transmitter	Diversion Wet Well #2	AI	24V DC	SCADA	Y	No	SCADA			0	100	% LEL				Y	Gas Monitoring Panel
	XA	312		XA312	I-103	Combustible Gas Detection - Petroleum - Diversion Wet Well #2	Common Trouble Status Contact	Diversion Wet Well #2	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Gas Monitoring Panel
	HSO	501		HSO501	I-104	Equalization Tank Motorized Isolation Valve - Open Command	Motorized Valve Actuator Open Command	Equalization Facility	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	501		HSC501	I-104	Equalization Tank Motorized Isolation Valve - Closed Command	Motorized Valve Actuator Close Command	Equalization Facility	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	501		ZIO501	I-104	Equalization Tank Motorized Isolation Valve - Open Position	Open Limit Switch	Equalization Facility	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							Y	
	ZIC	501		ZIC501	I-104	Equalization Tank Motorized Isolation Valve - Closed Position	Closed Limit Switch	Equalization Facility	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							Y	
	YN	501	A	YN501A	I-104	Equalization Tank Motorized Isolation Valve Local/Remote Status	Local/Remote Switch Status	Equalization Facility	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	~~HSO~~	~~502~~		~~HSO502~~	~~I-104~~	~~Diversion Flow to Equalization Motorized Isolation Valve - Open Command~~	~~Motorized Valve Actuator Open Command~~	~~Equalization Facility~~	~~DO~~	~~120 VAC~~	~~VALVE ACTUATOR~~	~~N~~	~~No~~	~~SCADA~~	~~Fully Open~~	~~Not Open~~							~~N~~	
	~~HSC~~	~~502~~		~~HSC502~~	~~I-104~~	~~Diversion Flow to Equalization Motorized Isolation Valve - Closed Command~~	~~Motorized Valve Actuator Close Command~~	~~Equalization Facility~~	~~DO~~	~~120 VAC~~	~~VALVE ACTUATOR~~	~~N~~	~~No~~	~~SCADA~~	~~Fully Closed~~	~~Not Closed~~							~~N~~	
	~~ZIO~~	~~502~~		~~ZIO502~~	~~I-104~~	~~Diversion Flow to Equalization Motorized Isolation Valve - Open Position~~	~~Open Limit Switch~~	~~Equalization Facility~~	~~DI~~	~~120 VAC~~	~~SCADA~~	~~N~~	~~No~~	~~SCADA~~	~~Fully Open~~	~~Not Open~~							~~Y~~	
	~~ZIC~~	~~502~~		~~ZIC502~~	~~I-104~~	~~Diversion Flow to Equalization Motorized Isolation Valve - Closed Position~~	~~Closed Limit Switch~~	~~Equalization Facility~~	~~DI~~	~~120 VAC~~	~~SCADA~~	~~N~~	~~No~~	~~SCADA~~	~~Fully Closed~~	~~Not Closed~~							~~Y~~	
	~~YN~~	~~502~~	~~A~~	~~YN502A~~	~~I-104~~	~~Diversion Flow to Equalization Motorized Isolation Valve Local/Remote Status~~	~~Local/Remote Switch Status~~	~~Equalization Facility~~	~~DI~~	~~120 VAC~~	~~SCADA~~	~~N~~	~~No~~	~~SCADA~~	~~Remote~~	~~Local~~							~~Y~~	~~from local control station~~
	LI	501		LI501	I-104	Equalization Tank Level	Radar Level Transmitter	Equalization Facility	AI	24V DC	SCADA	Y	N	SCADA			0	61	Feet	Absolute	5	57	Y	
	LAH	501		LAH501	I-104	Equalization Tank High Level	Capacitance High Level Switch	Equalization Tank Top	DI	120 VAC	SCADA	Y	Y	SCADA	Normal	HIGH							Y	
	LAHH	501		LAHH501	I-104	Equalization Tank High High Level	Capacitance High High Level Switch	Equalization Tank Top	DI	120 VAC	SCADA	Y	Y	SCADA	Normal	HIHI							Y	
	LAHH	502		LAHH502	I-104	Equalization Pipeline Junction Box High High Level	Float Level Switch	Flow Return Junction Box	DI	120 VAC	SCADA	Y	Y	SCADA	Normal	HIHI							Y	
	MN	501		MN501	I-104	Equalization Tank Jet Mixing Pump # 1 Running Status	"M" Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	501		XA501	I-104	Equalization Tank Jet Mixing Pump # 1 Common Trouble Status	Common Trouble Status Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	501		MC501	I-104	Equalization Tank Jet Mixing Pump # 1 Start/Stop Command	Motor Start/Stop	Equalization Facility Electrical Building	DO	120 VAC	Motor Starter	N	No	SCADA	Start	Stop							N	
	YN	501		YN501	I-104	Equalization Tank Jet Mixing Pump # 1 Motor Starter HOR in Remote Status	HOR Remote Status	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	MN	502		MN502	I-104	Equalization Tank Jet Mixing Pump # 2 Running Status	"M" Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend Record	Notes
	XA	502		XA502	I-104	Equalization Tank Jet Mixing Pump # 2 Common Trouble Status	Common Trouble Status Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	502		MC502	I-104	Equalization Tank Jet Mixing Pump # 2 Start/Stop Command	Motor Start/Stop	Equalization Facility Electrical Building	DO	120 VAC	Motor Starter	N	No	SCADA	Start	Stop							N	
	YN	502		YN502	I-104	Equalization Tank Jet Mixing Pump # 2 Motor Starter HOR in Remote Status	HOR Remote Status	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	PAH	501		PAH501	I-104	Equalization Tank Jet Mixing Pump # 1 High Discharge Pressure	Diaphragm Actuated Pressure Switch	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	N	SCADA	Normal	HIGH							Y	
	PAH	502		PAH502	I-104	Equalization Tank Jet Mixing Pump # 2 High Discharge Pressure	Diaphragm Actuated Pressure Switch	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	N	SCADA	Normal	HIGH							Y	
	HSO	504		HSO504	I-104	Equalization Tank Jet Mixing Pump # 1 Drain Valve - Open Command	Motorized Valve Actuator Open Command	Jet Mixing Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	504		HSC504	I-104	Equalization Tank Jet Mixing Pump # 1 Drain Valve - Closed Command	Motorized Valve Actuator Close Command	Jet Mixing Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	504		ZIO504	I-104	Equalization Tank Jet Mixing Pump # 1 Drain Valve - Open Position	Open Limit Switch	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	504		ZIC504	I-104	Equalization Tank Jet Mixing Pump # 1 Drain Valve - Closed Position	Closed Limit Switch	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	504		YN504	I-104	Equalization Tank Jet Mixing Pump # 1 Drain Valve - Local/Remote Status	Local/Remote Switch Status	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	505		HSO505	I-104	Equalization Tank Jet Mixing Pump # 2 Drain Valve - Open Command	Motorized Valve Actuator Open Command	Jet Mixing Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	505		HSC505	I-104	Equalization Tank Jet Mixing Pump # 2 Drain Valve - Closed Command	Motorized Valve Actuator Close Command	Jet Mixing Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	505		ZIO505	I-104	Equalization Tank Jet Mixing Pump # 2 Drain Valve - Open Position	Open Limit Switch	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	505		ZIC505	I-104	Equalization Tank Jet Mixing Pump # 2 Drain Valve - Closed Position	Closed Limit Switch	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	505		YN505	I-104	Equalization Tank Jet Mixing Pump # 2 Drain Valve - Local/Remote Status	Local/Remote Switch Status	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	506		HSO506	I-104	Equalization Tank Jet Mixing Pump # 1 Discharge Isolation Valve - Open Command	Motorized Valve Actuator Open Command	Equalization Facility	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	506		HSC506	I-104	Equalization Tank Jet Mixing Pump # 1 Discharge Isolation Valve - Closed Command	Motorized Valve Actuator Close Command	Equalization Facility	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	506		ZIO506	I-104	Equalization Tank Jet Mixing Pump # 1 Discharge Isolation Valve - Open Position	Open Limit Switch	Equalization Facility	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	506		ZIC506	I-104	Equalization Tank Jet Mixing Pump # 1 Discharge Isolation Valve - Closed Position	Closed Limit Switch	Equalization Facility	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	506		YN506	I-104	Equalization Tank Jet Mixing Pump # 1 Discharge Isolation Valve - Local/Remote Status	Local/Remote Switch Status	Equalization Facility	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	507		HSO507	I-104	Equalization Tank Jet Mixing Pump # 2 Discharge Isolation Valve - Open Command	Motorized Valve Actuator Open Command	Equalization Facility	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend / Record	Notes
	HSC	507		HSC507	I-104	Equalization Tank Jet Mixing Pump # 2 Discharge Isolation Valve - Closed Command	Motorized Valve Actuator Close Command	Equalization Facility	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	507		ZIO507	I-104	Equalization Tank Jet Mixing Pump # 2 Discharge Isolation Valve - Open Position	Open Limit Switch	Equalization Facility	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	507		ZIC507	I-104	Equalization Tank Jet Mixing Pump # 2 Discharge Isolation Valve - Closed Position	Closed Limit Switch	Equalization Facility	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	507		YN507	I-104	Equalization Tank Jet Mixing Pump # 2 Discharge Isolation Valve - Local/Remote Status	Local/Remote Switch Status	Equalization Facility	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	LAHH	503		LAHH503	I-104	Jet Mix Pump Station Washdown Sump High High Level	Float Level Switch	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	Y	SCADA	Normal	HHH							Y	
	~~LAHH~~	~~504~~		~~LAHH504~~	~~I-104~~	~~Equalization Facility Valve Vault Sump High High Level~~	~~Float Level Switch~~	~~Equalization Valve Vault~~	~~DI~~	~~120 VAC~~	~~SCADA~~	~~N~~	~~Y~~	~~SCADA~~	~~Normal~~	~~HHH~~							~~Y~~	
	UA	599		UA599	I-104	Equalization Facility Electrical Building Fire Alarm System Common Trouble Status	Common Trouble Status Contact	Diversion Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	from Fire Alarm Panel
	~~FI~~	~~503~~		~~FI503~~	~~I-105~~	~~Equalized Wastewater Discharge Flow~~	~~Magneter Flow Transmitter~~	~~Equalization Valve Vault~~	~~AI~~	~~24V DC~~	~~SCADA~~	~~Y~~	~~No~~	~~SCADA~~			~~0~~	~~40~~	~~MGD~~	~~Absolute~~			~~Y~~	~~flow metering vault~~
	~~FC~~	~~503~~		~~HC503~~	~~I-105~~	~~Equalized Wastewater Flow Control~~	~~Motorized Modulating Valve Positioning Control~~	~~Equalization Valve Vault~~	~~AO~~	~~24V DC~~	~~SCADA~~	~~Y~~	~~No~~	~~SCADA~~			~~0~~	~~100~~	~~Percent~~				~~Y~~	
	~~ZI~~	~~503~~		~~ZI503~~	~~I-105~~	~~Equalized Wastewater Flow Control Valve Position Feedback~~	~~Motorized Modulating Valve Position Feedback~~	~~Equalization Valve Vault~~	~~AI~~	~~24V DC~~	~~SCADA~~	~~Y~~	~~No~~	~~SCADA~~			~~0~~	~~100~~	~~Percent~~				~~Y~~	
	~~YN~~	~~503~~	~~A~~	~~YN503A~~	~~I-105~~	~~Equalized Wastewater Flow Control Valve Local/Remote Status~~	~~Local/Remote Switch Status~~	~~Equalization Valve Vault~~	~~DI~~	~~120 VAC~~	~~SCADA~~	~~N~~	~~No~~	~~SCADA~~	~~Remote~~	~~Local~~							~~Y~~	~~from local control station~~
	FI	531		FI531	I-105	Equalized Flow Return Pump # 1 Discharge Flow	Magneter Flow Transmitter	Equalized Flow Return Pump Station	AI	24V DC	SCADA	Y	No	SCADA			0	7,000	GPM	Absolute			Y	
	FAL	531		FAL531	I-105	Equalized Flow Return Pump # 1 Seal Water Low Flow	Seal Water Rotometer Low Flow Switch	Equalized Flow Return Pump Station	DI	120 VAC	SCADA	Y	Y	SCADA	Normal	Low							Y	contact from Pump VFD Cabinet
	MN	531		MN531	I-105	Equalized Flow Return Pump # 1 Running Status	"M" Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	531		XA531	I-105	Equalized Flow Return Pump # 1 Common Trouble Status	Common Trouble Status Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	531		MC531	I-105	Equalized Flow Return Pump # 1 Start/Stop Command	Motor Start/Stop	Equalization Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	531	A	YN531A	I-105	Equalized Flow Return Pump # 1 VFD HOR in Remote Status	HOR Remote Status	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	SI	531		SI531	I-105	Equalized Flow Return Pump # 1 Speed Feedback	VFD Speed Feedback	Equalization Facility Electrical Building	AI	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	SC	531		SC531	I-105	Equalized Flow Return Pump # 1 Speed Control	VFD Speed Control	Equalization Facility Electrical Building	AO	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	FI	532		FI532	I-105	Equalized Flow Return Pump # 2 Discharge Flow	Magneter Flow Transmitter	Equalized Flow Return Pump Station	AI	24V DC	SCADA	Y	No	SCADA			0	7,000	GPM	Absolute			Y	

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend / Record	Notes
	FAL	532		FAL532	I-105	Equalized Flow Return Pump # 2 Seal Water Low Flow	Seal Water Rotameter Low Flow Switch	Equalized Flow Return Pump Station	DI	120 VAC	SCADA	Y	Y	SCADA	Normal	Low							Y	contact from Pump VFD Cabinet
	MN	532		MN532	I-105	Equalized Flow Return Pump # 2 Running Status	"M" Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	532		XA532	I-105	Equalized Flow Return Pump # 2 Common Trouble Status	Common Trouble Status Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	532		MC532	I-105	Equalized Flow Return Pump # 2 Start/Stop Command	Motor Start/Stop	Equalization Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	532	A	YN532A	I-105	Equalized Flow Return Pump # 2 VFD HOR in Remote Status	HOR Remote Status	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	SI	532		SI532	I-105	Equalized Flow Return Pump # 2 Speed Feedback	VFD Speed Feedback	Equalization Facility Electrical Building	AI	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	SC	532		SC532	I-105	Equalized Flow Return Pump # 2 Speed Control	VFD Speed Control	Equalization Facility Electrical Building	AO	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	FI	533		FI533	I-105	Equalized Flow Return Pump # 3' Discharge Flow	Magneter Flow Transmitter	Equalized Flow Return Pump Station	AI	24V DC	SCADA	Y	No	SCADA			0	7,000	GPM	Absolute			Y	
	FAL	533		FAL533	I-105	Equalized Flow Return Pump # 3 Seal Water Low Flow	Seal Water Rotameter Low Flow Switch	Equalized Flow Return Pump Station	DI	120 VAC	SCADA	Y	Y	SCADA	Normal	Low							Y	contact from Pump VFD Cabinet
	MN	533		MN533	I-105	Equalized Flow Return Pump # 3 Running Status	"M" Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	533		XA533	I-105	Equalized Flow Return Pump # 1 Common Trouble Status	Common Trouble Status Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	533		MC533	I-105	Equalized Flow Return Pump # 3 Start/Stop Command	Motor Start/Stop	Equalization Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	533	A	YN533A	I-105	Equalized Flow Return Pump # 3 VFD HOR in Remote Status	HOR Remote Status	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	SI	533		SI533	I-105	Equalized Flow Return Pump # 3 Speed Feedback	VFD Speed Feedback	Equalization Facility Electrical Building	AI	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	SC	533		SC533	I-105	Equalized Flow Return Pump # 3 Speed Control	VFD Speed Control	Equalization Facility Electrical Building	AO	24V DC	VFD	N	No	SCADA			0	100	PCT				Y	
	HSO	531		HSO531	I-105	Equalized Flow Return Pump # 1 Drain Valve - Open Command	Motorized Valve Actuator Open Command	Equalization Flow Return Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	531		HSC531	I-105	Equalized Flow Return Pump # 1 Drain Valve - Closed Command	Motorized Valve Actuator Close Command	Equalization Flow Return Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	531		ZIO531	I-105	Equalized Flow Return Pump # 1 Drain Valve - Open Position	Open Limit Switch	Equalization Flow Return Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	531		ZIC531	I-105	Equalized Flow Return Pump # 1 Drain Valve - Closed Position	Closed Limit Switch	Equalization Flow Return Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	531		YN531	I-105	Equalized Flow Return Pump # 1 Drain Valve - Local/Remote Status	Local/Remote Switch Status	Equalization Flow Return Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	532		HSO532	I-105	Equalized Flow Return Pump # 2 Drain Valve - Open Command	Motorized Valve Actuator Open Command	Equalization Flow Return Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

Last Revised: 5/30/2012 6/24/2012 7/20/2012 8/27/2012 9/28/2012
Last Revision #: Preliminary 90% Update Additional Changes Revised EQ Tank Design Additional Changes

Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppresser	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Units	Alarms Type	Alarms Low	Alarms High	Trend Record	Notes
	HSC	532		HSC532	I-105	Equalized Flow Return Pump # 2 Drain Valve - Closed Command	Motorized Valve Actuator Close Command	Equalization Flow Return Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	532		ZIO532	I-105	Equalized Flow Return Pump # 2 Drain Valve - Open Position	Open Limit Switch	Equalization Flow Return Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	532		ZIC532	I-105	Equalized Flow Return Pump # 2 Drain Valve - Closed Position	Closed Limit Switch	Equalization Flow Return Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	532		YN532	I-105	Equalized Flow Return Pump # 2 Drain Valve - Local/Remote Status	Local/Remote Switch Status	Equalization Flow Return Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	533		HSO533	I-105	Equalized Flow Return Pump # 3 Drain Valve - Open Command	Motorized Valve Actuator Open Command	Equalization Flow Return Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	533		HSC533	I-105	Equalized Flow Return Pump # 3 Drain Valve - Closed Command	Motorized Valve Actuator Close Command	Equalization Flow Return Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	533		ZIO533	I-105	Equalized Flow Return Pump # 3 Drain Valve - Open Position	Open Limit Switch	Equalization Flow Return Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	533		ZIC533	I-105	Equalized Flow Return Pump # 3 Drain Valve - Closed Position	Closed Limit Switch	Equalization Flow Return Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	533		YN533	I-105	Equalized Flow Return Pump # 3 Drain Valve - Local/Remote Status	Local/Remote Switch Status	Equalization Flow Return Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	MN	534		MN534	I-105	Equalization Tank Drainage Pump # 1 Running Status	"M" Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	534		XA534	I-105	Equalization Tank Drainage Pump # 1 Common Trouble Status	Common Trouble Status Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	534		MC534	I-105	Equalization Tank Drainage Pump # 1 Start/Stop Command	Motor Start/Stop	Equalization Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	534	A	YN534	I-105	Equalization Tank Drainage Pump # 1 VFD HOR in Remote Status	HOR Remote Status	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	II	534		II534	I-105	Equalization Tank Drainage Pump # 1 Motor Current	MCC Motor Current Transmitter	Equalization Facility Electrical Building	AI	24V DC	MCC	N	No	SCADA			0	125	% FLC				Y	Trip Pump on low current after start
	MN	535		MN535	I-105	Equalization Tank Drainage Pump # 2 Running Status	"M" Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	
	XA	535		XA535	I-105	Equalization Tank Drainage Pump # 2 Common Trouble Status	Common Trouble Status Contact	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	
	MC	535		MC535	I-105	Equalization Tank Drainage Pump # 2 Start/Stop Command	Motor Start/Stop	Equalization Facility Electrical Building	DO	120 VAC	VFD	N	No	SCADA	Start	Stop							N	
	YN	535	A	YN535	I-105	Equalization Tank Drainage Pump # 2 VFD HOR in Remote Status	HOR Remote Status	Equalization Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	
	II	535		II535	I-105	Equalization Tank Drainage Pump # 2 Motor Current	MCC Motor Current Transmitter	Equalization Facility Electrical Building	AI	24V DC	MCC	N	No	SCADA			0	125	% FLC				Y	Trip Pump on low current after start
	MN	401		MN401	I-106	Diversion Wet Well Odor Control Fan Running Status	"M" Contact	Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	Motor Start in Odor Control Panel
	XA	401		XA401	I-106	Diversion Wet Well Odor Control Fan Common Trouble Status	Common Trouble Status Contact	Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Moter Start in Odor Control Panel
	MC	401		MC401	I-106	Diversion Wet Well Odor Control Fan Start/Stop Command	Motor Start/Stop	Facility Electrical Building	DO	120 VAC	RVSS	N	No	SCADA	Start	Stop							N	Motor Start in Odor Control Panel

Liddell Drive Equalization Facility - PLC I/O List

I&C Specification: 13120

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Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend / Record	Notes
	YN	401		YN401	I-106	Diversion Wet Well Odor Control Fan Starter HOR in Remote Status	HOR Remote Status	Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	Motor Start in Odor Control Panel
	UA	409		UA409	I-106	Diversion Wet Well Odor Control System Common Trouble Status	Common Trouble Status Contact	Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	from Odor Control Panel
	AI	410		AIT410	I-106	Hydrogen Sulfide Gas Detection - Diversion Facility Odor Control Scrubber Inlet	H2S Gas Transmitter	Diversion Facility Odor Control Scrubber OC-401	AI	24V DC	SCADA	Y	No	SCADA			0	30	PPM				Y	from Gas Monitoring Panel OCGMP-410
	XA	410		XA410	I-106	Hydrogen Sulfide Gas Detection - Diversion Facility Odor Control Scrubber Inlet	Common Trouble Status Contact	Diversion Facility Odor Control Scrubber OC-401	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	from Gas Monitoring Panel OCGMP-410
	AI	411		AI411	I-106	Hydrogen Sulfide Gas Detection - Diversion Facility Odor Control Scrubber	Combustible Gas Transmitter	Diversion Facility Odor Control Scrubber OC-401	AI	24V DC	SCADA	Y	No	SCADA			0	100	% LEL				Y	from Gas Monitoring Panel OCGMP-410
	AI	412		AI412	I-106	Hydrogen Sulfide Gas Detection - Diversion Facility Odor Control Scrubber after Filter Bed	H2S Gas Transmitter	Diversion Facility Odor Control Scrubber OC-401	AI	24V DC	SCADA	Y	No	SCADA			0	30	PPM				Y	from Gas Monitoring Panel OCGMP-410
	XA	412		XA412	I-106	Hydrogen Sulfide Gas Detection - Diversion Facility Odor Control Scrubber after Filter Bed	Common Trouble Status Contact	Diversion Facility Odor Control Scrubber OC-401	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	from Gas Monitoring Panel OCGMP-410
	AI	413		AI413	I-106	Hydrogen Sulfide Gas Detection - Diversion Facility Odor Control Scrubber Outlet	H2S Gas Transmitter	Diversion Facility Odor Control Scrubber OC-401	AI	24V DC	SCADA	Y	No	SCADA			0	30	PPM				Y	from Gas Monitoring Panel OCGMP-410
	XA	413		XA413	I-106	Hydrogen Sulfide Gas Detection - Diversion Facility Odor Control Scrubber Outlet	Common Trouble Status Contact	Diversion Facility Odor Control Scrubber OC-401	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	from Gas Monitoring Panel OCGMP-410
	FAL	415		FAL415	I-106	Diversion Facility Valve Room Low Ventillation Air Flow	Thermal Air Flow Switch	Diversion Facility Electrical Building	DI	120 VAC	SCADA	Y	Y	SCADA	Normal	Low							Y	contact output from Loss of Ventilation Alarming System
	MN	501		MN501	I-107	Equalization Facility Odor Control Fan Running Status	"M" Contact	Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Running	Stopped							Y	Motor Start in Odor Control Panel
	XA	501		XA501	I-107	Equalization Facility Odor Control Fan Common Trouble Status	Common Trouble Status Contact	Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	Motor Start in Odor Control Panel
	MC	501		MC501	I-107	Equalization Facility Odor Control Fan Start/Stop Command	Motor Start/Stop	Facility Electrical Building	DO	120 VAC	RVSS	N	No	SCADA	Start	Stop							N	Motor Start in Odor Control Panel
	YN	501		YN501	I-107	Equalization Facility Odor Control Fan Starter HOR in Remote Status	HOR Remote Status	Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	In Remote	Local							N	Motor Start in Odor Control Panel
	UA	509		UA509	I-107	Equalization Facility Odor Control System Common Trouble Status	Common Trouble Status Contact	Facility Electrical Building	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	from Odor Control Panel
	AI	510		AI510	I-107	Hydrogen Sulfide Gas Detection - Equalization Facility Odor Control Scrubber Inlet	Combustible Gas Transmitter	Equalization Facility Odor Control Scrubber OC-501	AI	24V DC	SCADA	Y	No	SCADA			0	30	PPM				Y	from Gas Monitoring Panel OCGMP-510
	XA	510		XA510	I-107	Hydrogen Sulfide Gas Detection - Equalization Facility Odor Control Scrubber Inlet	Common Trouble Status Contact	Diversion Facility Odor Control Scrubber OC-401	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	from Gas Monitoring Panel OCGMP-510
	AI	511		AI511	I-107	Combustible Gas Detection - Methane - Equalization Facility Odor Control Scrubber	Combustible Gas Transmitter	Equalization Facility Odor Control Scrubber OC-501	AI	24V DC	SCADA	Y	No	SCADA			0	100	% LEL				Y	from Gas Monitoring Panel OCGMP-510

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Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend / Record	Notes
	AI	512		AI512	I-107	Hydrogen Sulfide Gas Detection - Equalization Facility Odor Control Scrubber after Filter Bed	Combustible Gas Transmitter	Equalization Facility Odor Control Scrubber OC-501	AI	24V DC	SCADA	Y	No	SCADA			0	30	PPM				Y	from Gas Monitoring Panel OCGMP-510
	XA	512		XA512	I-107	Hydrogen Sulfide Gas Detection - Equalization Facility Odor Control Scrubber after Filter Bed	Common Trouble Status Contact	Diversion Facility Odor Control Scrubber OC-401	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	from Gas Monitoring Panel OCGMP-510
	AI	513		AI513	I-107	Hydrogen Sulfide Gas Detection - Equalization Facility Odor Control Scrubber Outlet	Combustible Gas Transmitter	Equalization Facility Odor Control Scrubber OC-501	AI	24V DC	SCADA	Y	No	SCADA			0	30	PPM				Y	from Gas Monitoring Panel OCGMP-510
	XA	513		XA513	I-107	Hydrogen Sulfide Gas Detection - Equalization Facility Odor Control Scrubber Outlet	Common Trouble Status Contact	Diversion Facility Odor Control Scrubber OC-401	DI	120 VAC	SCADA	N	No	SCADA	Normal	Trouble							Y	from Gas Monitoring Panel OCGMP-510
	FAL	515		FAL515	I-107	Equalization Facility Jet Mix Pump Room Low Ventilation Air Flow	Thermal Air Flow Switch	Equalization Facility Electrical Building	DI	120 VAC	SCADA	Y	Y	SCADA	Normal	Low							Y	contact output from Loss of Ventilation Alarming System
	FI	510		FI510	I-108	Equalization Tank Flushing Water Flow	Magneter Flow Transmitter	Jet Mixing Pump Station	AI	24V DC	SCADA	Y	No	SCADA			0	2000	GPM	Absolute			Y	
	HSO	511		HSO511	I-108	Equalization Tank Flushing Water Valve - Zone 1 - Open Command	Motorized Valve Actuator Open Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	511		HSC511	I-108	Equalization Tank Flushing Water Valve - Zone 1 - Closed Command	Motorized Valve Actuator Close Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	511		ZIO511	I-108	Equalization Tank Flushing Water Valve - Zone 1 - Open Position	Open Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	511		ZIC511	I-108	Equalization Tank Flushing Water Valve - Zone 1 - Closed Position	Closed Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	511		YN511	I-108	Equalization Tank Flushing Water Valve - Zone 1 - Local/Remote Status	Local/Remote Switch Status	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	512		HSO512	I-108	Equalization Tank Flushing Water Valve - Zone 2 - Open Command	Motorized Valve Actuator Open Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	512		HSC512	I-108	Equalization Tank Flushing Water Valve - Zone 2 - Closed Command	Motorized Valve Actuator Close Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	512		ZIO512	I-108	Equalization Tank Flushing Water Valve - Zone 2 - Open Position	Open Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	512		ZIC512	I-108	Equalization Tank Flushing Water Valve - Zone 2 - Closed Position	Closed Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	512		YN512	I-108	Equalization Tank Flushing Water Valve - Zone 2 - Local/Remote Status	Local/Remote Switch Status	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	513		HSO513	I-108	Equalization Tank Flushing Water Valve - Zone 3 - Open Command	Motorized Valve Actuator Open Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	513		HSC513	I-108	Equalization Tank Flushing Water Valve - Zone 3 - Closed Command	Motorized Valve Actuator Close Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	513		ZIO513	I-108	Equalization Tank Flushing Water Valve - Zone 3 - Open Position	Open Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	513		ZIC513	I-108	Equalization Tank Flushing Water Valve - Zone 3 - Closed Position	Closed Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	513		YN513	I-108	Equalization Tank Flushing Water Valve - Zone 3 - Local/Remote Status	Local/Remote Switch Status	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	514		HSO514	I-108	Equalization Tank Flushing Water Valve - Zone 4 - Open Command	Motorized Valve Actuator Open Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	

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Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend Record	Notes
	HSC	514		HSC514	I-108	Equalization Tank Flushing Water Valve - Zone 4 - Closed Command	Motorized Valve Actuator Close Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	514		ZIO514	I-108	Equalization Tank Flushing Water Valve - Zone 4 - Open Position	Open Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	514		ZIC514	I-108	Equalization Tank Flushing Water Valve - Zone 4 - Closed Position	Closed Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	514		YN514	I-108	Equalization Tank Flushing Water Valve - Zone 4 - Local/Remote Status	Local/Remote Switch Status	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	515		HSO515	I-108	Equalization Tank Flushing Water Valve - Zone 5 - Open Command	Motorized Valve Actuator Open Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	515		HSC515	I-108	Equalization Tank Flushing Water Valve - Zone 5 - Closed Command	Motorized Valve Actuator Close Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	515		ZIO515	I-108	Equalization Tank Flushing Water Valve - Zone 5 - Open Position	Open Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	515		ZIC515	I-108	Equalization Tank Flushing Water Valve - Zone 5 - Closed Position	Closed Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	515		YN515	I-108	Equalization Tank Flushing Water Valve - Zone 5 - Local/Remote Status	Local/Remote Switch Status	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	516		HSO516	I-108	Equalization Tank Flushing Water Valve - Zone 6 - Open Command	Motorized Valve Actuator Open Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	516		HSC516	I-108	Equalization Tank Flushing Water Valve - Zone 6 - Closed Command	Motorized Valve Actuator Close Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	516		ZIO516	I-108	Equalization Tank Flushing Water Valve - Zone 6 - Open Position	Open Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	516		ZIC516	I-108	Equalization Tank Flushing Water Valve - Zone 6 - Closed Position	Closed Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	516		YN516	I-108	Equalization Tank Flushing Water Valve - Zone 6 - Local/Remote Status	Local/Remote Switch Status	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	517		HSO517	I-108	Equalization Tank Flushing Water Valve - Zone 7 - Open Command	Motorized Valve Actuator Open Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	517		HSC517	I-108	Equalization Tank Flushing Water Valve - Zone 7 - Closed Command	Motorized Valve Actuator Close Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	517		ZIO517	I-108	Equalization Tank Flushing Water Valve - Zone 7 - Open Position	Open Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	517		ZIC517	I-108	Equalization Tank Flushing Water Valve - Zone 7 - Closed Position	Closed Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	517		YN517	I-108	Equalization Tank Flushing Water Valve - Zone 7 - Local/Remote Status	Local/Remote Switch Status	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	518		HSO518	I-108	Equalization Tank Flushing Water Valve - Zone 8 - Open Command	Motorized Valve Actuator Open Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	518		HSC518	I-108	Equalization Tank Flushing Water Valve - Zone 8 - Closed Command	Motorized Valve Actuator Close Command	Equalization Tank	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	
	ZIO	518		ZIO518	I-108	Equalization Tank Flushing Water Valve - Zone 8 - Open Position	Open Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	518		ZIC518	I-108	Equalization Tank Flushing Water Valve - Zone 8 - Closed Position	Closed Limit Switch	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	518		YN518	I-108	Equalization Tank Flushing Water Valve - Zone 8 - Local/Remote Status	Local/Remote Switch Status	Equalization Tank	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station
	HSO	519		HSO519	I-108	Equalization Tank Flushing Water Isolation Valve - Open Command	Motorized Valve Actuator Open Command	Jet Mixing Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Open	Not Open							N	
	HSC	519		HSC519	I-108	Equalization Tank Flushing Water Isolation Valve - Closed Command	Motorized Valve Actuator Close Command	Jet Mixing Pump Station	DO	120 VAC	VALVE ACTUATOR	N	No	SCADA	Fully Closed	Not Closed							N	

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Process Area	ISA Tag	Loop Number	Suffix	Full Tag Number	P & ID	Service Description	Instrument Description	Physical Location	I/O Type	I/O Voltage	I/O Power Source	Surge Suppressor	Instrinic Safety	Display	One State	Zero State	Display Low Range	Display High Range	Display Units	Alarms Type	Alarms Low	Alarms High	Trend / Record	Notes
	ZIO	519		ZIO519	I-108	Equalization Tank Flushing Water Isolation Valve - Open Position	Open Limit Switch	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Open	Not Open							N	
	ZIC	519		ZIC519	I-108	Equalization Tank Flushing Water Isolation Valve - Closed Position	Closed Limit Switch	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Fully Closed	Not Closed							N	
	YN	519		YN519	I-108	Equalization Tank Flushing Water Isolation Valve - Local/Remote Status	Local/Remote Switch Status	Jet Mixing Pump Station	DI	120 VAC	SCADA	N	No	SCADA	Remote	Local							Y	from local control station

SECTION 13150
INSTRUMENTATION AND CONTROLS – LOGIC DESCRIPTIONS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section contains written descriptions of control logic and control strategies provided as a guide to facilitate detailed design, configuration, implementation, and start-up of the Plant Control System. This information is provided as a supplement to other information provided by the Contract Drawings including the P&I Ds (Piping and Instrumentation Drawings). The intent of this section is not to define every detail or nuance of the Control System design but to provide general guidelines for estimating the engineering, check-out, and start-up time anticipated to be spent to complete the software configuration associated for providing the Plant Control System.

B. Control Strategies and logic presented in this section will require further refinement and coordination with the Contractor and/or Owner to achieve a fully integrated and fully functional control system design.

C. Work associated with this section may be performed by one or more parties including the Owner. This section does not attempt to apportion work or responsibility for work among the various sub-contractors, suppliers, and manufacturers.

PART 2 - PRODUCTS

2.01 GENERAL CONFIGURATION REQUIREMENTS

A. Graphics Configuration Standards

1. To minimize the training of the plant operators for the Liddell Drive Equalization Facility, the Plant Control System Graphics shall be designed to be compatible with the existing City of Atlanta graphics standards.

2. A complete set of Graphical displays to cover all existing and new process areas connected to the Plant Control System shall be provided. Each Operator Console shall be loaded with a complete hierarchical sequence of displays including Overview Graphic(s), Individual Process Graphics, Trend Displays, SCADA System Maintenance Graphics, Text Information Pages (Elapsed Motor Run Times, for instance), and Alarm Summary Pages.

B. Discrete Input Monitoring and Alarming

1. All Discrete Inputs shown on the P&IDs and/or Instrument Index/ I/O List shall be included in the system database of the Plant SCADA system and shall have their status shown on the appropriate plant graphic (s). Logic state descriptors shall be initially set to the values shown in the I/O list. Where indicated in the I/O List, discrete inputs shall be enabled for audible alarming. Where indicated in the I/O List, discrete inputs shall be included in the trend points database.

2. Graphics color conventions shall be established to denote when a point is in normal non-alarmed mode, alarm unacknowledged alarm mode, or alarm acknowledge alarm mode.

C. Analog Input Monitoring and Alarming

1. All Analog Inputs shown on the P&IDs and/or Instrument Index/ I/O List shall be included in the system database of the Plant SCADA system and shall have their status shown on the appropriate plant graphic (s). High and Low Alarm limits shall be initially set to the values shown in the I/O list. Where indicated in the I/O List, analog inputs shall be included in the trend points database.

2. Graphics color conventions shall be established to denote when a point is in normal non-alarmed mode, alarm unacknowledged alarm mode, alarm acknowledge alarm mode or measurement out of range (high or low).

D. Generic Motor Control Conventions

1. All motor controls shown on the P&IDs and/or Instrument Index/ I/O List shall be included in the system database of the Plant SCADA system and shall have their status shown on the appropriate plant graphic (s). Where the Plant Control System has any automatic sequencing type control of motor operation, Hand-OFF-Auto type selector switches shall be provided on the plant graphics to allow automatic interlocks to be bypassed. In Hand mode, the automatic software interlocks shall be bypassed and the motor run continuously except that any hardwired motor starter type interlocks shall still be enabled to protect equipment or operations. In the OFF mode, the motor shall be stopped. In the Auto position, operation of the motor shall be dependent on the associated automatic logic configured for that piece of equipment.

2. Graphics color conventions shall be established to denote when a motor is stopped normally, failed to start, or running (different colors for two speed motors running in slow or fast speeds). Status of software H-O-A Switches associated with each motor shall be clearly visible on each graphics. Associated status of trouble inputs or other status information for each motor shall be displayed as well in proximity to each motor/equipment symbol.

E. Priority of Local verses Remote Controls: The plant operating philosophy will be that local controls take precedence over remote controls in a hierarchical order. Local E-STOP pushbuttons shall disable any and all inputs to Control Panels, Motor Starters, or Variable Frequency Drives (VFD) to disable pump/fan/motor operation for as long as the E-STOP pushbutton is depressed – motor operation will be interrupted and will not automatically restart until motor start is reinitiated by the plant operators. Similarly local Hand-Off-Remote (Auto) type selector switches when in the OFF position shall disable motor operation and must be manually reinitiated. Local H-O-R(A) Selector Switches when in the HAND position shall enable the motor for operation regardless of the intended automatic operating mode for that motor. Hardwired Interlocks shall remain enabled to disable motor operation for equipment and/or operator protection. When the Local H-O-R(A) Selector switch is in the Remote (Auto) Position, operating control is passed to the associated Control Panel or Motor Starter/VFD. When there is a Control panel or Motor Starter/VFD H-O-R(A) type selector switch it shall similarly override the control of the Plant Control System as long as any local controls are in the Remote position. Only when both the local and Control Panel/Starter/VFD H-O-R(A) Selector Switches are in the Remote Position is the Plant Control System in complete control of the associated motor. There will be a Plant Control System status indication that the H-O-R switch on the Control Panel/Starter/VFD is in "Auto/Remote" allowing Plant Control System control of the motor.

F. Motor Elapsed Run Timers: All process motors that the Plant Control System monitors the running status of will be configured to accumulate elapsed run time to be displayed on a

consolidated run time status graphic. The run time accumulators shall be configured to be able to be commonly reset by a common run time reset pushbutton that might later to be reconfigured to reset on some other automatic basis.

2.02 LIDELLL DRIVE EQUALIZATION OPERATING STRATEGY

A. General Plant Operating Strategy:

1. The Liddell Drive Equalization project will be designed to be able to be run in a fully automated standalone local operation mode. The facility will be designed to not require an on-site operations staff. Operators will be required to visit the site periodically for visual inspections, periodic cleaning and other maintenance purposes. The control system will be designed for local operation but will have remote monitoring for selected operating conditions and limited override capability for pumping equipment at the RM Clayton or an alternate City of Atlanta (CoA) facility.

2. Normal operation of the Equalization Facility will be standby – offline mode. Only on a rain event when the flow thru the South Fork Peachtree Creek sanitary sewer trunk line exceeds a set amount of flow (initial set at 24 MGD) or the level in the sanitary sewer at the Peachtree Creek Trunk Relief Sewer Level Monitoring Manhole exceeds a set level or as determined by the Operations at the RM Clayton WRC will the sanitary sewer flow be diverted to the Equalization Tank for short term short (from a few hours up to 3 days) storage of the excess/peak wastewater flow that would otherwise would contribute to increased peak flows at the RM Clayton WRC.

3. When the rain event has passed, the wastewater stored in the Equalization Tank will be pumped to the Cheshire Bridge Junction Box, then flow by gravity to the South Forks Peachtree Creek Trunk sewer to continue to flow by gravity to the RM Clayton WRC. Total Flow in the Sanitary Sewer and Downstream Level at the existing Peachtree Creek Trunk Relief Sewer Level Monitoring Manhole will be monitoring during the gravity return operation to limit surging. Operation of the gravity return of wastewater from the Equalization Tank shall operate to slowly drain down the wastewater in the Tank in automatic manner in keeping with the Peachtree Creek Trunk Relief Manhole level and total sanitary sewer flow limits established by plant operations.

B. Remote Monitoring and Control Requirements: Remote monitoring and control features proposed include the following:

1. Remote Monitoring
   a. Peachtree Creek Trunk Relief Manhole (PCTRM) Level
   b. Sanitary sewer flow rate
   c. Diversion Wet Well levels
   d. Diversion Pump Discharge Flow rates
   e. Equalization Tank level
   f. Equalization Flow Return Pumps Discharge flow rate
   g. Equipment status – auto/run/fault
   h. Motorized Sluice Gate and Valve status – open/close/remote enable
   i. Relief Event Active

2. Remote Control
   a. Prohibit Equalization Tank emptying
   b. Initiate (or Inhibit) Sanitary Sewer diversion to Diversion Wet Wells
   c. Selection of Lead/Lag Diversion Structures and Wet Wells
   d. Individual submersible pump start/stop
   e. Sewage Grinder start/stop
   f. Motorized Sluice Gate control (open/close)
   g. Motorized isolate valve control (open/close)
   h. Jet Mix Pumps start/stop
   i. Flow Control of the return of Equalized Wastewater thru the Flow Return and individual pump start.stop
   j. Individual EQ Tank Drainage pump start/stop
   k. Initiate or manually control Equalization Tank Flushing
3. The following main control devices are provided:
   a. Diversion Structure #1 Sluice Gates SLG-101-1, 101-2, 101-3 (Open/Close with status) and Diversion Structure #2 Sluice Gates SLG-102-1, 102-2, 102-3 (Open/Close with status)
   b. Diversion Wet Well #1 Isolation Sluice Gates SLG-201 and 202 (Open/Close with status). Diversion Wet Well Interconnection Sluice Gate SLG-203 (Open/Close with status)
   c. Redundant Radar Level transmitter LIT-201 and LIT-202 at Diversion Wet Well # 1and hardwired level level float switches LSL-203 (stops Diversion Pumps P-201, 202, and 203s) and LSL-204 (stops drainage Pump P-204)
   d. Flow transmitter (Magmeter) FIT-210 on outlet of Diversion Pumps P-201, 202, and 203
   e. Diversion Wet Well #2 Isolation Sluice Gates SLG-301 and 302 (Open/Close with status)
   f. Redundant Radar Level transmitter LIT-301 and LIT-302 at Diversion Wet Well # 2and hardwired level level float switches LSL-303 (stops Diversion Pumps P-301, 302, and 303) and LSL-304 (stops drainage Pump P-304)
   g. Flow transmitter (Magmeter) FIT-310 on outlet of Diversion Pumps P-301, 302, and 303
   h. Open/Close Motorized Valves FCV-203 (Isolation of diversion flow from returning to Sanitary Sewer), and FCV-501 (Equalization Tank Isolation ValveRadar Level Transmitter LIT-501 on top of the Equalization Tank and Capacitance High and High High Level Switches LSH-501 and LSHH-501 on the top of the Equalization Tank
   i. Cheshire Bridge Junction Chamber High High Level Switch LSHH-502
   j. Open/Close Motorized Valves FCV-506/507 (Jet Mixing Pumps Discharge Isolation valves)
   k. Open/Close Motorized Valve FCV-504/505 (Jet Mix system back flushing valves)
   l. Open/Close Motorized Valve FCV-531/532/533 (Drain valves for Flow Return pumps P-531/532/533)
   m. Redundant Flow transmitter (Marsh McBirney Flo Dar) FIT-110A and FIT-110B downstream of the two diversion structures

n. Redundant Ultrasonic Level transmitters LIT-120A and LIT-120B at Peachtree Creek Trunk Relief Manhole (PCTRM) MH 23180203601.

o. Equalization Tank Flushing Water flow transmitter (magmeter) FIT-510

p. Equalization Tank Flushing Water Motorized Valves FCV-511 thru FCV-518.

q. Flow Transmitters (Magmeters) FIT-531/532/533 on the outlet of the Equalized Flow Return Pumps

r. H2S and Combustible Gas Monitors AIT-410/411/412/413 at the Diversion Facility odor control system

s. H2S and Combustible Gas Monitors AIT-510/511/512/513 at the Equalization Facility odor control system

C. Pump Station Operating Modes: There will be essentially three modes of operation for the facility as follows:

1. Dry Weather Operation – Equalization Facility is bypassed, equipment operating in Maintenance Mode to empty wet well drainage and maintain pumps. During Wet Weather Operations when a Relief is Event is Inactive due to Equalization Tank being full or Diversion is inhibited for any other reason, the Facility will enter its Dry Weather Maintenance Operating Mode.

2. Wet Weather Operation/Relief Event Active – – Diversion Pump stations are operating transferring flow to the equalization tank. Equalization Tank is in service. Wet Weather Operations being defined as flows in the South Peachtree Creek Trunk Sewer above normal operating levels. Such sewer flows and high pipeline levels are typical of sewer operation during the periods of stormy, rainy weather in the Atlanta area where the influent flow to RM Clayton WRC greatly exceeds the normal diurnal flow to the wastewater treatment plant. During such wet weather operation, Relief of excess sewer flow will be diverted to be stored in the Equalization Tank if tank capacity and equipment operations permit such Relief event to be active.

3. Dry Weather Flow/Equalized Flow Return Mode – Return flow to Sanitary Sewer system to empty the equalization tank. When flow rates in the South Peachtree Creek Trunk sewer drops below its Wet Weather operating limits, RM Clayton Plant operations can permit the wastewater temporarily stored in the Equalization tank to be slowly pumped back into the sewer system to ready the EQ facility to be ready to intercept future peak sewer flows.

D. Dry Weather Operations

1. Standby Operation: During normal operating/dry weather conditions (i.e., less than 24 MGD of flow) the sewage flow in the sanitary sewer system will flow through the two diversion structures and continue to flow in the South Forks Relief sewer without any flow being diverted to the Equalization Facility.

2. Dry Weather Operations Controls: The following systems are in operation in dry weather standby mode:
   a. Level is monitored at the Peachtree Creek Trunk Relief Manhole (PCTRM) (LIT-120A and LIT-120B)
   b. Sanitary sewage flow monitored downstream of the Diversion Structures by FIT-110A and FIT-110B.
   c. Wet well drainage pumps (P-204 and P-304) are operational to pump drainage or seepage out of the wet wells.

d. Wet Well Diversion Pumps, sludge grinders and other systems are in Maintenance Mode

3. Diversion Structure Sluice Gate Control: During dry weather flow, the diversion structure sluice gates are all closed so no flow enters the diversion pump station except minor gate leakage. If any gate is not closed and a relief event is not in progress, a gate position alarm will be initiated.

E. Diversion Wet Well Drainage Pumps: During dry weather conditions, the diversion wet well drainage pumps (P-204 and P-304) will operate in a start/stop mode based on level. The pumps will discharge flow back into the Peachtree Creek Relief Sewer. When the wet well level rises to the start level, the associated pump will start and run until the wet well level drops to the low/pump stop level at which point the pump will stop. If the water level continues to rise above the pump start level to the high level set point, an alarm will be activated indicating excessive dry weather flow into the pump station or a pump blockage.

1. A separate low level switch in each Wet Well is provided to stop the drainage pumps on an abnormally low water level.

F. Dry Weather Maintenance Mode

1. Dry Weather Maintenance Operation: Maintenance Mode is provided to periodically exercise equipment during extended periods of inactivity to ensure pumps are maintained in operational condition and do not sit stationary for an extended period of time. In Maintenance Mode, the wet well diversion pumps, wet well odor control fan (F-401), sewage grinders, Jetmixing pumps, equalized flow return pumps, equalization tank drainage pumps, and all other pieces of non-operational motorized equipment will be "bumped" periodically to rotate the equipment if it has not operated in a relief event for more than an adjustable number of days (initially set at 14 days). Each pump, fan or grinder will be started and run for a short adjustable period (that will be established by the equipment manufacturer). A different time will be allowed for each type or size of equipment and the control system will sequence each piece of equipment such that they do not start and stop simultaneously. After a piece of equipment has operated for any reason, the Maintenance Mode timer for that piece of equipment will reset. Pumps will be operated at minimum speed during maintenance mode. Level and flow interlocks must be bypassed during this mode.

2. Indication of dry weather maintenance mode: A maintenance mode indication will be indicated when maintenance mode is active. If a relief event is initiated during maintenance mode, maintenance mode will be interrupted and the relief sequence activated.

G. Wet Weather Operations (Relief Event Active)

1. Initiating Wet Weather Operating Mode: Wet weather operating mode will be active whenever a relief event is triggered. The control system will be designed with flexibility for control and set points. Over time, as operational information and feedback on flow rates and sewer levels is developed, adjustments to the control strategy and set points may be beneficial as the response to the system from relief and flow return is recorded. Ideally the controls will divert the minimum flow rate possible to prevent system surcharges and overflow events. The initial setpoints should be conservative to ensure that these conditions are met at the facility start-up, but can be adjusted if required in the future.

2. A relief event can be triggered by the following conditions:
   a. High water level at the Peachtree Creek Trunk Relief Manhole (PCTRM) MH 23180203601 (LIT-120A and LIT-120B. If a flow diversion is initiated from high level being measured at the remote level monitoring manhole – the entire flow from the South Fork Peachtree Creek Trunk and Relief Line will be diverted. Entire diversion up to the design flow of 67 MGD is required since there is no flow information currently available to generate a flow diversion rate set point. This will be the level control mode. In the future, if/when flow data is available, this control could switch to flow control mode.
   b. High flow rate at the Flow Metering Structure (FIT-110A and FIT-110B) at SFPC site downstream of the two diversion structures is greater than an adjustable flow rate (initially set at 24 MGD) initiates flow control mode.
   c. Alternate trigger point from CoA facility or remote monitoring location.
   d. Manually initiated on the pump station graphics on the local control panel.
   e. Based on conditions within the Peachtree Creek sewer system, the permissible flow set point can be adjusted automatically by external input. There will be an initial set point that is used to initiate diversion based on the South Fork Peachtree Creek sewage flow at FE-110. However, if the diversion is triggered by an alternate input from somewhere else in the system such as the PCTRM, the permissible flow can be set to a lower flow rate that could be as low as 0, requiring diversion of all flow from the South Fork relief sewer.
   f. During a relief event the total sanitary sewer flow rate will be calculated and recorded by the control system by summing flow meters FE-110, FE-210 and FE-310.
3. Diversion Structure Sluice Gate Controls
   a. There are two diversion structures, DS-101 and DS-102 each with three sluice gates. The diversion structures control the diversion of sanitary sewage into the Diversion Pump Station. Each diversion structure can be set as lead or lag by the operator. Typically DS-101 will be the lead diversion structure. Within each diversion structure there are three sluice gates that can be set as lead, lag1, or lag2 by the operator. When a wet weather relief event is initiated by one of the above conditions, the lead slide gate will open allowing some flow to be diverted to the pump station. The opening time for the gates will be adjustable to control the initial diversion rates to the pump station. Once the lead slide gate is open, the lag1 sluice gate will open. Then when the lag1 sluice gate is open, the lag2 sluice gate will open. The gates will remain open until the relief event has ended or the equalization tanks are full..
   b. Operation of the lag diversion structure will be initiated by the diversion pump station controls as described below. Once the lag diversion structure operation is initiated, operation will be identical to the lead diversion structure operation.
4. Diversion Pump Station Controls
   a. When a relief event is initiated, the diversion pump station operation will switch from Maintenance Mode to Wet Weather Relief Active Mode
   b. When a relief event is triggered and a diversion structure becomes active, the diverted flow will enter the respective diversion pump station wet well. Two wet wells are provided at the pump station that operate independently of one other. Each wet well is dedicated to a specific diversion structure. There is an interconnection gate between the two wet wells for flexibility and for operation when there can be equipment out of service. The operation of each diversion pump station wet well is identical.

c. Each wet well is provided with two inlet sluice gates (SLG-201, SLG-202, SLG-301 and SLG-302) for maintenance isolation. Each gate is installed upstream of a sewage grinder and can be used to isolate the respective grinder or the entire wet well if both gates are closed. The gates are normally in the open position when a Relief Event is active. The gates can be operated either locally or remotely. If any gate is closed when the associated Diversion Chamber is called to operate, the gates will be opened at or before the time the lead sluice gate in the associated diversion structure is instructed to open.

d. Each wet well is provided with two wastewater grinders (WWG-201, WWG-202, WWG-301 and WWG-302). Each grinder is provided with a local control panel that controls grinder operations although normally they will be switched for remote control (start/stop) and status monitoring from the plant control system. The grinders will start at the same time as the lead sluice gate in the associated diversion structure is instructed to open. The grinders will operate continuously once they are started and will be shut down when the last diversion pump in the wet well stops.

e. A total of six diversion pumps are provided in the pump station, three in each wet well (P-201, P-202, P-203 and P-301, P-302, P-303). Five pumps are duty pumps and one is a standby. All pumps will be configured for operation; the standby pump will simply not be required for operation to meet process conditions. The pumps in each wet well will be configured as lead, lag1, lag2. The pump wet wells will also operate as lead / lag. The lead wet well will be the one associated with the lead diversion structure.

f. The flow rate into the diversion pump station and the required diversion flow rate will vary continuously during operations. Under some conditions, the diversion flow rate into the pump station will exceed the required diversion flow rate and under other conditions the flow rate into the wet well will be less than the required diversion flow rate. When the flow into the wet well exceeds the required diversion flow rate, the wet well level will fill to the level in the sanitary sewer and the flow rate will be controlled by the pumping system to match the required diversion flow rate. When the flow into the wet well is less than the diversion flow rate, the wet well will be pumped down to a low level and the flow rate will be controlled by the pumping system to match the maximum diversion flow rate possible at that time.

g. To accommodate the varying conditions there will be two modes of control, flow and level. In flow control mode, the pump operation will be controlled by the flow rate as measured at FE-110. The pump operation will be controlled to pump all flow above the permissible flow set point to the equalization tanks. In level control mode, the pumps will operate to maintain the set wet well level. If the required flow set point is "0", the pumps will operate in level control mode and pump all flow possible up to the pump station capacity. The two wet wells can operate in different modes to suit the current flow requirements. So one wet well can be in flow control and one in level control, both in flow control or both in level control.

h. Each of the diversion pumps is provided with a variable frequency drive to control the pump speed and flow rate. There is also a minimum pumping rate/pump speed that must be maintained for satisfactory pump operations.

i. Level control mode will be used whenever the Wet Weather Relief mode is initiated by high level at the remote level monitoring manhole (LI-120) or when flow control mode set point is not available for another reason. In this mode, there will be a target level set point in each wet well and the pumps will be started, stopped and speed controlled to

maintain the target level within an acceptable band above/below the target set point. Pumps must be started and stopped such that the flow rate from each wet well is maintained within the limits stated below to ensure proper pump operation.

j. In flow control mode, the pumps will be started, stopped and speed controlled to achieve the target flow rate. Pumps must be started and stopped such that the flow rate from each wet well is maintained within the limits stated below to ensure proper pump operation.

k. When a diversion event starts and the first pump is started, the pipeline to the equalization tank will be empty so there will be no outlet pressure on the pump so an artificial pressure control device is necessary to ensure proper pump operation. The magnetic flow meters will also be empty, so the flow signal must be ignored for an adequate time until the pipeline is filled.

l. The magmeter will become active and control switched to flow control mode after the diversion pump(s) have operated for a long enough period to fill the discharge piping and flow meters. If a single diversion pump is operating, this start-up filling time will be 16 minutes. If two diversion pumps are operating, start-up filling time will be 8 minutes. If more than two pumps are operating, this start-up filling time will be 6 minutes. These pre-set timer valves will be operator adjustable.

m. During start-up/pipeline filling mode, the pumps will be operated at minimum speed and the discharge pressure will be controlled by the pump control valves PCV-201/202/203 and PCV-301/302/303. The pressure set point (initially set at 8 psi) and pump speed (initially set at 30 Hz) will be set such that the nominal flow rate during start-up will be approximately 10.0 MGD.

n. There will be an adjustable time delay between pump starts to establish pump operation and minimize pressure surges during start-up and shutdown.

o. Pump start will be different depending on whether the pipeline is full or not. When the pipeline is empty – pipeline filling time not reached, the pump start will be as follows:

   i) When the pump starts, the associated pump control valve PCV-201/202/203 and PCV-301/302/303 will be closed. The pump will start and ramp up to the minimum speed set point.

   ii) As soon as the upstream pressure (pump outlet Pressure) reaches 10 psi, the valve will open to maintain the 10 psi pump discharge pressure.

   iii) The valve will open and throttle as required to maintain the 10 psi pump discharge pressure – pressure on outlet side is less than 8 psi.

   iv) When the valve opens and upstream pressure remains above 8psi, the valve will fully open.

   v) Each pump will start in this manner following the time delay until the required number of pumps are in operation.

p. Pump start after the pipeline filling time has been reached will be as follows:

   i) When the pump starts, the associated pump control valve PCV-201/202/203 and PCV-301/302/303 will be closed. The pump will start and ramp up to the speed of the other operating pumps. The pump control valve will slowly open and open continuously until the valve is fully open.

   ii) The pump speed will then be adjusted in conjunction with the other operating pumps to meet the control set point.

iii) When pumps are operating in level or flow control mode, the pumps must operate within a confined range depending on the number of pumps in operation. The control set points will be adjustable and initially set as:

Number Of Pumps In Operation In The Respective Wet Well	Minimum Acceptable Flow	Maximum Acceptable Flow
1	7 mgd	14 mgd
2	12.5 mgd	28 mgd
3	25 mgd	42 mgd

iv) Pumps will be started and stopped to maintain operation within these limits..

q. Pump Stop Operation. When a pump is called to stop under normal operation the pump shutdown operation shall be as follows:

i) Pump stop signal is activated; the associated pump control valve begins to close.

ii) When the valve closes to an adjustable set point, the pump will be stopped.

iii) The valve will continue closing until fully closed.

r. Loss of Power Operation. When power is lost for any reason during operation, the pump control valve will automatically close without external power under a controlled rate to prevent slamming and reverse flow.

s. The lag diversion structure and associated wet well will be called to operate whenever either of the following conditions occurs:

i) The wet well level in the lead wet well drops to the level control set point and the flow rate at flow metering structure (FE/FIT-110A/B) still exceeds the permissibleflow rate. This will occur if the flow rate from the diversion structure is not adequate to meet the diversion flow rate required.

ii) All available pumps in the lead wet well are called to operate and reach full speed (or maximum allowable speed) and the permissible flow rate cannot be maintained at flow metering structure (FE/FIT-110A/B). This will occur if the required diversion flow rate exceeds the capacity of the available pumps in the lead wet well.

t. When the relief event has ended, the pump station will return to Dry Weather Maintenance Mode.

u. Open/Close Isolation Valve FCV-203 will be used to determine whether the flow from the Diversion Pump Stations will be returned to the South Forks Peachtree Creek Relief Sewer or diverted to the Equalization Tank. Normally it will be closed whenever a relief event is in progress and any diversion pump is in operation.

v. A separate low level switch in each Wet Well will be provided to initiate an alarm and stop the associated Diversion pumps in each Wet Well if an abnormally low water level is detected. The pumps will alternate lead/lag1/lag2 status after each operating cycle.

w. Pumps shall have thermal sensors to monitor motor stator temperatures. Thermal sensors shall be placed in each motor winding. Moisture sensors shall be provided in the seal chambers and/or motor housing to protect the gear and motor from moisture. Pump motor protection monitoring shall be as required by the submersible pump manufacturer. The motor protection system shall disable each individual pump when an abnormal operating condition has been detected. This will result in a high priority alarm being generated and the next pump in the operating sequence shall be started.

x. Process alarms will be indicated for any of the following condition:

i) Permissible flow rate at flow metering structure (FE/FIT-110A/B) exceeds the set point for a minimum adjustable period of time. A time delay is provided to allow time for start-up and speed adjustment of the pumping system.

ii) Permissible flow rate at flow metering structure (FE/FIT-110A/B) is less than the set point for a minimum adjustable period of time. A time delay is provided to allow time for start-up and speed adjustment of the pumping system.

5. Wet Well Drainage Pumps: After a relief event has ended, the diversion pumps have stopped, and the flow return conditions described below have been met, the wet well drainage pumps will start and run to empty the respective pump wet wells. The pumps will discharge into the sanitary sewer system, not the equalization tanks. If the wet well level is above the inlet pipe invert elevation (793.0') because the Diversion Pump stopped due to the EQ tank reaching the tank full level or other condition, the sewage grinders will re-start when the associated drainage pump starts. Once the wet well is empty, the pumps and grinders will return to their maintenance mode of operation.

6. Diversion Pump Station Odor Control System: When a relief event is initiated, the odor scrubber fan F-401 will start and run continuously. The fan will stop after an adjustable time period following the end of the relief event.

7. Equalization System:

a. Flow from the diversion station(s) will be transferred to the 10 million gallon capacity equalization tank. The equalization tank will fill to whatever level is required for the current high sanitary sewer flow condition which will be relative to the size and intensity of the associated rainfall event or other high flow condition. Once the reliefevent has ended, the diverted wastewater will be held in the tank until the sanitary sewer flow rates and the PCTRM water levels return to normal levels.

b. Once a relief event is triggered, all equipment at the Equalization Facility will switch from Maintenance Mode to Wet Weather Operating Mode. When a relief event is active, open/close isolation valves FCV-501 FCV- 506 and FCV-507 will be open and Jet Mixing Pump backflushing valves FCV-504, FCV-505 and Flow Return Pump drainage valves FCV-531/532/533 will be closed . Additionally open/close isolation valve FCV-203 will be closed to prevent recirculation of the Wet Well Diversion pump flow back to the South Forks Peachtree Creek Relief Sewer.

c. Equalization Jet Mixing System Operation: When the tank water level rises to the Mixing system start level, the tank jet mixing pump(s) will start in sequence. Once started, the pumps will operate continuously as the tank fills, for as long as wastewater is being stored in the equalization tank, and until the tank is emptied to the mixing system stop elevation. At this level, the mixing system is stopped and the mixing equipment will return to maintenance mode. A low pressure switch shall be installed on each Jet Mix Pump to generate a high priority alarm if there is not enough flow thru the Jet Mix System indicating nozzle blockage.

d. Equalization Tank Odor Control System: As soon as a wastewater from the diversion pumps is diverted to the equalization tank (One of the Diversion Pump starts), the equalization tank odor control fan F-501 will start. The fan will stop after an adjustable time period following the end of the relief event and after the equalization tank is emptied to the South Forks Peachtree Creek Relief Sewer.

H. Equalization Mode

1. Equalization mode will begin when the wet weather relief event/diversion pumping ends.
2. The equalization mixing system and odor control system will be active and there will be no wastewater flowing into or out of the Equalization Tank.
3. The Equalization Facility will switch to flow return mode upon receiving the start command from the Peachtree Creek flow, FIT-110A/B (less than 18 MGD – operator adjustable), and level, LIT-120A or LIT-120B, (less than 5 Feet – operator adjustable) monitoring systems.
   a. Flow will be returned from the equalization tank to the sanitary sewer system by pumping using the Equalized Flow Return Pumps P-531, P-532 and P-533. When the return flow permissive level at the Peachtree Creek Trunk Relief manhole, LIT-120A or LIT-120B is reached and the return flow rate at flow metering structure (FE/FIT-110A/B) is reached, the equalized flow can be returned to the sanitary sewer system.
   b. As soon as flow return is called for, open/close isolation valve FCV-203 will be opened to allow flow of equalized wastewater from the Equalization Tank back to the South Forks Peachtree Creek Relief Sewer. Valve FCV-203 will open slowly to allow draining of the 48" diameter transfer pipe. Once FCV-203 is fully opened, the flow return controls shall start
   c. Under pumped flow control mode, equalized wastewater will be returned to the sewer system by the equalized wastewater flow return pumps. Each pump will be furnished with its own variable frequency drive (VFD) and discharge flow meter (magmeter) FE/FIT-531/532/533.
   d. When a pump is called to start, the pump will start at minimum speed and ramp up to the speed required to match the target flow rate using the associated flow meter FE/FIT-531/532/533.
   e. The Plant Control System will control the equalized wastewater flow return pumps based on the Operator set Required Flow Return Flow Rate and Flow Return Operating Mode (Constant flow or Proportional Flow mode) as described below to determine the number of pumps to operate. Each pump will be controlled independently on flow and can operate between 5 and 11 MGD. The pumps are also limited in operating range when the Equalization Tank is at a high level as there is insufficient discharge pressure to maintain the pumps on the pump curve. Under the high level conditions, the pumps must operate at the minimum speed. So the Equalized return flow pumps cannot start until the required return flow is greater than 9 MGD. The number of pumps and pump speed/ will then be adjusted in conjunction with the other operating pumps to meet the control set point.
   f. Constant Flow Return. In constant flow return mode, the operator will set the desired return flow set point on the master return flow controller FIC-531 . Then the plant control system shall start and stop the equalized wastewater flow return pump and adjust pump speed based on the totalized pump discharge flow rates as monitored by FIT-531/532/533. This constant return flow set point will be adjustable and initially set at 15 MGD (30 MGD is maximum allowable set point). This flow rate will be maintained as long as the sanitary sewer flow rate remains below the adjustable permissive flow limit, initially set at 18 MGD and the PCTRM, LIT-120A or LIT-120B, level is below the flow return permissive level.
   g. Proportional Flow Return. In proportional flow return mode, the amount of total permissive flow in the South Peachtree Creek Trunk sewer shall be set by the operator. The master equalized wastewater flow return flow controller set point FIC-531 shall be

calculated as the operator set total permissible sewer flow rate minus the current actual flow in the sanitary sewer, FE-110A/B. Then the plant control system shall start and stop the equalized wastewater flow return pumps and adjust pump speed based on the totalized pump discharge flow rates as monitored by FIT-531/532/533. All pumps once started will operate at the same flow rate. The minimum required flow rate that must be reached before a pump can start is 9 MGD. This minimum flow rate is required to ensure that the pumps operate at acceptable points on the pump curve.

h. When the tank is at high levels, the pumps must operate within a limited range to ensure they operate at acceptable points on the pump curve. When the EQ tank water level is above 834.0 ft the pumps will operate at a narrow flow range (initially set at 9 to 10 MGD). Under these conditions, the pumps will be started and stopped in increments of 9 MGD and each pump flow rate will be controlled between 9 and 10 MGD. So when the tank level is over 835.0 ft, the permissible return flow rate must reach 9 MGD before the lead pump can start. Then the permissible flow must increase to 18 MGD before the second pump can start and 27 MGD before the third pump can start.

i. Once the tank level drops to 835.0 ft, the flow control will switch to completely modulating control and the speed of all pumps will be adjusted to match the required return flow rate.

j. During flow return operation, the level in the existing downstream Peachtree Creek Trunk Sewer Level Monitoring Manhole (PCTRM) (Radar Level Transmitters LIT-120A and LIT-120B) shall be monitored continuously and the flow return operation disabled if a high level is detected. Similarly the current flow in the sanitary sewer shall be monitored and if reaches its maximum allowed flow set point; the equalized flow return operation shall be disabled. Both of these conditions shall be priority alarmed and the operator must acknowledge and reset the alarms to permit the flow return operation to resume. If a high water level is detected at the PCTRM, the equalized wastewater flow return will be stopped by disabling flow controller FIC-531 , stopping the equalized flow return pumps P-531/532/533 and also closing open/close isolation valve FCV-203. If the equalized wastewater flow return is interrupted by either high flow or high level in the in South Forks Peachtree Creek Relief Sewer, the return flow operation will be discontinued and a new Wet Weather Relief event will start.

k. Pump Stop Operation. When the EQ tank level drops to the pump stop elevation, the pumps will stop sequentially with a minimum adjustable time delay between pump stops to minimize surging.

l. There will be a high high level float switch LSHH-502 at the Cheshire Bridge Junction Chamber that will be hardwired to the flow return pumps to immediately shutdown all operating Flow Return Pumps if it is activated and a high-high level alarm will also be activated.

m. After all pumps have stopped, the motorized pipeline drain valves, FCV-531/532/533 will open allowing the pipeline to drain back into the suction header where it will be pumped out by the drainage pumps.

4. Equalization tank drainage pump operation.

a. There are two equalization tank drainage pumps, P-534/535, provided to empty the bottom of the EQ tank and suction pipeline to the jet mix building. After the equalized wastewater flow return pumps have stopped, the lead equalization tank drainage pump will start followed by the lag pump. Once started, the pumps will be interlocked to stop when the associated motor current from the starter in the MCC drops below its normal operating current (low motor current) for a preset but adjustable period of time. The

low current switch will be bypassed for a short duration at pump start to prevent normal starting motor inrush current from tripping the pump.

b. After both drainage pumps P-534/535 have stopped, the equalized flow return pipe drainage valves, FCV-531/532/533 will be closed and a tank flushing sequence will be initiated as described below.

5. Equalization Tank Flushing Operation

a. A motorized open/close flushing water isolation valve, FCV-511/512/513/514/515/516/517/518, shall be provided for each of the eight (8) flushing zones associated with cleaning out the debris and remaining wastewater left inside the Equalization Tank after a Relief Event. After the EQ tank has been emptied as determined by having the drainage pump P-534/535 stop at the end of their tank emptying drainage cycle, a tank flushing sequence shall be initiated. A tank flushing sequence can also be initiated by the operator. When initiated, the Equalization Tank Automatic Flushing Sequence shall open each of the motorized flushing water control valves in a sequential fashion. Each valve will be opened and the flow rate on the non-potable water magmeter FE/FIT-510 confirmed to be greater than the minimum flushing water flow rate (initially set at 750 GPM per open zone flushing valve). When the flushing flow rate has been confirmed, a zone flushing timer shall be started. When the zone flushing period has expired, the next flushing water valve shall be opened and after an adjustable time period when both zones are flushing simultaneously (initially set at 1 minute) the current valve will be closed.

b. When a flushing sequence has been initiated, a drainage pump start timer will be activated. After the time period expires, the lead EQ tank drainage pump, P-534/535 will be started followed by the lag pump. The time delay is required to allow the flushing water to reach the pump suction piping. The EQ tank drainage pumps will operate until stopped by the discharge low flow switch FSL-534/535. If any pump stops and the flushing sequence is still active, the drainage pump start timer will reset and the pump will be restarted after it times out. When the drainage pumps stop after the EQ tank flushing sequence is complete, the pumps will remain off until the next relief event cycle. The flow return to Peachtree Creek Relief Sewer Motorized Open/close Isolation valve FCV-203 shall remain open during operation of the EQ tank drainage pumps to allow flow from the EQ pipeline Junction Box to flow back to the sanitary sewer.

c. If an EQ tank drainage pump stops 3 times in a short period when called to operate indicating a pipe blockage, the pump will be stopped and an alarm indicated. If the second pump continues to operate, the flushing sequence can continue. If both pumps are shutdown, and not available, the flushing sequence will be prohibited or terminated if in progress.

d. When both EQ tank drainage pumps stop following a EQ tank flushing sequence, flow return to Peachtree Creek Relief Sewer Motorized Open/close Isolation valve FCV-203 shall be remain open for an adjustable period of time (initially set at 2 hours) allowing gravity drainage of the flow return piping back to the sanitary sewer system. At the end of this adjustable period of time FCV-203 will be fully closed so that the system is ready for the next relief event. The time delay is provided to ensure that the entire system is emptied before the system is place off-line.

e. Once this EQ tank flusihing sequence is complete, the Equalization Facility and Diversion Facility equipment will return to dry weather maintenance mode with timers reset accordingly.

6. Jet Mix System Flushing sequence.
   a. Periodically the jet mixing system will require flushing to remove solids that may have accumulated in the mixing nozzles. The operator can input the number of tank/jet mixing cycles between flushing intervals. When the number of operating cycles has been completed, a flushing sequence will proceed as follows. There is also a pressure sensor on each pump discharge line that will indicate an alarm is an abnormally high pressure is detected in either jet mix header indicating nozzle plugging.
   b. When the tank level lowers to the Jet Mixing System Flush elevation (initially set at 20% level), the equalized wastewater flow return pumps will stop under the normal sequence. Once the flow return pumps are stopped, the jet mix pumps will also be stopped. Once the jet mix pumps are stopped, EQ Tank Motorized open/close isolation valve FCV-501 and the pump isolation valves FCV-506/507 will be closed. When all valves are closed the lead jet mix pump flushing valve FCV-504 will open. Once FCV-504 is open the lead flow return pump will start and ramp up to achieve 3500 GPM. After an adjustable flushing time period, FCV-505 will open followed by FCV-504 closing and the flushing timer reset. After the flushing time period expires again, the equalized flow return pump will stop followed by FCV-505 closing. Once FCV-505 closes, FCV-501 and FCV-506/507 will open and once open, the jet mix system and equalized flow return system will restart under the normal start sequence.

7. Diversion Pump Emergency Shutdown.
   a. Secondary shutdown methods shall be provided to stop the Six Diversion pumps to ensure that the equalization tank cannot be overfilled.
   b. There will be a high level switch LSH-501 at the equalization tank that will be wired to the diversion pumps to stop the pumps. This switch will initiate a standard pump stop sequence and a tank full alarm sill be indicated.
   c. There will be a high-high level switch LSHH-501 at a slightly higher elevation to immediately shutdown all operating Diversion pumps if it is activated and a tank high-high level alarm will also be activated.
   d. Additionally, on high high level (LSHH-502) in the Cheshire Bridge Junction Chamber all Diversion Pumps will be disabled by a hardwired interlock.

      The two diversion pump flow meters FE-210/310 shall begin totalizing flow during each Relief event. When an adjustable high volume (initially set at 10.25 million gallons) has been reached, a normal Diversion pump shutdown sequence will be initiated and a tank full alarm indicated.
   e. If the totalized flow exceeds a high-high volume (initially set at 10.55 million gallons) all operating Diversion pumps will be stopped and a high-high volume alarm activated.

2.03 DIVERSION STRUCTURE CONTROL LOGIC

A. Diversion Structure DS-101 and DS-102 Lead/Lag Control (P&ID I-101): There are two diversion structures to divert flow from the South Fork Peachtree Creek Trunk Sewer to the new Liddell Drive Equalization Facility. The plant operations staff shall select which Diversion Structure will be the lead structure for diverting sanitary sewer flow to the Diversion Wet Wells and ultimately the Equalization Facility when either high flow or level in monitored in the South Fork Peachtree Creek Trunk sewer. Normally DS-101 will be the lead diversion structure along with Diversion Wet Well #1. Status of the Lead/Lag Selection shall be clearly visible on the operating graphics as well as indication of a Relief Event in progress.

B. Diversion Structure #1 Diversion Sluice Gates Control - SLG-101-1, d SLG-101-2, SLG-101-3 (P&ID I-101): The Plant Control System shall both monitor and control the position of the motorized modulating sluice gates SLG-101-1, SLG-101-2, and SLG-101-3. Within each Diversion Structure, the three diversion gates will open in a lead/lag1/lag2 fashion to limit surging of flow when diversion is started or ended. When a relief event is initiated and DS-101 is selected as the lead diversion structure, the lead sluice gate will open slowly to divert flow to its Wet Well. Once the lead sluice gate is fully open, the lag1 sluice gate will also slowly open. Then when the lag1 sluice gate is fully open, the lag2 sluice gate shall slowly open. Once all three of the sluice gates in the Lead Diversion Structure are fully open, the lead sluice gate in the lag Diversion Structure shall slowly open to divert flow to its associated Wet Well. Similarly when the lead sluice gate in the Lag Diversion Structure is fully open, the lag1 sluice gate in the Lag Diversion Structure shall slowly open. Similarly, the lag2 sluice gate will slowly open when the lag1 sluice gate is fully open. Upon end of the Relief Event, the gates shall close in a reverse manner. Discrete Inputs and Outputs shall be configured as shown in the I/O List. Note this gate can be locally operated by the plant operations staff (there is a remote status input to warn when the gate cannot be control by the Plant Control System). Failure of the Sluice Gates to travel in an appropriate time (adjustable timer initially set to 5 minutes) shall generate a high priority alarm. A high priority alarm shall be generated any time these Sluice Gates are not enabled for Remote Control (Local/Remote gate actuator status input).

C. Diversion Structure #2 Diversion Sluice Gates Control - SLG-102-1, SLG-102-2, and SLG-102-3 (P&ID I-101): The Plant Control System shall both monitor and control the position of the motorized modulating sluice gates SLG-102-1, SLG-102-2, and SLG-102-3. Within each Diversion Structure, the three diversion gates will open in a lead/lag1/lag2 fashion to limit surging of flow when diversion is started or ended. When a relief event is initiated and DS-102 is selected as the lead diversion structure, the lead sluice gate will open slowly to divert flow to its Wet Well. Once the lead sluice gate is fully open, the lag1 sluice gate will also slowly open. Then when the lag1 sluice gate is fully open, the lag2 sluice gate shall slowly open. Once all three of the sluice gates in the Lead Diversion Structure are fully open, the lead sluice gate in the lag Diversion Structure shall slowly open to divert flow to its associated Wet Well. Similarly when the lead sluice gate in the Lag Diversion Structure is fully open, the lag1 sluice gate in the Lag Diversion Structure shall slowly open. Similarly, the lag2 sluice gate will slowly open when the lag1 sluice gate is fully open. Upon end of the Relief Event, the gates shall close in a reverse manner. Discrete Inputs and Outputs shall be configured as shown in the I/O List. Note this gate can be locally operated by the plant operations staff (there is a remote status input to warn when the valve cannot be control by the Plant Control System). Failure of the Sluice Gates to travel in a appropriate time (adjustable timer initially set to 5 minutes) shall generate a high priority alarm. A high priority alarm shall be generated any time these Sluice Gates are not enabled for Remote Control (Local/Remote gate actuator status input).

D. South Fork Flow Measurement - Loop 110 (P&ID I-101): Redundant Marsh McBirney Flo Dar surface radar open channel flow transmitters shall be providedfor the Liddell Drive Equalization Facility and shall be installed in manholes downstream of the Diversion Structure to monitor the flow in the South Fork Peachtree Creek Trunk sanitary sewer system. Two redundant flow transmitters will be provided with separate analog inputs to the Plant Control System. Each transmitter shall be separately wired to PLC analog inputs in the Pump Station Local Control Panel in the Diversion Facility Electrical Building. Both measurements shall be separately monitored and alarmed on the Graphics. For Wet Weather pump operation, the plant operators shall have an Auto/Manual Flow Measurement for Control Selector Switch. In Automatic mode, the highest flow measurement shall be utilized for control. In the manual mode, the operator can selected either flow transmitter for control. Transmitter failure (analog input failure) shall be

monitored and shall prevent that transmitter from being used for control. High and Low alarms shall be configured.

E. Peachtree Creek Trunk Relief Manhole Level Measurement - Loop 120 (P&ID I-101): Two new redundant ultrasonic type level transmitters will be provided for monitor sanitary sewer level in the existing Peachtree Creek Trunk Relief Sewer manhole located in the vicinity of the Cross Creek Housing Division. Because this manhole is some 25,000 feet from the Liddell Drive Project Site, a Telemetry RTU panel will be located at this remote location. The RTU panel will communicate via a telephone type connection to a RTU Panel (to handle the communications and polling of this remote location) in the Diversion Facility Electrical Building. There will also be a RTU Panel in the Equalization Facility Electrical Building that will monitor this remote level measurement. The level transmitters will be wired to 4-20 ma analog inputs in the local RTU panel. Both measurements shall be separately monitored and alarmed on the Graphics. For Wet Weather/Relief Operation, the plant operators shall have an Auto/Manual Downstream Level Measurement for Control Selector Switch. In Automatic mode, the highest level measurement shall be utilized for control. In the manual mode, the operator can selected either level transmitter for control. Transmitter failure (analog input failure) shall be monitored and shall prevent that transmitter from being used for control. Loss of Communication with the remote RTU will be monitored and alarmed when it occurs. Upon loss of communication, the last good level transmitter signal shall be displayed but control based on this level shall be disabled. High and Low alarms shall be configured.

2.04 DIVERSION WET WELL CONTROL LOGIC

A. Wet Well Submersible Pumps Loops 201/202/203/204 (P&ID I-102) and Loops 301/302/303/304 (P&IDs I-103)

1. The Plant Control System shall both monitor and control the starting and stopping and speed of the three submersible diversion pumps (P-201/202/203 in Wet Well # 1 and P-301/302/303 in Wet Well # 2) in each Wet Well to control the Wet Well level or discharge flow depending on operating mode in each Wet Well. The running and trouble status plus status of whether the VFD H-O-R switch is in Remote for each pump will also be monitored. Additionally the status of whether the local E-STOP pushbutton is pressed shall be monitored.

2. The Plant Control System shall both monitor and control the starting and stopping of the single constant speed submersible drainage pump (P-204 in Wet Well # 1 and P-304 in Wet Well # 2) in each Wet Well on a high level start/low level stop basis to remove drainage during dry weather operations and to empty the Wet Well after the Diversion to Equalization is complete. The running and trouble status plus status of whether the Motor Starter H-O-R switch is in Remote for each pump will also be monitored. Additionally the status of whether the local E-STOP pushbutton is pressed shall be monitored.

3. The submersible pumps shall be furnished, in accordance with specification 11199, with vendor furnished pump monitoring controls (enclosed in a separate pump monitoring panel for each pump) that will become hardwired interlocks to the respective VFD (Pumps P-201, P-202, P-203, P-301, P-302, and P-303) The Pump Monitoring Panel will monitor the following conditions:
   a. Stator winding temperature sensor (platinum RTD) x 3 (one per motor phase).
   b. Stator housing leakage (ball float switch).
   c. Motor temperature switch (PTC) for each phase.

d. Support bearing temperature (platinum RTD)
e. Motor junction box leakage (ball float switch).
f. Oil/Inspection Chamber leakage (ball float switch).
g. Main bearing temperature (platinum RTD).
h. Pump vibration sensor (2 axis vibration with velocity readout).

4. Additionally the pumps shall have a low low wet well level hardwired interlock from the Level Monitoring Panel associated with each Wet Well. The Diversion Pumps will have a separate low low level switch from the drainage pumps. LSLL-203 shall be provided for Wet Well # 1 and LSLL-303 for Wet Well # 2 to interlock the respective diversion pumps in each Wet Well (one low low level switch for each set of diversion pumps but a individual interlock contact will be generated in the Level Monitoring Panel for each pump). A separate low low level switch in each wet well shall be interlocked to disable the drainage pump if the level is too low to safely operate (LSLL-204 for Wet Well # 1 and LSLL-304 for Wet Well # 2). Any of these hardwired interlocks or drive internal fault or motor overload will generate a common trouble alarm that will be wired to the Plant Control System as a priority alarm (that will also be logged). Upon receiving this fault signal, the fault status shall be latched to inhibit pump restart until an Operator accesses the situation and determines that it is safe to restart the pump. The associated pump will not be automatically stopped to prevent false alarms/maintenance from disrupting normal pump operation. Note each of these low low level interlocks will be separated wired (from the Level Monitoring Panel) to the Plant Control System for generating a high priority status alarm as well the common fault alarm generated by each VFD or motor stater.

5. To insure that the Equalization Tank does not overflow there will be an interlock from the High Level Switch (LSH-501) on the Equalization Tank to disable the operation of all Diversion pumps on high Equalization Tank level. This high level switch input will initiate a normal sequential shutdown of all operating Diversion Pumps and inhibit any other Diversion Pumps from starting. Additionally, on high high level (LSHH-502) in the Cheshire Bridge Junction Chamber all Diversion Pumps will be sequentially shutdown and pumping of wastewater from the Diversion Wet Wells to the Equalization Tank disabled. If the Relief Event is still active, the Diversion Pump station shall switch to Level Control Mode and the Diversion to South Fork Peachtree Creek Trunk Sewer Motorized Isolation Valve FCV-203 shall be automatically opened to prevent additional flow from being pumped into the Equalization Tank. Once the position of the FCV-203 has changed (it is normally closed when the Diversion Pumps are pumping to the Equalization Tank), the Diversion Pump Station can resume operation in only a LEVEL Control Mode. (Note that the flow thru the Wet Well Magmeter FE/FIT-210 must be disabled when Diversion pumps are not pumping to the Equalization Tank).

6. The Pump Monitors in the Pump Monitoring Panels shall be furnished with a remote monitoring capability via a RS-485 type daisy chained ModBus type network connection to the PLC in the Diversion Facility Local Control Panel. The Plant Control System shall be configured to monitor and display information for each Pump Monitor on a separate Graphical Display. This information shall be available locally at the HMI display on the local control panel and available via the remote connection for the City to display on City of Atlanta Foxboro I/A DCS System at the RM CLayton or other CoA facility as determined in the project.
   a. For estimating purposes assume that each pump will be required to monitor the 4 discrete and 6 analog inputs associated with each MAS unit (assuming the same submersible pumps are provided by ITT Flygt for previous pump station projects) –

following the existing tagging convention – as noted below this is the tagging convention for Pump P-201. Note drainage pumps have different controls than diversion pumps – they are missing motor stator temperature measurements (only temperature switches in each phase wired together as one discrete input), Inspection chamber leakage detection, and pump vibration indication.

i) DI TAH201 – Motor thermals high
ii) DI XA201A – Stator housing leakage
iii) DI XA201B – Connection housing leakage
iv) DI XA201C – Inspection chamber leakage
v) AI TI201A – Motor stator phase 1 temperature
vi) AI TI201B – Motor stator phase 2 temperature
vii) AI TI201C – Motor stator phase 3 temperature
viii) AI TI201D – Main bearing temperature
ix) AI TI201E – Support bearing temperature
x) AI VI201 – Pump vibration

b. Additionally, ModBus communication failure should be alarm – if possible some kind of "watchdog" timer scheme should be utilized – coordinate with ITT Flygt or alternate pump manufacturer. Also if there is a master diagnostic fault signal available for each MAS unit it should also be monitored and alarmed.

c. Engineering Range and Alarm limits should be coordinated with the pump supplier from specification 11199.

7. The VFD's and Motor Starters (for Drainage Pumps) will be hardwired to PLC I/O Points in the Local Control Panel located in the Diversion Facility Electrical Room.. The hardwired interface to the PLC shall include one (1) maintained start/stop contact (maintained start/stop contact powered from the associated motor starter/drive), four (4) dry status contacts (emergency stop status, H-O-R Remote status, and running and trouble indication). Additionally, all variable speed drives will include one (1) isolated speed reference output and one (1) remote speed control input from the Foxboro Control System. All interface contacts shall be rated for 120VAC at 10 amps (i.e. no 24V DC interfaces will be allowable – provide standard industrial grade interposing relays as required).

8. Pump Restart Delay – the submersible pumps will self-drain (no discharge check valve) upon loss of electrical power, or abnormal or normal stopping. There will be a hardwired mechanical restart time delay (initially set for about 90 seconds) in the drives. The restart logic must also be implemented in the Plant Control System to protect the pump from starting against reverse flow. These motors will be nominally specified for 10 starts per hour but because of the motor size, the Pump Sequencing logic should be designed to limit the automatic mode pump starts to only once per a preset but adjustable period of time (initially set at every 6 minutes). This pump restart delay logic may be implemented as part of the associated VFD drive/motor starter.

9. Each Submersible Pump shall be capable of being started by the PLC in the Pump Station Local Control Panel located in the Diversion Facility Electrical Building or via the local H-O-A operating mode selector switch at the associated RVSS or VFD drive. Each pump will have a Hand-Off-Auto (H-O-A) Switch located on the front of each drive. The plant operating philosophy is that local controls take precedence over remote controls in a hierarchical order. Additionally, the Graphics will have its own H-O-A software switch to allow the operators to manually start or disable each pump independently of the automatic

pump sequencing logic. Also, note that there is a local Emergency Stop Pushbutton associated with each pump that can disable pump operation.

10. The two Diversion Wet Well Drainage pumps will be furnished with flushing water solenoids to add in removing debris from the Wet Wells and associated pump discharge pumping when emptying the Wet Well after a relief event has occurred and during the periodic cleanout mode of the Wet Well between Relief Events. A flushing water solenoid (SV-204 for Pump P-204 and SV-304 for Pump P-304) will be hardwired to the associated pump motor starter and will automatically open the flushing water supply each time the pump is running. There will be no control of these solenoids from the Plant Control System. The solenoids valves will have manual overrides to permit operating testing/manual operation of the flushing system.

B. Wet Well Level/Flow Control of Diversion Pump Loops 201/202 (P&ID I-201) and Loops 301/302 (P&ID I-301): Wet Well level/flow control shall start and stop and control the speed of the submersible diversion pumps (P-201/202/203 or P-301/302/303) as noted below.

1. Two Redundant Radar (microwave) level transmitters are located in each Wet Well. All four level transmitters (two per Wet Well) will be identical so they can be installed in any location.

2. The Radar level measurement selected for control in each Wet Well shall be selectable by the plant operators to permit maintenance. There will be selector switch on the Pump Station Graphics to select the transmitter used for pump control. This selector switch shall allow any of the two transmitters to be manually selected for control or automatic level transmitter selection based on lowest level. Failure of any transmitter shall inhibit from being used for pump control and shall generate a high priority alarm. Additionally, generate a deviation alarm for each transmitter if it differs from the selected level transmitter signal by a tunable amount (initially set at 4 inches) – deviation alarm will be disabled if transmitter failure is detected. The level transmitter input to the Plant Control System will be in terms of feet of water above the bottom of the Wet Well. There will also be a calculation of volume of wastewater stored in the wet well based on the Selected Level transmitter used for Control

3. Approximate Wet Well operating levels (in Elevation above sea level)

Top of Wet Well	824.5 Feet
Bottom of Wet Well	785.0 Feet
Diversion Pump Settings	
High High Water Level Alarm	811.0 Feet
Lead Diversion Pump Start (Rising Level)	790.0 Feet
All Diversion Pumps Stop (Falling Level)	788.75 Feet
Low Water Level Alarm (Diversion Pumps)	788.33 Feet
Level Control Setpoint	795.0 Feet
Drainage Pump Settings	
High High Water Level Alarm (Dry Weather)	789.0 Feet
Drainage Pump Start	786.75 Feet
Drainage Pump Stops (Falling Level)	786.25 Feet
Low Low Water Level Alarm (Drainage Pumps)	786.0 Feet

4. To measure the amount of wastewater being pumped out of each Wet Well an inline magnetic flow meter will be installed on the discharge of the Diversion Pumps for each Wet Well. Each Wet Well can operate in either level or flow control mode depending on the amount of excess wastewater in the South Fork Peachtree Trunk Sewer above the operator entered permissible normal flow rate and how fast that flow is being diverted to each Wet Well. Since the diversion of wastewater to each Wet Well is by gravity, there is no control of the flow coming into the Wet Well only control of the amount of flow being pumped to the Equalization Facility. The operator can select which mode each Wet Well can initially be operating in.

5. To accommodate the varying conditions there will be two modes of control, flow and level. In flow control mode, the pump operation will be controlled by the discharge flow rate with a set point calculated from the difference between the operator entered permissible sewer flow rate and the current sewer flow as measured at flow metering structure (flow measurement FIT-110A or FIT-110B). The diversion pump operation will be controlled to pump all flow above the permissible flow set point to the equalization Facility. In level control mode, the pumps will operate to maintain the set wet well level. If a wet well is operating in Flow Control Mode and the calculated flow set point reaches minimum operating flow for a single pump (as set by the manufacturer based on the Equalization Tank Level – pump discharge head) for a adjustable period of time, that Wet Well will be switched to Level Control Mode. The two wet wells can operate in different modes to suit the current flow requirements. The non-operating controller shall be switched to output tracking mode so that there will be a bump less transfer should it again be selected to control the pumping operation.

6. A total of six diversion pumps are provided in the diversion pump station, three in each wet well (P-201, P-202, P-203 and P-301, P-302, P-303). Normally, five of the diversion pumps will operate as duty pumps and one will be standby. All six pumps will be configured the same for pump operations; the capacity of the standby pump will simply not be required for operation to meet normal process conditions. The pumps in each wet well will be configured as LEAD, LAG1, and LAG2. The initial LEAD/LAG1/LAG2 selection will be determined by the Operator. The two Wet Wells will also be operated as LEAD/LAG (matching their associated Diversion Structure). The lead Wet Well will be the one associated with the lead diversion structure.

7. As the wet well begins to fill, the lead pump in that Wet Well will start at the minimum speed when the level reaches the pump start level. The lead pump will operate at minimum speed for an adjustable period of time (initially set at 10 minutes) to fill the transfer pipeline. Whether in Level or Flow Control Mode, the output of the selected controller shall control the speed of the Diversion Pump or Pumps that are currently operating. When the controller output reaches full permissible pump speed (pre-set adjustable setting – assume 95% for initial value – also see pump maximum speed limits based on variable discharge head requirements as noted in paragraph 12 below) for at pre-set period of time (initial value of 1 minute), additional pumping capacity shall be added by starting the next pump in the sequence and ramping down the controller output slightly to accommodate the increased pumping capacity being added by starting another pump. Once the new pump has started and reached its speed set point, the selected controller will be released to resume control. The LAG2 pump will start similarly if the controller output again reaches the full permissible pump speed for a pre-set but adjustable period of time (initially set at 1 minute). When the Last LAG pump in both Wet Wells has started and the variable speed pumps are operating at full allowable speed for an adjustable period of time (initial value of 5 minutes), a high priority alarm shall be generated on the plant control system.

8. The lag diversion structure and associated wet well will be called to operate whenever either of the following conditions occurs (the pumps in the lag diversion wet well shall operate the same as described for the lead wet well above):
   a. The wet well level in the lead Wet Well rises above the level control set point and the flow rate at flow metering structure (FE/FIT-110A/B)still exceeds the permissible flow rate. This will occur if the flow rate from the diversion structure is not adequate to meet the diversion flow rate required.
   b. All available pumps in the lead wet well are called to operate and reach full speed (or maximum allowable speed) and the permissible flow rate cannot be maintained at the flow metering structure (FE/FIT-110A/B). This will occur if the required diversion flow rate exceeds the capacity of the available pumps in the lead wet well.

9. When the measurement for the selected controller drops below set point, the variable speed pump(s) will slow till it reaches its pre-determined minimum operating speed. If the measurement is still dropping and the variable speed pump has set at its minimum operating speed (preset adjustable level/speed controller output – initial value of 35% – also see pump minimum speed limits based on variable discharge head requirements as noted in **paragraph 12 below**) for a preset adjustable period of time (initial value of 1 minute), the last pump started will be stopped and controller output frozen at its current output. Once that pump has stopped, the controller will be released to resume control. LAG pumps shall continue to be stopped in a similar manner if the controller measurement continues to stay below set point and the output reaches minimum operating speed. When the level in the Wet Well reaches its minimum pump operating level, the lead pump shall be stopped. A high priority alarm shall be generated to notify the operator that that Wet Well has gone out of service due to insufficient flow into the Wet Well (in case of possible pump failure or blockage in the flow to the Wet Well.

10. If any of the pumps does not start (running feedback from starter) within a pre-set time delay after being called to run (initially set to 30 seconds), the next pump in the sequence shall be called to run, and the corresponding pump common trouble alarm (combined with the starter common trouble status signal) shall be activated. This pump fault alarm shall be latched until reset by the Operator. The selection of LEAD pump will change automatically if the LEAD pump fails to start or fails during normal pump operation.

11. Automatic Lead-Lag Alternation: When a pump fails to start or fails to run during required normal operation, the selection of LEAD/LAG1/LAG2 pumps shall change automatically. Also when all three pumps are shutdown during normal operation, the LEAD/LAG1/LAG2 pump selection shall be automatically changed.

12. The Diversion Pumps are variable speed due to the required operation over a very large range of discharge head requirements. The PLC shall be programmed to vary the speed command output to the VFDs according to the selected Wet Well Level/Flow controller output. The Pump manufacture during plant start-up will provide a table of minimum and maximum speed ranges for the VFD's that the pumps and associated VFDs can safely operate at a specified discharge pump head (normally wastewater level in the Equalization Tank). The PLC shall be programmed to adjust the high and low analog output limits to keep the pump speed above and below these vendor furnished operating limits at the variable discharge head conditions specified. The operator may choose to adjust the pump speed within these limits as the pumps operate.

13. A Magnetic flow meter (magmeter) (FE/FIT-210 and FE/FIT-310) will be used to measure the wastewater being pumped from each Diversion Wet Well by the associated Diversion Pumps. The flow tube will be located below ground in the Diversion Facility Valve Room.

The magmeter transmitters are currently located in the Diversion Facility Electrical Room.. The flow transmitter output will be wired to the PLC local control panel in the Diversion Facility Electrical Room for monitoring and control. High and Low absolute alarms shall be confirmed (initially set to 90% and 10% level respectively). Since the Equalization Facility is normally offline and the wastewater in the associated piping is normally drained back to the South Fork Peachtree Creek Sanitary Sewer when the Facility is offline, the plant control system shall disable the indication of flow thru the magmeters until there is a minimum adjustable level in the Equalization Tank (initially to be set at 5% of level). Flow Control will be disabled when the measurement signal is not of good quality. Both of the Diversion Facility Wet Wells will be furnished with similar magmeter on discharge of its associated set of three Diversion Pumps. Because the Return to South Fork Peachtree Creek Sanitary Sewer Isolation Valve FCV-203 is downstream of FE/FIT-210, the flow metering reading will be disabled when the Equalization Tank is operating in its Pump Flow Return to sewer operating mode (i.e. there will be reverse flow thru this magmeter). Additionally during normal operation of the diversion pumps, total flow thru each flow meter shall be totalized (provide low flow cutoff for totalization set at 10% initially). Should an adjustable high total discharge flow limit be reached (operator adjustable but initially set at 10.25 Million Gallons), the diversion pumps shall be sequentially shutdown in Last on – First Off fashion till the all the diversion pumps have been shutdown. If the totalized flow exceeds a high-high volume (initially set at 10.55 million gallons) all operating Diversion pumps will be stopped immediately and a high-high pumped flow alarm activated.

14. To insure that the Equalization Tank does not overflow there will be several secondary shutdown interlocks to disable flow from the Diversion Pumps from being pumped to the EQ Tank. There will be a high level switch LSH-501 mounted on the top of the Equalization Tank. When this switch (LSH-501) detects high EQ tank level, the Plant Control system shall initiate a software interlock to sequentially stop all of the diversion pumps with a time delay between pump stops. An EQ Tank full high priority alarm shall be generated. Additionally, another high level switch LSHH-501 set at a slightly higher level will be hardwired to each Diversion Pump VFD to disable the operation of all Diversion pumps on high high Equalization Tank level. Additionally, on high high level (LSHH-502) in the Cheshire Bridge Junction Chamber all Diversion Pumps will be disabled via a hardwired interlock. If the Relief Event is still active, the Diversion Pump station shall switch to Level Control Mode and the Diversion to South Fork Peachtree Creek Trunk Sewer Motorized Isolation Valve FCV-203 shall be automatically opened to divert flow from the EQ tank to the South Peachtree Creek Trunk Sewer. Once the position of the FCV-203 has changed from closed to open, the Diversion Pump Station can resume operation in only a LEVEL Control Mode. (Note that the flow thru the Wet Well Magmeter FE/FIT-210 must be disabled when Diversion pumps are not pumping to the Equalization Tank).

C. Level Monitoring Panels Loops 201, 202, (P&ID I-102) and Loops 301, 302 (P&ID I-103): A Level Monitoring Panel shall be located in the Diversion Facility Electrical Building to allow local (to Submersible Pump Drives) monitoring of wet well level in case of PLC failure and to provide multiple hardwired low low wet well level hardwired interlock signals to all drives. There will be separate Level Monitoring Panel for each Wet Well. For Redundancy there will be two Radar (microwave) level transmitters installed in each Wet ell. Each level transmitter shall be wired to its associated Level Monitoring Panel with a front mounted panel indicator displaying level in Feet of Water above the bottom. The Level transmitter signal will then be output via signal isolators to analog PLC Inputs inside the Local Control Panel in the Diversion Facility Electrical Building. Additionally two float level switch will be located inside each Wet Well to provide low low water level hardwired interlock protection to all of the submersible pumps. The

Diversion Pumps will have a separate low low level switch from the Drainage Pumps. LSLL-204 shall be provided for Wet Well # 1 Diversion Pumps and LSLL-304 for Wet Well # 2 Diversion Pumps. A separate low low level switch in each wet well shall be interlocked to disable the drainage pump if the level is too low to safely operate (LSLL-203 for Wet Well # 1 and LSLL-303 for Wet Well # 2). The Level Monitoring Panel shall be fabricated to generate an audible alarm plus strobe beacon light indication when either low low signal is received (open on low low level to alarm). The low low level interlock signal for the diversion pumps shall be designed to connect to a multiple output contact relay to provide a separate dry relay contact output for each Diversion Pump hardwired interlock and an additional relay contact output to provide remote low low level alarming via a PLC Input in the Local Control Panel located in the Electrical Building. Similarly the low low level hardwired interlock input for the drainage pump shall be wired to a relay that shall provide a relay output to the PLC for remote alarming as well as the hardwired interlock signal to be sent to the associated RVSS drive. Detection of low low water level by the Plant Control System shall generate a high priority alarm.

D. Wet Well Gas Monitoring Panels - Loops 210, 211, 212 (P&ID I-102) and Loops 310, 311, 312 (P&ID I-103): A Hazardous Gas Monitoring Panel shall be provided for each Diversion Pump Station Wet Well and will be local to each Wet Well. Each Gas Monitoring Panel shall detect and monitor the Combustible Gas Level and Hydrogen Sulphite (H2S) Concentration inside the Wet Well. Combustible Gas Detection will be monitored via Infrared Absorption type Sensor located above the Wet Well Odor concrete cover. A Gas Sampling System and associated explosion proof sampling pump shall be utilized to draw a sample from inside the Wet Well thru the Combustible Gas Sensor before returning to the Wet Well. Two Combustible Gas Detection Systems for each Wet Well will be provided one calibrated for Methane Gas and another for Petroleum Vapors. Additionally, a separate Gas Sampling System and associated explosion proof sampling pump shall be furnished for a Hydrogen Sulphide (H2S) Gas Sensor. The actual Analyzer Transmitters and relays for local alarming and remote monitoring will be located in the Gas Monitoring Panel. Per NFPA 820, local and remote alarming of combustible gas detection shall be provided via the Gas Monitoring Panel. A discrete input from both sampling systems shall be wired to the Plant Control System to indicate sampling system failure/low flow alarm. Both Analog and Discrete inputs from the Combustible Gas Transmitters (one for Methane LEL and another for Petroleum LEL) and H2S Gas Transmitters located remotely in Gas Monitoring Panel shall be wired to the Plant Control System for remote monitoring and alarming. Detection of High Combustible Gas Levels or High H2S Concentrations shall generate a high priority alarm.

E. Diversion Wet Well Sluice Gates Control - SLG-201/202 (P&ID I-102), SLG-203 (P&ID I-102), and SLG-301/302 (P&ID I-103): Each wet well is provided with two inlet slide gates (SLG-201 and SLG-202; SLG-301 and SLG-302) for maintenance isolation. Additionally, there will be a Wet Well Interconnect Sluice Gate SLG-203 to equalize the level in the two wet wells as required. Each gate is installed upstream of a sewage sludge grinder and can be used to isolate the respective grinder or the entire wet well if both gates are closed. The gates are normally in the open position (except for the Interconnect Sluice Gate SLG-203 which will normally be closed)The gates can be operated either locally or remotely. The Plant Control System shall both monitor and control the position of the motorized sluice gates. Discrete Inputs and Outputs shall be configured as shown in the I/O List. When the plant control system opens the lead sluice gate in the associated Diversion Structure, the associated sluice gates in the associated Diversion Wet Well will be automatically opened if not already opened. A High Priority Alarm shall be generated if neither sluice gate is fully opened when the associated Diversion Structure diverts flow to the Wet Well. When Wet Well is taking out of service for diverting flow to the Equalization Facility, the sluice gates will be left in their current position. A high priority alarm

shall be generated any time these Sluice Gates are not enabled for Remote Control (Local/Remote gate actuator status input).

F. Diversion Wet Well Sewage Grinders Control -WWG-201/202 (P&ID I-102) and WWG-301/302 (P&ID I-103): Each wet well is provided with two wastewater grinders (WWG-201 and WWG-202;, WWG-301 and WWG-302). Each grinder is provided with a vendor furnished local control panel that controls grinder operations. The grinders will start at the same time a slide gate in the associated diversion structure is instructed to open. The grinders will operate continuously once they are started and will be shut down when the last diversion pump in the wet well stop. The sewage grinders will also restart when the wet well drainage pumps are started to empty the wet well at the end of a relief event. The local control panel will be hardwired to PLC I/O Points in the Local Control Panel located in the Diversion Facility Electrical Room. The hardwired interface to the PLC shall include one (1) maintained start/stop contact (maintained start/stop contact powered from the associated motor starter/drive) and three (3) dry status contacts (H-O-R Remote status, and running and trouble indication). A High Priority Alarm shall be generated if any sewage grinder is not operating when the associated Wet Well is in service (unless its associated sluice gate has been manually closed). A high priority alarm shall be generated any time these Sewage Grinders are not enabled for Remote Control (Local/Remote selector switch status input).

G. Diversion to South Fork Peachtree Creek Trunk Sewer Motorized Isolation Valve FCV-203 (P&ID I-102): The Plant Control System shall both monitor and control the position of the motorized open/close valve FCV-203 that controls flow from the Diversion Pumps or pumped flow return from the Equalization Tank. The isolation valve is normally closed but opens when the Diversion Pumps are doing their initial filling of the Discharge piping back to the South Fork Peachtree Creek Sanitary Sewer or when the Equalization Tank is enabled for pump flow return back into the Sanitary Sewer. Discrete Inputs and Outputs shall be configured as shown in the I/O List. Note this motorized valve can be locally operated by the plant operations staff (there is a remote status input to warn when the valve cannot be control by the Plant Control System). Failure of the motorized valve to travel in an appropriate time (adjustable timer initially set to 2 minutes) shall generate a high priority alarm. A high priority alarm shall be generated any time this valve is not enabled for Remote Control (Local/Remote valve status input).

H. Diversion Valve Room Sump Pump P-205 (P&ID I-102): A vendor furnished plug-in type automatic starting constant speed sump pump system shall be provided for the Equalization Diversion Valve Room. This pump will require a local GFI Protected electrical power outlet to plug in the attached 20 foot power cable and will include integral start/stop float level switches for automatic sump pump operation. The Instrument Contractor shall provide a high high level float level switch LSHH-205 to monitor the sump in case of pump failure. The high high level float switch shall be wired to the PLC local control panel in the Diversion Facility Electrical Building for remote monitoring The high high level switch input shall generate an alarm when high hjgh level is sensed (open to alarm on high high level).

2.05 EQUALIZATION FACILITY CONTROL LOGIC

A. Equalization Tank Level Loop 501 (P&ID I-104): A radar (microwave) type level transmitter will be used to measure the wastewater level in the Equalization Tank. The transmitter sensor shall be bolted to a 3 inch flanged connection on top of the tank and the level transmitter shall be located beside the tank mounted 4 foot 6 inches off the ground to provide local level indication. The level transmitter output will be wired to the PLC local control panel in the Equalization Facility Electrical Building for monitoring and control. High and Low absolute

alarms shall be confirmed (initially set to 90% and 10% level respectively). A low level signal from the transmitter input shall be used to enable the Equalization Mixing pump operation.

B. Equalization Tank High Level Interlocks Loop 501 (P&ID I-104): A Capacitance High Level Switch (LSH/LSHH-501) will be mounted on top of the Equalization Tank to disable the Diversion Pumps (P-201/202/203/301/302/303) on high level or high high level. Both the High and High High Level switch inputs shall also be wired to to the PLC local control panel in the Equalization Facility Electrical Building for remote alarming and interlocking. Either level switch input (wired to be open to alarm) shall generate a high priority alarm (that will also be logged). When this switch (LSH-501) detects high EQ tank level, the Plant Control system shall initiate a software interlock to sequentially stop all of the diversion pumps with a time delay between pump stops. A separate contact off the High High Level Switch LSHH-501 shall be wired to high EQ Tank level interlocking relays (See Electrical Elementary E7-605) in the PLC Cabinet that shall multiplex the high level switch as a separate hardwired interlock to each VFD to disable the operation of all Diversion pumps on high high Equalization Tank level.

C. Cheshire Bridge Junction Chamber: High High Level Interlocks Loop 502 (P&ID I-104): A float level switch (LSHH-502) will be mounted in the Junction Box to disable the Diversion Pumps (P-201/202/203/301/302/303) on high high level. The Equalized Flow Return pumps will also be disabled on high high level. This level switch will be wired to the high EQ Tank level interlocking relays (See Electrical Elementary E7-605) inside the PLC local control panel in the Equalization Facility Electrical Building for interlockin and remote alarming. A high priority alarm (that will also be logged) will be generated when high high level is detected. A four pole multiplexing relay in the PLC Cabinet shall repeat the high high level status of this float level switch as separate hardwired high level interlocks to each of the Equalized Wastewater Flow Return Pump VFD's (VFD-531, 532, 533).

D. Equalization Jet Mixing Pumps Loops 501/502 (P&ID I-104): The Plant Control System shall start and stop and monitor the operation of the constant speed equalization jet mixing pumps P-501 and P-502. Each mixing pump shall have a motor starter in the 480V MCC located in the Equalization Facility Electrical Building. Each motor starter will be hardwired to PLC I/O Points in the Local Control Panel located in the Equalization Facility Electrical Room. The hardwired interface to the PLC shall include one (1) maintained start/stop contact (maintained start/stop contact powered from the associated motor starter/drive) and three (3) dry status contacts (H-O-R Remote status, and running and trouble indication). When the level in the Equalization Tank rises to the Mixing system start level, the tank mixing pumps available for operation will start sequentially with a short adjustable time delay between starts.. Once started, the pumps will operate continuously as the tank fills and for as long as wastewater is being stored in the equalization tank. When the tank is emptied back into the South Fork Peachtree Creek Trunk Sewer, the mixing system shall continue to mix the contents of the Equalization tank until the level is drawn down to the mixing system stop elevation (pre-set adjustable level where in the mixing pumps will be stopped sequentially and their operation returned to offline maintenance mode.

E. Equalization Jet Mix Pump high Discharge Pressure Loops 501/502 (P&ID I-104): A diaphragm operated high pressure switch with attached diaphragm seal will be installed on the discharge of each Jet Mix Pump to sense improper operation of the Jet Mix System (low circulation flow – possible plugging). Both high pressure switches will be wired to the PLC local control panel in the Equalization Facility Electrical Building for remote monitoring The pressure switch input shall generate a high priority alarm when high discharge pressure is sensed (open to alarm on high pressure).

F. Equalization Jet Mix Pumps Motorized Drainage Valves FCV-504 and FCV-505 (P&ID I-104): The Plant Control System shall both monitor and control the position of the motorized open/close valves FCV-504 (on Pump P-501) and FCV-505 (on Pump P-502) on the Jet Mix Pumps. When the Jet Mixing System is shutdown on low Equalization Tank level, both motorized drainage valves will be opened to drain the Jet Mixing System piping back into the gravity return line to the South Fork Peachtree Creek Sanitary Sewer. Discrete Inputs and Outputs shall be configured as shown in the I/O List. Note these valves can be locally operated by the plant operations staff (there is a remote status input to warn when the valve cannot be control by the Plant Control System). Failure of the motorized valves to travel in an appropriate time (adjustable timer initially set to 2 minutes) shall generate a high priority alarm. A high priority alarm shall be generated any time these valves are not enabled for Remote Control (Local/Remote valve status input).

G. Equalization Jet Mix Pumps Discharge Isolation Valves FCV-506 and FCV-507 (P&ID I-104): The Plant Control System shall both monitor and control the position of the motorized open/close valves FCV-506 (on Pump P-501) and FCV-507 (on Pump P-502) on the Jet Mix Pumps. When the associated jet mix pump is started, each associated discharge isolation valve shall open automatically. Discrete Inputs and Outputs shall be configured as shown in the I/O List. Note these valves can be locally operated by the plant operations staff (there is a remote status input to warn when the valve cannot be control by the Plant Control System). Failure of the motorized valves to travel in an appropriate time (adjustable timer initially set to 2 minutes) shall generate a high priority alarm. A high priority alarm shall be generated any time these valves are not enabled for Remote Control (Local/Remote valve status input).

H. Equalization Facility Motorized Valve FCV-501, and FCV-503 (P&ID I-104): The Plant Control System shall both monitor and control the position of the motorized open/close valve FCV-501 (Equalization Tank Isolation). This motorized open/close valve shall normally be normally open but can be closed by the Operator to do maintenance on the outlet piping from the EQ Tank.. As long as there is wastewater in the Equalization Tank isolation valve FCV-501 shall remain open to allow the Jet Mix System to recirculate the wastewater in the Tank to limit settling of the suspended solids in the Equalized Wastewater. The Plant Control System shall also monitor and control the position of motorized modulating control valve FCV-503. FCV-503 shall normally be closed but will open for modulating control when the Equalization System is conducting a Relief Event and the Equalization tank is enabled for Gravity Return to the Sanitary Sewer. Discrete Inputs and Outputs shall be configured as shown in the I/O List. Note this motorized valve can be locally operated by the plant operations staff (there is a remote status input to warn when the valve cannot be control by the Plant Control System). Failure of the motorized valve to travel in an appropriate time (adjustable timer initially set to 2 minutes) shall generate a high priority alarm. A high priority alarm shall be generated any time this valve is not enabled for Remote Control (Local/Remote valve status input).

I. Equalized Wastewater Flow Return Pumps Loops 531/532/533 (P&ID I-105): The Plant Control System shall start and stop and monitor the operation of the variable speed Equalized Wastewater Flow Return pumps P-531, P-532, and P-533. Each flow return pump shall have a variable speed drive (VFD) located in the Equalization Facility Electrical Building. Each VFD will be hardwired to PLC I/O Points in the Local Control Panel located in the Equalization Facility Electrical Room. The hardwired interface to the PLC shall include one (1) maintained start/stop contact (maintained start/stop contact powered from the associated VFD) and three (3) dry status contacts (H-O-R Remote status, and running and trouble indication) and analog input for speed monitoring and analog output for speed control. When the flow and level in the Peachtree Creek Trunk Sewer returns to normal operating limits and the Operator has initiated Pump Flow Return,

the flow return pumps will be automatically started in a Lead, Lag1, Lag 2 fashion according to the Pump Flow Return Operating Logic. There will be preset but operator adjustable time delay between successive pump starts. Once started, the pump shall operate continuous as long as there is level in the EQ tank and as long as the Flow and Level Limits in the Peachtree Creek Trunk Sewer are not exceeded. When either condition is meet (low EQ tank level or flow/level limits exceed), the flow return pumps will be stopped sequentially and their operation returned to offline maintenance mode.

J. Equalized Wastewater Flow Return Pumps Motorized Dischaarge Pipeline Drainage Valves FCV-531, FCV-532, and FCV-533 (P&ID I-105): The Plant Control System shall both monitor and control the position of the motorized open/close valves FCV-531 (on Pump P-531), FCV-532 (on Pump P-532), and FCV-533 (on Pump P-533). When all three flow return pumps have shutdown, the motorized discharge pipeline drainage valves shall open for a pre-set but adjustment period of time (initially set at 2 minutes) to allow the discharge pipeline to drain back into the suction header where it will be pumped out by the EQ Tank drainage pumps. Discrete Inputs and Outputs shall be configured as shown in the I/O List. Note these valves can be locally operated by the plant operations staff (there is a remote status input to warn when the valve cannot be control by the Plant Control System). Failure of the motorized valves to travel in an appropriate time (adjustable timer initially set to 2 minutes) shall generate a high priority alarm. A high priority alarm shall be generated any time these valves are not enabled for Remote Control (Local/Remote valve status input).

K. Equalization Pumped Flow Return Flow Control Loop 531 (P&ID I-105):

1. After the period of high flow in the South Fork Peachtree Creek Trunk sewer has passed by observing that sewer flow (as observed by FE-110) has gone below permissible limits and the level monitored in the existing Peachtree Creek Trunk Relief Manhole (PCTRM) has reached normal levels, the Equalization Facility shall enter its storage mode until Flow Return to the South Fork Peachtree Creek Trunk sewer is initiated. Flow will be returned from the equalization tank to the sanitary sewer system by pumping using the Equalized Wastewater Flow Return Pumps P-531/532/533..
2. To measure the amount of wastewater being pumped out of the EQ tank, an inline magnetic flow meter will be installed on the discharge of each Flow Return pump. Each flow transmitter output will be wired to the PLC local control panel in the Equalization Facility Electrical Building for monitoring and control. High and Low absolute alarms shall be confirmed (initially set to 90% and 10% level respectively). The sum of all three flowmeters shall be calculated and used to generate the master Flow Return Flow Controller input measurement. Totalized Flow Return Flow shall also be calculated and displayed. Flow Control and totalized will be disabled whenever any of the flow measurement signal is not of good quality
3. When the return flow permissive level at the Peachtree Creek Trunk Relief manhole, LIT-120A or LIT-120B is reached and the return flow rate at FE-110 is reached, the equalized flow can be returned to the sanitary sewer system. When flow return starts, open/close motorized isolation valve FCV-203 will be opened to allow flow of equalized wastewater from the Equalization Tank back to the South Forks Peachtree Creek Trunk Sewer. Stored Equalized Wastewater will be returned to the South Peachtree Creek Trunk sewer via pump return flow utilizing a master flow controller that shall monitor the Equalized Wastewater Storage Tanks outlet flow (summing the flow return discharge flow Magmeters 0 FIT-531/532/533) and modulating the speed of the three flow return pumps. There will be two

methods of flow return control designed into the system. The first is constant flow return and the second is flow proportional control.

4. Constant Flow Return. In constant flow return mode, the operator will set the desired return flow set point on the master Flow Return flow controller FIC-531 and the speed of the Flow Return Pumps will modulate to maintain this desired flow set point. Then the plant control system shall start and stop the equalized wastewater flow return pump and adjust pump speed based on the totalized pump discharge flow rates as monitored by FIT-531/532/533. This constant return flow set point will be adjustable and initially set at 15 MGD (30 MGD is maximum allowable set point). This flow rate will be maintained as long as the sanitary sewer flow rate remains below the adjustable permissive flow limit, initially set at 18 MGD and the PCTRM, LIT-120A or LIT-120B, level is below the flow return permissive level..

5. Proportional Flow Return. In proportional flow return mode, the amount of total permissive flow in the South Peachtree Creek Trunk sewer shall be set by the operator. The master equalized wastewater flow return flow controller set point FIC-531 shall be calculated as the operator set total permissible sewer flow rate minus the current actual flow in the sanitary sewer, FE-110A/B. Then the plant control system shall start and stop the equalized wastewater flow return pumps and adjust pump speed based on the totalized pump discharge flow rates as monitored by FIT-531/532/533. All pumps once started will operate at the same flow rate. The minimum required flow rate that must be reached before a pump can start is 9 MGD. This minimum flow rate is required to ensure that the pumps operate at acceptable points on the pump curve.

6. When the tank is at high levels, the pumps must operate within a limited range to ensure they operate at acceptable points on the pump curve. When the EQ tank water level is above 834.0 ft the pumps will operate at a narrow flow range (initially set at 9 to 10 MGD). Under these conditions, the pumps will be started and stopped in increments of 9 MGD and each pump flow rate will be controlled between 9 and 10 MGD. So when the tank level is over 835.0 ft, the permissible return flow rate must reach 9 MGD before the lead pump can start. Then the permissible flow must increase to 18 MGD before the second pump can start and 27 MGD before the third pump can start.

7. Once the tank level drops to 835.0 ft, the flow control will switch to completely modulating control and the speed of all pumps will be adjusted to match the required return flow rate.

8. During flow return operation, the level in the existing downstream Peachtree Creek Trunk Sewer Level Monitoring Manhole (PCTRM) (Radar Level Transmitters LIT-120A and LIT-120B) shall be monitored continuous and the flow return operation disabled if a high level is detected. Similarly the current flow in the sanitary sewer shall be monitored and if reaches it maximum allowed flow set point, the gravity return operation shall be disabled. Both of these conditions shall be priority alarmed and the operator must acknowledge and reset the alarms to permit the gravity flow return operation to resume. If a high water level is detected at the PCTRM, the equalized wastewater flow return will be stopped by disabling the master Flow Return flow controller FIC-531 and ramping the pump speed to minimum before disabling all three flow return pumps and also closing open/close isolation valve FCV-203. If the equalized wastewater flow return is interrupted by either high flow or high level in the in South Forks Peachtree Creek Trunk Sewer, the return flow operation will be discontinued and a new Wet Weather Relief event will start.

9. When the equalization tank level reaches a low level stop return flow set point, the master Flow Return flow controller FIC-531 shall be disabled and the Equalization System shall return to its offline stand-by operation. Open/Close isolation valve FCV-203 shall be closed to isolate flow from the Equalization Tank

L. Equalization Jet Mix Pump Station Sump Pump P-503 (P&ID I-104): A vendor furnished plug-in type automatic starting constant speed sump pump system shall be provided for the Jet Mix Pump Station Washdown Sump. This pump will require a local GFI Protected electrical power outlet to plug in the attached 20 foot power cable and will include integral start/stop float level switches for automatic sump pump operation. The Instrument Contractor shall provide a high high level float level switch LSHH-503 to monitor the sump in case of pump failure. The high high level float switch shall be wired to the PLC local control panel in the Equalization Facility Electrical Building for remote monitoring The high high level switch input shall generate a high priority alarm when high hjgh level is sensed (open to alarm on high high level).

M. Equalization Tank Drainage Pumps Loops 534/535 (P&ID I-105): The Plant Control System shall start and stop and monitor the operation of the constant speed Equalization Tank drainage pumps P-534 and P-535. Each mixing pump shall have a motor starter in the 480V MCC located in the Equalization Facility Electrical Building. Each motor starter will be hardwired to PLC I/O Points in the Local Control Panel located in the Equalization Facility Electrical Room. The hardwired interface to the PLC shall include one (1) maintained start/stop contact (maintained start/stop contact powered from the associated motor starter/drive) and three (3) dry status contacts (H-O-R Remote status, and running and trouble indication) as well as motor current input. When the level in the Equalization tank drops to below the Flow Return Pump operating level and all the Flow Return Pumps have stopped, The EQ Tank Drainage Pumps shall start sequentially (selected lead pump first then lag pump). The pumps shall be interlocked to stop on low motor current which should indicate when the EQ Tank and suction piping have been pumped dry (causing the motor current to drop below its normal operating current). Having both pumps stop on low motor current will disable the EQ Tank Drainage Pump operation. The drainage pumps will also operate during the EQ Tank Flushing Sequence described below to pump flushing water and any collected sediment from the EQ tank and discharge piping to the EQ pipeline junction box and then thru the bidirectional Equalization System Supply/Flow Return Piping back to the Peachtree Creek Relief Sewer (thru the pipeline to the Diversion Facility and Motorized Isolation Valve FCV-203).

2.06 EQUALIZATION FACILITY TANK FLUSHING SYSTEM CONTROL LOGIC

A. Equalization Tank Flushing Flow Loop 510 (P&ID I-108): A Magnetic flow meter (magmeter) will be used to measure the non-potable water to be used to flush the Equalization Tank and its associated Jet Mix System at the end of a Relief Event. The flow tube will be located below ground in a underground valve/flow meter vault. The magmeter transmitter shall be located above ground mounted 4 foot 6 inches off the ground to provide local flow indication. The local control station for each of the motorized Flushing Water Valves FCV-511 thru FCV-518 should be located close to this magmeter to permit manually flushing of the Tank if required. The flow transmitter output shall be wired to the PLC local control panel in the Equalization Facility Electrical Building for monitoring and control. High and Low absolute alarms shall be confirmed (initially set to 80% and 20% level respectively).

B. Equalization Tank Flushing Water Valve Control – FCV-511/512/513/514/515/516/517/518 (P&ID I-108): A motorized open/close valve shall be provided for each of the eight (8) flushing zones associated with cleaning out the debris and remaining wastewater left inside the Equalization Tank after a Relief Event. When a Relief Event has ended and the Equalization and Jet Mixing System has drained back by gravity to the South Fork Peachtree Creek Trunk Sewer, the Plant Control System shall initiate a Equalization Flushing Sequence. The Plant Control System shall confirm that Diversion Pump are not pumping wastewater to the Equalization (all pumps are shutdown) and the Equalization tank level is at its minimum level (may not be

completely empty when gravity flow stops) and there is no flow thru the Flow Return pump discharge magmeters FE/FIT-531/532/533 and the EQ Tank drainage pumps have completed their drainage operation When it is confirmed that the Equalization Tank is out of service – the Equalization Tank Automatic Flushing Sequence can be initiated. The Plant Control System shall provide an indication that Equalization Tank is now out of service and requesting permission from the operator to enter into a return to stand-by service Automatic Flushing Sequence. There will be a selector switch to allow the operator to manual initiate the flushing sequence or for it to automatically start at the end of the Flow Return operation. The operator will also be able to interrupt the flushing operation at any time prior to its completion. When initiated the Equalization Tank Automatic Flushing Sequence shall sequentially operate each of the motorized flushing water control valves in sequential fashion. Each valve will be fully opened and the flow rate on the non-portable water magmeter FE/FIT-510 confirmed to be greater than the minimum flushing water flow rate (initially set at 750 GPM per open zone flushing valve). When the flushing flow rate has been confirmed, a zone flushing timer shall be started. The open flushing water valve shall remain open for an adjustable period of time (initially set at one minute). The timer shall held at its current elapsed time any time that the observed flow rate drops beyond the flushing water set point mentioned previously. When the zone flushing period has expired, the next flushing water valve shall be opened and the current valve closed. The Plant Control System shall both monitor and control the position of the motorized open/close valves. Discrete Inputs and Outputs shall be configured as shown in the I/O List. A High Priority Alarm shall be generated if a motorized valve fails to open or close when commanded to operate or when the Flow Rate as measured by FE/FIT-510 drops below the flushing water flow set point (initially set at 750 GPM per open zone flushing valve) during the period of time that the associated valve is opened for flushing of its zone of the Equalization Tank interior. A high priority alarm shall be generated any time these valves are not enabled for Remote Control (Local/Remote valve status input). Note that during the EQ Tank Flushing Sequence, the EQ Tank drainage pumps will be started (after a pre-set but adjustable time delay to allow the water to reach the pump suction) and will operate continuous to pump the flushing water and collected debris back to the South Forks Peachtree Creek Trunk sewer.

C. Non-Potable Water to Equalization Tank Flushing Water Header Motorized Isolation Valve FCV-519 (P&ID I-108): The Plant Control System shall both monitor and control the position of the motorized open/close valve FCV-519 that controls flow from the non-potable water supply to the Equalization Tank Flushing Water Magmeter and Flushing water header isolation valves FCV-511 thru FCV-518. The isolation valve is normally closed (has a build-in battery pack to insure that the valve closes or stays closed on loss of 208 VAC power feed to the valve actuator) but opens when EQ Tank Automatic Flushing Sequence is initiated. Discrete Inputs and Outputs shall be configured as shown in the I/O List. Note this motorized valve can be locally operated by the plant operations staff (there is a remote status input to warn when the valve cannot be control by the Plant Control System). Failure of the motorized valve to travel in an appropriate time (adjustable timer initially set to 2 minutes) shall generate a high priority alarm. A high priority alarm shall be generated any time this valve is not enabled for Remote Control (Local/Remote valve status input).

2.07 ODOR CONTROL LOGIC

A. Diversion Wet Well Odor Control Scrubber - Loop 401 (P&ID I-106): A vendor furnished NEMA 4X local control panel OCP-401 shall be provided with the Odor Control System and shall be located local to the Odor Control Scrubber (must at least 3 feet away from all Odor ControL Equipment and ducts). All controls for the Odor Control system will be located within this panel. The Plant Control System shall receive a discrete input from this panel for remote

common trouble alarming and shall monitor status (running, common trouble, H-O-A Selector Switch in Auto) and enable the operation of the Odor Control Fan per the logic noted below.

B. Diversion Wet Well Odor Control Operation - Loop 401 (P&ID I-106): The Odor Control System consists of a Dry Media Bed Scrubber and a Fan F-401 to pull foul air from the both Diversion Wet Wells thru the Scrubber media. The plant control system shall start and stop and monitor running and trouble status of this Fan to enable operation of the Odor Control System. Like the Diversion Facility itself, the Odor Control System will normally be left in a passive standby mode. However, when the Diversion Facility enters its Wet Weather Operation/Relief Event Operating Mode and wastewater is allowed to diverted to the Diversion Wet Wells, the Plant Control System shall start the Fan Motor F-401 which will continue to run until the Diversion Facility enters its Dry Weather Flow/Maintenance Mode and will continue operating for an Operator adjustable period of time (initially set for 92 hours – 4 days) after the Wet Well has been emptied and the Diversion Facility has returned to its normal offline mode. Once this adjustable timer has expired the fan motor will be turn off and the Wet Well Odor Control System will be offline and in standby until another Relief event occurs. The Odor Control System will not run when Diversion Facility is only operating in its Dry Weather Maintenance Mode. The Odor Control System shall be disabled on Diversion Facility Fire Detection Loop 199.

C. Diversion Facility Valve Room Loss of Ventilation Alarming System Loop 415 (P&ID I-106): At thermal air flow switch FSL-415 shall be mounted in the discharge duct from Exhaust Fans EF-301 and EF-302 (100% redundant capacity) to monitor the ventilation air flow from the Diversion Facility Valve Room. At least 6 Air Changes per Hour is required by NFPA 820 to lower the classification of the Valve Room from Class 1 Division 2 to unclassified. Per NFPA 820 (2003 Edition) Article 7.5.2/3 Local and Remote alarms are required to be provided in case of Ventilation System failure. A discrete contact from the low air flow switch shall be wired to the Loss of Ventilation Alarming System located inside the Diversion Facility PLC Cabinet where relays shall activate local audible and visual alarms inside the ventilated area and at all ingress/egress points. The loss of ventilation alarming relays will also generated a contact output on low air flow to be wired to the Plant Control System for Remote Alarming. The low air flow switch input to the Diversion Facility PLC Local Control Panel shall generate a high priority alarm when detected (open to alarm on low air flow). Additionally a switch contact from the Diversion Wet Well Gas Monitoring Panels for Wet Wells #1 and 2 (ASH-210 and ASH-310) shall be wired to the Loss of Ventilation Alarming System to activate the horns and lights on high combustible gas detection (in addition to the alarming on loss of ventilation air flow).

D. Diversion Facility Odor Control Combustible Gas Detection - Loops 410/411/412/413 (P&ID I-106): A Combustible Gas Detector AIT-411 shall be provided for the Diversion Facility Odor Control System OC-401 and will be local to the Odor Control Scrubber. Combustible Gas Detection will be monitored via Infrared Absorption type Sensor located next to the Odor Scrubber. Per NFPA 820, local and remote alarming of combustible gas detection shall be provided. Detection of High Combustible Gas Level by the Plant Control System shall generate a high priority alarm. Additional, Hydrogen Sulphide Gas Detectors shall be provided for the Inlet, after the filter bed, and on the scrubber outlet of the Odor Control Scrubber OC-401 (AIT-410 Inlet, AIT-413 after filter bed, and AIT-412 Outlet). These analyzers shall be furnished with sampling systems and shall be part of a new Gas Monitoring Panel OCGMP-410 to be located at the Scrubber which shall provide the local alarming function as well as house the analyzer transmitters and sampling systems. Loss of sampling flow/sampling system failure signal from each Sampling system shall be wired to the Plant Control System for generating a high priority alarm. The analyzers themselves will also be wired to the Plant Control System for monitoring and alarming. High Hydrogen Sulphide Gas Detection after the filter bed of the Scrubber shall

generate an high priority alarm to warn the operator that it may be time to change the media in the Scrubber. This alarm shall be latched and must be manually reset by the operator.

E. Equalization Facility Odor Control Scrubber - Loop 501 (P&ID I-107): A vendor furnished NEMA 4X local control panel OCP-501 shall be provided with the Odor Control System and shall be located local to the Odor Control Scrubber (must at least 3 feet away from all Odor ControL Equipment and ducts). All controls for the Odor Control system will be located within this panel. The Plant Control System shall receive a discrete input from this panel for remote common trouble alarming and shall monitor status (running, common trouble, H-O-A Selector Switch in Auto) and enable the operation of the Odor Control Fan per the logic noted below.

F. Equalization Facility Odor Control Operation - Loop 501 (P&ID I-107): The Odor Control System consists of a Dry Media Bed Scrubber and a Fan F-501 to pull foul air from the both Diversion Wet Wells thru the Scrubber media. The plant control system shall start and stop and monitor running and trouble status of this Fan to enable operation of the Odor Control System. Like the Equalization Facility itself, the Odor Control System will normally be left in a passive standby mode. However, when the Equalization Facility enters its Wet Weather Operation/Relief Event Operating Mode and wastewater is pumped fromDiversion Wet Wells to the Cheshire Bridge Junction Chamber, where it flows by Gravity to the Equalization Tank, the Plant Control System shall start the Fan Motor F-501 which will continue to run until the Equalization Facility enters its Dry Weather Flow/Maintenance Mode and will continue operating for an Operator adjustable period of time (initially set for 92 hours – 4 days) after the Equalization Tankhas been emptied and the Equalization Facility has returned to its normal offline mode. Once this adjustable timer has expired the fan motor will be turn off and the Wet Well Odor Control System will be offline and in standby until another Relief event occurs. The Odor Control System will not run when Equalization Facility is only operating in its Dry Weather Maintenance Mode. The Odor Control System shall be disabled on Equalization Facility Fire Detection Loop 599..

G. Equalization Facility Jet Mix Pump Room Loss of Ventilation Alarming System Loop 515 (P&ID I-107): Redundant thermal air flow switches FSL-515A/B shall monitor the ventilation air flow to the Equalization Facility Jet Mix Pump Room produced by the Exhaust Fans EF-701 and EF-702 (100% Redundant Capacity). At least 6 Air Changes per Hour is required by NFPA 820 to lower the classification of the Jet Mix Pump Room from Class 1 Division 2 to unclassified. Per NFPA 820 (2003 Edition) Article 7.5.2/3 Local and Remote alarms are required to be provided in case of Ventilation System failure. A discrete contact from each low air flow switch shall be wired to the Loss of Ventilation Alarming System located inside the Diversion Facility PLC Cabinet where relays shall activate local audible and visual alarms inside the ventilated area and at all ingress/egress points The loss of ventilation panel will also generated a contact output on low air flow to be wired to the Plant Control System for Remote Alarming. The low air flow switch input to the Equalization Facility PLC Local Control Panel shall generate a high priority alarm when detected (open to alarm on low air flow).

H. Equalization Facility Odor Control Combustible Gas Detection - Loops 510, 511, 512, 513 (P&ID I-107): A Combustible Gas Detector AIT-511 shall be provided for the Equalization Facility Odor Control System OC-501 and will be local to the Odor Control Scrubber. Combustible Gas Detection will be monitored via Infrared Absorption type Sensor located next to the Odor Scrubber. Per NFPA 820, local and remote alarming of combustible gas detection shall be provided. Detection of High Combustible Gas Level by the Plant Control System shall generate a high priority alarm. Additional, Hydrogen Sulphide Gas Detectors shall be provided for the Inlet, after the filter bed, and on the scrubber outlet of the Odor Control Scrubber OC-501 (AIT-510 Inlet, AIT-513 after filter bed, and AIT-512 Outlet). These analyzers shall be furnished

with sampling systems and shall be part of a new Gas Monitoring Panel OCGMP-5410 to be located at the Scrubber which shall provide the local alarming function as well as house the analyzer transmitters and sampling systems. Loss of sampling flow/sampling system failure signal from each Sampling system shall be wired to the Plant Control System for generating a high priority alarm. The analyzers themselves will also be wired to the Plant Control System for monitoring and alarming. High Hydrogen Sulphide Gas Detection after the filter bed of the Scrubber shall generate an high priority alarm to warn the operator that it may be time to change the media in the Scrubber. This alarm shall be latched and must be manually reset by the operator.

2.08 MISCELLANEOUS

A. Fire Alarm Panel –- Loop 199 (P&ID I-101) - Reference Electrical Drawing E3-103 and Fire Alarm System Riser Drawing E0-603: In accordance with NFPA 820, the Diversion Facility shall be monitored for fire detection via a new fire alarm panel located in the Diversion Facility Electrical Building that will be able to be remotely monitored via a telephone connection. The fire alarm system will be configured with a duplex telephone dialer. There will be a common trouble alarm wired from the Fire Alarm Panel to the plant control system for remote alarming logging.

B. Fire Alarm Panel –- Loop 599 (P&ID I-104) - Reference Electrical Drawing E7-103 and Fire Alarm System Riser Drawing E0-603: In accordance with NFPA 820, the Equalization Facility shall be monitored for fire detection via a new fire alarm panel located in the Equalization Facility Electrical Building that will be able to be remotely monitored via a telephone connection. The fire alarm system will be configured with a duplex telephone dialer. There will be a common trouble alarm wired from the Fire Alarm Panel to the plant control system for remote alarming logging.

C. Bridge Crane BCO-101– Diversion Wet Well - Reference Electrical Power Plan Drawing E3-103 and Electrical Single Line Drawing E3-101: There will be a Bridge Crane installed above the submersible pumps in the Diversion Wet Well Area. All control of the Bridge Crane motor(s) shall be local only.

D. Bridge Crane BCO-102 – Diversion Pump Station Valve Room - Reference Electrical Power Plan Drawing E3-103 and Electrical Single Line Drawing E3-101: There will be a Bridge Crane installed in the Diversion Valve Room. All control of the Bridge Crane motor(s) shall be local only.

E. Bridge Crane BCO-104 – Equalization Facility - Reference Electrical Power Plan Drawing E7-102 and Electrical Single Line Drawing E7-101: There will be a Monorail installed above the Jet Mixing Pumps in the Equalization Facility. All control of the Bridge Crane motor(s) shall be local only.

F. Monorail BCO-103 – Equalization Facility - Reference Electrical Power Plan Drawing E7-102 and Electrical Single Line Drawing E3-101: There will be a Monorail installed above the Jet Mixing Pumps in the Equalization Facility. All control of the Monorail motor(s) shall be local only.

END OF SECTION 13150

SECTION 13200
CONTROL PANELS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. The provisions and requirements of Division 13, Section 13000 "General Provisions" of this Specification shall apply to the work specified in this section.

C. Components associated with the furnishing and fabricating of control panels associated with this Specification shall be as specified in Division 13, Section 13250 "Control Panel Components" or as specified in Division 13, Section 13300 "Instrumentation Specifications" for panel mounted instruments (electronic controllers, signal conditioners, panel meters/indicators, etc.)

D. Control Panels and/or other Cabinets furnished under this Specification shall provide transient surge and lightning protection as required in Division 13 Contract Specification 13270 "Surge and Lightning Protection".

1.02 SUMMARY

A. This Section covers the furnishing of new or reworking of existing control panels and/or Control System or Telemetry System Processor or I/O Cabinets associated with instrumentation and control system that are not provided under other sections of the Contract and as necessary to complete the instrumentation and controls as shown on the Contract Drawings and Contract Specifications.

B. Panel(s) shall be fabricated; instruments installed, and wired in the manufacturer's factory. Wiring shall be completed and tested prior to shipment. External connections shall be by way of numbered terminal blocks.

C. Furnish all labor, supervision, materials, equipment and incidentals required to complete and ready for operation, said control panels and/or cabinets as depicted on the Contract Drawings or on the P&IDs or on any Instrumentation Details provided. Where required this shall include reworking existing control panel(s) to add or eliminate functionality as shown on the Contract Documents. Unless otherwise noted, the installation of all control panels or other cabinets furnished under this Specification shall be performed by the General Contractor and/or Electrical Contractor. The party responsible for the design and fabrication of all new or reworked control panels and cabinets (Instrumentation and Controls Subcontractor or Telemetry System Subcontractor) shall be responsible to certify the proper installation and operation of all supplied equipment.

All the Work in this Section shall be the sole responsibility of the designer of the associated system (Instrumentation and Controls Subcontractor or Telemetry System Subcontractor). Components and enclosures may be provided to the appropriate Subcontractor by other suppliers and/or manufacturers, but the packaging, wiring and testing of these components and the production of the final product shall conform to this specification and shall be the sole

responsibility of the appropriate designer (Instrumentation and Controls Subcontractor or Telemetry System Subcontractor if separate entities).

D. The control panels shall be provided under this Section shall include those panels listed in the attached Table of Required Control Panels.

1.03 REFERENCE STANDARDS

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Reference Standards" and as specified herein.

1.04 QUALITY ASSURANCE

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Quality Assurance" and as specified herein.

1.05 SUBMITTALS

A. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. In accordance with the General Conditions and the Special Conditions of the Contract and with Contract Specification 13000, submit to the Engineer the following documentation to demonstration compliance with submittal requirements of the Contract:

C. Control Panel Engineering Submittal: The Contractor shall submit a control panel engineering submittal for each control panel and enclosure provided and/or existing control panel to be reworked. The submittal shall completely define and document the construction, finish, layout, power circuits, signal and safety grounding circuits, fuses, circuit breakers, signal circuits, internally mounted instrumentation and SCADA/Telemetry system components, face plate mounted instrumentation components, internal panel arrangements, and external panel arrangements. All panel drawings shall be "B" size, and all data sheets and manufacturer specification sheets shall be "A" size. The submittal shall be in conformance with NEMA Standard ICS-1-1.01, shall be submitted as a singular complete bound volume or multi-volume package and shall have the following content:

1. List of all new Control Panels and I/O Cabinets and/or new sub-panels associated with existing Control Panels to be furnished.
2. A complete index shall appear in the front of each bound volume. Panels shall be indexed by system or process area, and drawings and data associated with a panel shall be grouped

together. All panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.

3. Definition of all rework to be performed on existing control panels and I/O Cabinets including panel name, location, and general description of work to be done in each panel or cabinet.

4. General Arrangement (GA) drawing(s) of all control panels and I/O Cabinets. GAs shall include outline, dimensions, and estimated weight for each panel or cabinet. Drawings shall denote the physical location of all panel ingress and egress points.

5. Complete Identified Bill of Materials for each control panel or cabinet. Bill of Materials shall reference General Arrangement drawing(s) and shall include ID#, manufacturer, model number, description, and quantity for each item.

6. Complete Identified list of nameplates and annunicator windows associated with each panel or cabinet. Include ID#, tag number, and service description (engraving inscription). These shall be cross-referenced to the GA Drawings.

7. Project specific identified product data sheets for each component in the Bill(s) of Materials.

8. Interconnect wiring drawings for all internal panel or cabinet wiring. Interconnect drawings shall identify all terminal strips, wiring, and devices located inside the panel and shall note where external connections shall be made. External connections shall be denoted with a description and tag number, where available.

9. Where available, provide manufacturer instruction manuals containing manufacturer installation and maintenance requirements and troubleshooting guide.

10. Complete list of Spare Parts, Expendables, and Test Equipment to be provided in accordance with Specification 13000 and General Conditions section of the Contract. If not included in the Subcontractor's bid, complete pricing for all recommended Spare Parts, Expendables, Special Tools, etc that are recommended but not specifically included shall be furnished.

D. After Fabrication, Installation, and Testing are complete and approved, submit Record Documents per Contract Specification 13000 Section "Record Drawings".

E. After Record Drawings have been approved, submit Operation and Maintenance Manuals per Contract Specification 13000 Section "Operation and Maintenance Manuals".

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Identification, Storage and Handling of all supplied control panels and cabinets shall be in full conformance with the Contract Specifications and with Division 13 Contract Specification 13000 Section "Delivery, Storage, and Handling" and as specified herein.

B. Control Panels and Cabinets shall be mounted on wooden skids at least four inches high suitable for movement via forklift truck. Control Panels and Cabinets shall be suitably wrapped or crated depending on the distance to be traveled and the amount of transfers to be made during shipment from point of origin to point of actual installation.

C. Control Panels and Cabinets shall be only shipped via Air-Ride Van.

D. Control Panels and Cabinets shall not be stored out-of-doors even if designed for outdoor installation until temporary or permanent sun and rain shields have been erected at the installation or storage location (assuming the enclosure is rating for outdoor installation).

E. Instruments and control devices inside control panels or cabinets shall be "blocked" and "tied off" to prevent damage during shipment. Front of panel instruments shall be removed and re-packed in their original containers for shipment. Similarly, all Control System processors, I/O Cards, and other sensitive electronic equipment shall be removed and re-packed in their original containers for shipment. All removed instruments and controls shall be properly labeled to facilitate re-assembly at the jobsite.

F. All mounting hardware, accessories, and at least one set of drawings and instruction manuals necessary to complete the field installation shall be shipped with the Control Panel/Cabinet Shipment.

1.07 SIZE OF EQUIPMENT

A. Investigate each space in the structure through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the structure.

B. The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passing through such restricted areas during transportation, the manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

1.08 WARRANTY

A. Provide a warranty for all instrumentation and controls in accordance with the general requirements of the Contract Specifications. Unless specified more stringently elsewhere in the general requirements, the components of the instrumentation and controls system shall be warranted against defective materials, design, and workmanship for a period of one (1) year from the date of final acceptance.

B. During the warranty period, the Supplier shall furnish personnel to inspect, test, and take corrective action to correct all deficiencies in his "Scope of Work" such that the corrective action is consistent with the quality of materials and work of the original construction and is in conformance with the Contract Specifications, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Furnish, fabricate, test, and make ready for operation the control panels and cabinets required to complete the Instrumentation and Controls design per the Contract Specifications including Contract Specification 13000 "Instrumentation and Controls – General Provisions" and as shown on the Contract Drawings.

B. Unless otherwise specified on the Contract Drawings, all control panels and cabinets shall be of the fully enclosed type suitable for the mounting of the instrumentation and control devices as listed in the Contract Specifications and as shown on the Contract drawings.

C. All control panel and cabinets shall be fully lockable with a lock installed in the door handle or by padlocking using a hasp and staple for padlocking. Locks for each panel or cabinet provided under this Contract shall be keyed alike.

D. All panel components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates, in such a manner that the component may be removed without removing the plate, and shall not be directly mounted to the enclosure. Mounting shall be rigid and stable unless shock mounting is required

otherwise by the manufacturer to protect equipment from vibration. Mounting orientation shall be in accordance with the requirements of each component.

E. Front of panel devices (indicating lights, pushbuttons, selector switches, etc.) shall be grouped together by associated equipment/function. Layout of the control devices shall be in accordance with the sequence of operations proceeding from left to right across the front of the control panel.

F. The instruments designated for rear-of-panel mounting shall be arranged within the panel in a manner to allow for ease of maintenance and adjustment.

G. Instruments to be mounted inside panels that require rear access for wiring, calibration, or testing and that can not be surface mounted on interior back plates while still providing access to all wiring (even if pre-wired to external terminal strips), calibration or testing functions shall be mounted on swing-out sub-panels to facilitate such maintenance, troubleshooting, or testing activities without requiring one to physically stand inside the panel.

H. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

I. Front of panel instruments that are more than 6 inches deep, weight more than 10 pounds, or exert more than 4 ft-lb moment force on the face of the panel shall be supported underneath by at least 1 inch x 1/8 inch thick steel angle to prevent wrapping or damage to the panel and/or instrument. Front of panel instruments shall be design to be flush or semi-flush mounted.

J. Conductors running from the field to the panels shall be continuous without splices, except at approved junction boxes. The junction boxes shall have terminal blocks with at least 20 percent spare terminals. Special care shall be exercised to pass all grounding and shield conductors through such junction boxes with the least possible resistance. Conduit and cables entering panels shall be sealed to prevent the intrusion of gases or moisture.

K. The internal framework of each panel shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging and lifting of the control panels during installation. Plugs shall be provided and shall unobtrusively fill the panel lifting ring holes when substituted for the lifting rings after installation is complete. The control panel framework and instrument supports associated with each Control Panels shall be designed in accordance with the Seismic Zone associated with the project as noted in the Contract Drawings.

L. Each control panel or cabinet shall be provided with exterior nameplate that identifies the panel in accordance with the panel name and description as shown on the Contract Drawings. Nameplates shall be at least 1-inch high x 3-inch wide constructed of plastic laminate that is at least 1/16 inch

(1.6 mm) thickness for nameplates up to 20 square inch (129 square cm) or at least 1/8 inch thick (3.2 mm) for larger sizes. Nameplate shall be engraved using a "sans serif" type font like Arial or Helvetica typefaces. Lettering shall be approximately ¼" in height, consisting of Black Lettering on a White background. Nameplates shall be beveled and attached to panels by self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers. Nameplates that are only adhesive bonded or glued to the panel or cabinet shall not be accepted.

M. Additionally each control panel or cabinet shall be provided with nameplates identifying each major component including relays, timers, signal conditioners, power supplies, terminal strips, circuit breakers, fuse assembly, selector switches, pilot lights, etc. Nameplates shall be laminated plastic, engraved white letters with a black background. Nameplates shall be mounted adjacent to but not on each component and shall be clearly visible. Nameplates shall be permanently affixed with stainless steel self-tapping screws.

N. Where applicable, also provide a nameplate, which reads as follows "CAUTION - THIS PANEL CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE." Engraving shall be approximately 3/16" in height, consisting of black lettering on a high visibility yellow background. Nameplates shall be beveled and attached to panels by self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers. Adhesive bonded or glued on nameplates shall not be accepted.

O. Control Panels containing Programmable Logic Controllers or programmable relays or programmable instruments (ie electronic controllers, etc.) shall be provided with a fold-down shelf where a laptop computer can be placed when troubleshooting or reprogramming devices inside the control panel. The shelf can be internal or external to the control panel. From the fold-down shelf, there will be convenient access to plug-in programming input ports on the device and a 120VAC convenient outlet for powering the laptop. For PLC or DCS Processors or Remote I/O Cabinets, programming ports shall include the ability for the laptop to connect to the PLC or DCS Communication Data Highway(s). If there is not convenient access to connections for programming – additional plug-in programming connections shall be installed local to the fold-down shelf. Shelves that are external to a furnished Control Panels shall be attached to the front of the Control panel and shall provide for this access to AC power and programming/troubleshooting port(s) without having to open up the control panel.

2.02 PANEL MATERIALS AND CONSTRUCTION

A. General Requirements

1. Unless otherwise specified, all panels located in indoor non-hazardous, non-process areas shall be of NEMA 12 construction and shall be labeled by Underwriters Laboratories. Freestanding panels shall be constructed of 14 gauge or thicker sheet steel, suitably braced internally for structural rigidity and strength. Stainless steel shall be substituted where specified in the Drawings. Wall or Unistrut mounted panels shall be 16 gauge or better steel. All exposed welds, seams, or edges shall be ground smooth. Front panels or panels containing instruments shall be 14 gauge or thicker sheet steel, reinforced to prevent warping or distortion. All doors shall be lockable, mounted with strong, continuous, piano type hinges and be provided with door handles and three point latches, or screw clamps.

2. All panels located in non-hazardous, outdoor areas or in indoor process areas, and where specified in the Contract Documents, shall be of NEMA 4X construction and shall be labeled by Underwriters Laboratories.

a. Except where indicated otherwise in Contract Documents, wall or Unistrut mounted panels shall be constructed of fiberglass-reinforced polyester (FRP) material with a minimum wall thickness of 0.19 inches, reinforced on top, bottom and sides with epoxy painted steel, fiberglass hinges, and stainless steel captivated door screws. Interior panels of 14 gauge or thicker steel construction shall be provided where necessary for instrument mounting.

b. Freestanding panels, and all those specified as stainless steel in the Drawings, shall be constructed of 316 Stainless Steel. Minimum thickness shall be 14 gauge for freestanding panels, 16 gauge for wall or Unistrut mounted panels. Continuous door hinge, hinge pin, door clamps, hasp and staple for padlocking, shall be of stainless steel construction. Interior panels of 14 gauge or thicker steel construction shall be provided where necessary for instrument mounting.

3. Provide explosion-proof enclosures where required in hazardous areas.

4. Panels shall be provided with full length, fully gasketed rear doors or front access doors as shown on the panel details. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments. For freestanding panels, full length rear access door shall be not greater than 36 inches in width. All doors shall open a minimum of 90 degrees.

5. The panel shall be suitable for top or bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry the panel top shall be provided with nominal one foot square removable access plates which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, or other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

B. Finish Requirements

1. All sections shall be descaled, degreased, filled, ground and finished. The enclosure, when fabricated of carbon steel, shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.

2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.

3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and topcoat of two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.

4. All FRP panels located in direct sunlight shall be provided with a UV protective coating to prevent discoloration and cracking.

5. Apply a minimum of two coats of flat white lacquer on the panel interior after priming.

6. Unless otherwise noted, the finish exterior colors to be used shall be selected by the Owner from color clips supplied by the System Supplier.

C. Manufacturer

1. Except for DCS equipment, all panels shall be by Hoffman, ITS Enclosures, Rittal, or approved equal.

2. Unless otherwise noted on the Contract Drawings, Vendor standard cabinets shall be provided for DCS Control Systems, where applicable.

2.03 TEMPERATURE CONTROL

A. Freestanding panels shall be provided with louvers and/or forced air ventilation as required to prevent temperature buildup due to electrical devices mounted in or on the panel.

B. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.

C. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.

D. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.

E. Should sufficient heat be generated within a panel where dissipation cannot be adequately accomplished with natural convection or forced air ventilation, a heat exchanger or air conditioner shall be provided. Air conditioners that require cooling water supply shall only be provided where approved by Engineer. Pneumatic panel coolers shall only be supplied where sufficient excess instrument quality air is available and only then when approved by Engineer.

F. Control panels that are exposed to sunlight shall be equipped with adequate sunshields. The sunshield shall consist of one or more pieces of stainless steel, FRP, or other suitable material of sufficient size to cover the top, sides, and rear of the panel (where applicable), and to hang over the front of the panel to shade any instruments mounted there. Sunshield pieces shall be secured to the panel by bolts and shall have no less than 1 inch of clearance from the panel and from one another, to allow for air circulation over the sunshield surfaces and access to panel door(s).

G. The internal temperature of all panels shall be regulated so as not to exceed 100 degrees Fahrenheit. Under no circumstances shall the panel cooling equipment compromise the NEMA rating of the panel.

H. Control panels and Cabinets to be located in areas where the air temperature inside the enclosure can go below the dew point shall be provided with thermostatically (adjustable) controlled heaters to prevent moisture formation inside the enclosure.

2.04 CORROSION CONTROL

A. Control panels or cabinets shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Hoffman Engineering Model A-HCI; or approved equal.

2.05 INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

1. The completed control panel or I/O cabinet assembly shall be UL certified per UL 508 (non-hazardous locations) or UL 698 (class 1 division 2 hazardous locations).

2. Panel equipment shall be mounted and wired on or within the cabinet. Wiring shall comply with the National Electrical Code. Wiring within the panel shall be grouped together with harnesses or ducts and secured to the structure. All internal panel wiring shall be shown on interconnect type-wiring drawings utilizing symbology that is compatible with ISA Standard S5.4 "Instrument Loop Diagrams". Wiring drawings shall show all internal panel AC and DC power distribution and control signal wiring and shall clearly note all external field connections. All panel wiring shall be identified and numbered in compliance with the numbering system shown on the wiring / interconnection diagrams. All panel general arrangement, wiring, and interconnection diagrams shall be submitted by the supplier as part of the Shop Drawings for review by the Engineer.

3. All panel wiring shall comply with the Transient Surge and Lightning Protection requirements of the Contract Drawings and Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Controls – General Provisions" and Division 13 Contract Specification 13270 – "Surge and Lightning Protection".

4. AC Power (and AC discrete signal wiring) and low voltage DC signal wiring shall be routed in separate wire ways. Crossing of the AC and low voltage DC signal wiring shall be at right angles.

5. AC Power and discrete signal wiring shall be stranded copper, minimum size #14 AWG (except for shielded instrumentation cable), with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.

6. Panel Graphic light or annunicator wiring (24 volt maximum) may be 16 AWG if properly fuse protected and terminated in a terminal block capable of accepting No. 14 AWG field wiring.

7. Analog signal wiring shall be single pair 16 gauge stranded copper conductors, PVC insulated, PVC jacket, 600 Volt, 75/90 degrees Celsius rated, 100 percent aluminum-Mylar shield with drain wire, NEC Tray Cable; Belden 9342 or equal.

8. Panel wiring colors shall be as follows:
   a. AC Power Supply – Line or Hot – BLACK – Wire Label Suffix L
   b. AC Power Supply – Neutral or Common – WHITE - Wire Label Suffix N
   c. AC Power Supply – Ground – GREEN - Wire Label Suffix PG
   d. AC/DC Discrete Control Signals – RED - Wire Label Suffix C [Non Isolated Digital Outputs 120 VAC or 24 VDC hot leg (PLC Panel Feeds Power) or Non Isolated Digital Inputs 120 VAC or 24 VDC hot leg going to the field (PLC Panel Feeds Power)]
   e. AC/DC Discrete Control Signals – BLUE - Wire Label Suffix C [Non Isolated Digital Outputs 120 VAC or 24 VDC switched leg (PLC Panel Feeds Power)]
   f. AC/DC Discrete Control Signals – ORANGE - Wire Label Suffix C [Isolated Digital Outputs 120 VAC or 24 VDC hot leg (Field Device Feeds Power)]
   g. AC/DC Discrete Control Signals – PURPLE - Wire Label Suffix C [Isolated Digital Outputs 120 VAC or 24 VDC return or neutral (Field Device Supplies Return)]
   h. AC/DC Discrete Control Signals – YELLOW - Wire Label Suffix C [Non Isolated Digital Inputs 120 VAC or 24 VDC switched leg (PLC Panel Feeds Power) or Isolated Digital Inputs 120 VAC or 24 VDC hot leg (Field Device Feeds Power)]

i. AC/DC Discrete Control Signals – WHITE - Wire Label Suffix C [Non Isolated Digital Inputs 120 VAC or 24 VDC neutral or common (PLC Panel Feeds Power)]

j. AC/DC Discrete Control Signals – GREY - Wire Label Suffix C [Isolated Digital Inputs 120 VAC or 24 VDC return or neutral (Field Device Supplies Return)]

k. Analog Control Signals – Positive – WHITE or CLEAR - Wire Label Suffix C

l. Analog Control Signals – Negative – BLACK - Wire Label Suffix C

m. Equipment or Chassis Ground – GREEN - Wire Label Suffix PG

n. Discrete Control Signals that are externally powered – YELLOW

9. Externally connections for AC Power supply and Field wiring shall be connected thru the use of terminal blocks mounted inside the enclosure. Each enclosure shall be provided with a minimum of 20 percent spares terminals.

10. Terminal blocks shall be arranged in vertical rows and separated into groups (AC Power, AC control, DC control, Analog signal, and alarm). Each terminal strip shall be individually labeled and the associated terminal blocks numbered in numerical order from top to bottom.

11. Terminal blocks shall be IEC style, screw clamp type, single height feed through style terminal blocks rated for the appropriate voltage level (300V minimum) similar to Allen Bradley model 1492-W4 or approved equal. Double and Triple Height terminal can be used for internal panel distribution but should be avoided for field terminations unless as approved by Owner or Engineer. Terminal Blocks used for termination of grounds (including instrument shield grounds) shall be green/yellow stripped similar to Allen Bradley model 1492-WG4 or approved equal. Fused terminal blocks shall be provided with LED type blown fused indicators, similar to Allen Bradley model 1492-H5 or approved equal. High current terminal blocks to be NEMA Open Construction style terminal blocks similar to Allen Bradley 1492-CA1 or CE2 or approved equal.

12. Wiring trough for supporting internal wiring shall be plastic type with snap on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the sub panel by using stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.

13. Each wire shall be provided with a pre-typed identification markers at both ends and the numbering shall be in accordance with the wiring drawings.

14. Wiring troughs shall not be filled to more than 60 percent visible fill. Wiring trough covers shall be match marked to identify placement. If component identification is shown on covers for visibility, the ID shall also appear on the mounting sub-panel.

15. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and individually circuit breaker protected.

16. Each panel shall have a specification grade duplex GFI protected convenience receptacle mounted internally within a stamped steel device box with appropriate cover. The convenience outlet shall be individually protected by a circuit breaker.

17. A lamp test push button shall be provided on the front of each control panel to test all the indicator lamps bulbs at the same time.

18. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

19. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

20. Each panel, where applicable, shall be provided with analog signal isolation (I/I) where analog signals are sent from one panel or cabinet to another.

21. Each panel shall be provided with an incoming AC power circuit breaker. AC powered individual instruments and controls shall be individual fused protected.

22. All wiring to hand switches and the like which are live circuits independent of the panel's normal circuit breaker protection shall be clearly identified as such.

23. Panels shall have an initial installed capacity of I/O points as shown on drawings and as described in the specification sections plus 25 percent installed spares and capacity for 20 percent input/output expansion within the enclosures provided.

24. Provide interposing heavy duty interposing relays for start/stop control of Size 4 and larger motor starters.

B. Pneumatic Tubing: Pneumatic tubing shall be a minimum of 1/4-in O.D manufactured from copper; PVC coated copper; or 316 stainless steel as noted on Contract Drawings and interconnected with compression type fittings. All tubing shall be rigidly supported and run in horizontal or vertical planes. All pneumatic equipment shall be provided with separate shut-off valves. Flexible polyethylene tubing shall be used on all devices mounted on hinged doors, etc. A screened vent shall be provided on all enclosures using pneumatic instruments.

C. Print Storage Pockets: Print storage pockets shall be provided on the inside of each panel. Its size shall be sufficient to hold all of the prints required to service the equipment.

2.06 MAINTENANCE REQUIREMENTS

A. Maintenance Requirements of all supplied control panels and cabinets shall be in full conformance with the Contract Specifications and with Division 13 Contract Specification 13000 Section "Maintenance Requirements" and as specified herein.

B. Spare Parts: In addition to any spare parts required by the related contract specification sections, Provide the following spare parts where the associated item is included in the design of the control panel or cabinet being furnished under this specification:

1. All spare parts shall be new and unused.

2. All spare parts shall be individually packaged and labeled.

3. Materials shall be delivered in the manufacturer's original containers labeled to completely describe contents and equipment for which it is furnished.

4. Fuses: Provide 20 percent and no less than ten of each type and rating of fuse used in the panels specified in this section excluding those provided with individual instruments or devices.

5. Motor Starters: Provide two sets of thermal overloads for each size and type used. Provide one starter coil for each size and type used. Provide one overload relay of each size and type used.
6. General Purpose Relays: Provide 20 percent of each type used, but no less than five of each type or rating/style of relay.
7. Heavy Duty or Timing Relays: Provide 10 percent of each type used, but no less than one of each type.
8. Indicating Lamp Assembly: Provide one of each type.
9. Indicating Light Bulbs: Provide 20 percent but not less than 10 of each size, color, and type of each light bulb used in the panels specified in this section.
10. Selector Switch or Pushbutton: Provide 10 percent of each type used, but no less than one of each type.
11. DC Power Supplies: 20 percent of each size and type used, but no less than two of each size and type.
12. Panel Mounted Analog Indicator: Provide one of each type.
13. Electronic Controller: Provide one of each type.
14. Signal Conditioner or Isolator: Provide one of each type.
15. Control System Power Supply: Provide two of each type.
16. Control System I/O Cards: Provide two of each type.
17. Intrinsic Safety Barrier: Provide two of each type.
18. Surge Protective Device: 20 percent and no less than 5 of each type
19. Terminals: Provide 10 percent of each type of terminal used, but no less than five of each type.
20. Corrosion Protector: Provide 20 percent and no less than 5 of corrosion protector.
21. One hand held programming module for each electronic controller type supplied (with carrying case and instruction manuals).
22. One copy of any programming software (including job specific program listing and programming manual) associated with any programmable electronic controller or signal conditioner being supplied.
23. Provide one gallon of touch-up paint, in one-quart containers, for each type and color used for all cabinets, panels, consoles, etc., supplied under this section.
24. The spares listed above shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Control Panels or I/O Cabinets supplied under this section shall be installed per the Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Controls – General Provisions" and Division 13 Contract Specification 13270 – "Surge and Lightning Protection".

B. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of control panels and I/O Cabinets shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of instrumentation and controls work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

C. Control panels and I/O Cabinets furnished under this specification shall be factory tested prior to shipment. Field installation shall consist only of setting the panel in place and making necessary electrical and pneumatic external connections.

D. The Instrumentation and Controls Subcontractor and/or Control System Subcontractor and/or Telemetry System Subcontractor shall be responsible for checking out grounding and other safe operation concerns for all supplied control panels, PLC hardware, and other sensitive electrical or electronic control system equipment prior to energization of temporary or permanent power supplies.

E. Instrumentation and Controls shall at all times during construction be adequately protected against mechanical injury, water damage, corrosion, dirt, dust and foreign material. Equipment equipped with internal electrical heaters shall have them energized to keep the equipment dry. Doors to control panels and cabinets shall be kept closed at all times when work on them is not being done. Control Panels, Analyzers, sensitive electronic or computer equipment and/or controls or other materials not sealed and/or suitable for continuous outdoors storage shall not be stored out-of-doors. Such Instrumentation and Controls shall be stored in dry permanent shelters. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner, the damaged units or systems shall remain on site and returned to the manufacturer after the replacement units or systems have been delivered to the site. Under no circumstances will instrumentation or controls equipment damaged by water be rehabilitated or repaired; new equipment shall be supplied, and all costs associated with replacement shall be borne by the Contractor.

F. Any damage to factory applied paint finish shall be repaired using touch-up paint furnished by the instrument or equipment manufacturer. The entire damaged enclosure panel or section shall be repainted per the field painting specification Section 09900, at no additional cost to the Owner.

3.02 INSPECTION AND TESTING

A. Control Panels or I/O Cabinets supplied under this section shall be inspected and tested per the Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Controls – General Provisions" and Division 13 Contract Specification 13270 – "Surge and Lightning Protection".

B. Test all instrumentation and control system components furnished under this Specification and repair or replace all defective equipment or work. Make all necessary adjustments and instruct the Owner's personnel in the proper operation of the instrumentation and controls provided.

C. All control panels and cabinets associated with the Control System and/or Telemetry System shall have a 100 % point to point wiring checkout prior to being shipped from vendor or panel fabricator. Engineer and/or Owner shall have to opportunity to witness all testing.

D. Test grounding and verify any other safe operation concerns associated with all supplied control panels, PLC hardware, intrinsic safety equipment, and other sensitive electrical or electronic control system equipment prior to energization. Supplier shall certify that the grounding and installation is in conformance with the manufacturer's warranty requirements prior to providing temporary or permanent power to any supplied equipment. Submit copies of certified installation and grounding test reports.

E. Prior to plant operation, test all instrumentation, controls, and interlocks to verify that the instrumentation and control systems will function properly and as indicated by the Contract Drawings and as noted in the approved shop drawings. Verify wiring installation against loop sheets and interconnect wiring. Verify software I/O addressing and configuration against detailed software engineering documents. Virtual I/O communication links shall be tested and verified for fully functionality per approved PLC or DCS Software Submittals.

F. All testing shall be scheduled and coordinated by the Contractor. Notify the Engineer and Owner at least two (2) weeks in advance of conducting tests. The Contractor or Subcontractors under this Division shall have qualified personnel present during all testing.

G. All test data and procedures followed during testing shall be logged, and certified copies of the logs shall be provided to the Engineer and Owner.

3.03 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner or clean lint-free rags. Do not use compressed air.

3.04 TRAINING

A. Control Panels or I/O Cabinets supplied under this section shall be incorporated in the overall training plan as required by the Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Controls – General Provisions".

TABLE OF REQUIRED CONTROL PANELS

SITE/ LOCATION	PANEL TAG NO.	SERVICE	PANEL TYPE	PANEL SIZE	LOCATION / REMARKS
Remote Level Monitoring Manhole	LCP-120	Remote Level Monitoring Manhole Level Monitoring Panel	Front Access – Wall Mounted (Instrument Rack)– NEMA 4X 316 Stainless Steel	24"H x 16"W x 10"D MINIMUM	SEE ELECTRICAL DRAWINGS
Diversion Facility Electrical Building	LCP-201	Diversion Wet Well # 1 Level Monitoring Panel	Front Access – Wall Mounted – NEMA 12 Painted Steel	24"H x 16"W x 10"D MINIMUM	SEE ELECTRICAL POWER PLAN E3-103
Diversion Wet Well # 1	LCP-210	Diversion Wet Well # 1 Gas Monitoring Panel	Front Access – Wall Mounted (Instrument Rack)– NEMA 4X 316 Stainless Steel	24"H x 24"W x 10"D MINIMUM	SEE ELECTRICAL POWER PLAN E3-103
Diversion Facility Electrical Building	LCP-301	Diversion Wet Well # 2 Level Monitoring Panel	Front Access – Wall Mounted – NEMA 12 Painted Steel	24"H x 16"W x 10"D MINIMUM	SEE ELECTRICAL POWER PLAN E3-103

SITE/ LOCATION	PANEL TAG NO.	SERVICE	PANEL TYPE	PANEL SIZE	LOCATION / REMARKS
Diversion Wet Well # 2	LCP-310	Diversion Wet Well # 2 Gas Monitoring Panel	Front Access – Wall Mounted (Instrument Rack)– NEMA 4X 316 Stainless Steel	24"H x 24"W x 10"D MINIMUM	SEE ELECTRICAL POWER PLAN E3-103
Diversion Facility Electrical Building	PLC-101	Diversion Facility Local Control Panel (PLC Control System)	Front Access – Floor Mounted – NEMA 12 Painted Steel	72"H x 60"W x 18"D MINIMUM	SEE ELECTRICAL POWER PLAN E3-103
Equalization Facility Electrical Building	PLC-201	Equalization Facility Local Control Panel (PLC Control System)	Front Access – Floor Mounted – NEMA 12 Painted Steel	72"H x 60"W x 18"D MINIMUM	SEE ELECTRICAL POWER PLAN E7-103
Diversion Facility Electrical Building	LCP-3	Remote Level Monitoring RTU Communication Panel	Front Access – Wall Mounted – NEMA 12 Painted Steel	24"H x 16"W x 10"D MINIMUM	SEE ELECTRICAL POWER PLAN E3-103

SITE/ LOCATION	PANEL TAG NO.	SERVICE	PANEL TYPE	PANEL SIZE	LOCATION / REMARKS
Diversion Facility Odor Control Scrubber OC-401	OCGMP-410	Diversion Facility Odor Control Gas Monitoring Panel	Front Access – Wall Mounted (Instrument Rack)– NEMA 4X 316 Stainless Steel	24"H x 24"W x 10"D MINIMUM	SEE ELECTRICAL POWER PLAN E3-103 ??
Equalization Facility Odor Control Scrubber OC-501	OCGMP-510	Equalization Facility Odor Control Gas Monitoring Panel	Front Access – Wall Mounted (Instrument Rack)– NEMA 4X 316 Stainless Steel	24"H x 24"W x 10"D MINIMUM	SEE ELECTRICAL POWER PLAN E8-101

END OF SECTION 13200

SECTION 13250
CONTROL PANEL COMPONENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. The provisions and requirements of Division 13, Section 13000 "General Provisions" of this Specification shall apply to the work specified in this section.

C. The furnishing and fabricating of control panels associated with this Specification shall be as specified in Division 13, Section 13200 "Control Panels".

1.02 SUMMARY

A. This Section covers the specification of miscellaneous components associated with Control Panels and I/O Cabinets furnished and installed under other Contract specifications.

1.03 REFERENCE STANDARDS

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Reference Standards" and as specified herein.

1.04 QUALITY ASSURANCE

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Quality Assurance" and as specified herein.

1.05 SUBMITTALS

A. In accordance with the General Conditions and the Special Conditions of the Contract and with Contract Specifications 13000 and 13200, submit to the Engineer project specific and identified product data sheets for each component to demonstration compliance with submittal requirements of the Contract:

1.06 WARRANTY

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Warranty" and as specified herein.

PART 2 - PRODUCTS

2.01 PILOT-TYPE INDICATING LIGHTS - INCANDESCENT

A. Type: Indicating Light - Heavy duty, industrial grade, oil tight unit that utilizes a low voltage incandescent lamp with a push-to-test feature.

B. Lamp: Low voltage (6V) incandescent lamp with integral reduced voltage transformer. Lamp shall be field replaceable from front of the unit.

C. Lamp/Lens Color: Color of Lamp or Lens shall be as indicated on the instrument index.

D. Mounting: Single Hole, 30.5 mm NEMA, Octagonal-mounting ring.

E. Enclosure: Units shall be rated NEMA 13 for indoor panels. Units located outdoors, and indoor process areas, or indicated to be weatherproof shall be rated NEMA 4X.

F. Accessories: Provide legend faceplate engraved to indicate the required function of each device. Provide stackable sealed contact blocks when used for illuminated pushbutton station.

G. Acceptable Manufacturers: Allen Bradley (800H series), General Electric, Honeywell Micro-Switch, Schneider Electric (Square D Class 9001), or approved equal.

2.02 PILOT-TYPE INDICATING LIGHTS - LED

A. Type: Indicating Light - Heavy duty, industrial grade, oil tight unit that utilizes a low voltage lamp with a push-to-test feature.

B. Lamp: 6V Light Emitting Diode (LED) type (High visibility Multi-LED cluster) with integral reduced voltage transformer. Lamp shall be field replaceable from front of the unit.

C. Lamp/Lens Color: Color of LED(s) shall be as indicated on the instrument index. LEDs available only in RED, GREEN, WHITE, BLUE and AMBER (YELLOW).

D. Mounting: Single Hole, 30.5 mm NEMA, Octagonal-mounting ring.

E. Enclosure: Units shall be rated NEMA 13 for indoor panels. Units located outdoors, and indoor process areas, or indicated to be weatherproof shall be rated NEMA 4X.

F. Accessories: Provide legend faceplate engraved to indicate the required function of each device. Provide stackable sealed contact blocks when used for illuminated pushbutton station.

G. Acceptable Manufacturers: Allen Bradley (800H series), General Electric, Honeywell Micro-Switch, Schneider Electric (Square D Class 9001), or approved equal.

2.03 PUSHBUTTONS

A. Type: manually operated pushbutton station. Heavy-duty operator, industrial grade, oil tight unit with or without pilot type illumination.

B. Operator: Provide momentary flush head operator for "START" or "STOP" pushbuttons. Provide maintained mushroom head operator for "E-STOP" pushbutton.

C. Contact Blocks: Provide stackable sealed heavy-duty contact blocks. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC. Provide NO and NC Contact blocks as required per individual application.

D. Panel Mounting: Single Hole, 30.5 mm NEMA, Octagonal-mounting ring.

E. Enclosure: Units shall be rated NEMA 13 for indoor panels. Units located outdoors, and indoor process areas, or indicated to be weatherproof shall be rated NEMA 4X.

F. Accessories: Provide legend faceplate engraved to indicate the switch position / required function of each device. Provide key locked operators, padlockable covers, guards, etc, as indicated on the instrument index.

G. Acceptable Manufacturers: Allen Bradley (800H series), General Electric, Honeywell Micro-Switch, Schneider Electric (Square D Class 9001), or approved equal.

2.04 SELECTOR SWITCHES

A. Type: manually operated selector switch station. Heavy-duty operator, industrial grade, oil tight unit.

B. Operator: Provide knob or handle type manual operator. Operator for "Jog" positions shall be spring return. Number of switch positions, operator type, and number and type of contacts for each position shall be as required for each individual application.

C. Contact Blocks: Provide stackable sealed heavy-duty contact blocks. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC. Provide make-before-break bridging contacts where required. Provide NO and NC Contact blocks as required per individual application.

D. Panel Mounting: Single Hole, 30.5 mm NEMA, Octagonal-mounting ring.

E. Enclosure: Units shall be rated NEMA 13 for indoor panels. Units located outdoors, and indoor process areas, or indicated to be weatherproof shall be rated NEMA 4X.

F. Accessories: Provide legend faceplate engraved to indicate the switch position / required function of each device. Provide key locked operators, padlockable covers, guards, etc, as indicated on the instrument index.

G. Acceptable Manufacturers: Allen Bradley (800H series), General Electric, Honeywell Micro-Switch, Schneider Electric (Square D Class 9001), or approved equal.

2.05 SQUARE-TYPE SELECTOR SWITCHES/PUSHBUTTONGS WITH MULTI-LIGHT INDICATORS

A. Type: Integral multi-position selector switches or pushbutton station with illuminated, multiple lamp assembly. Assembly to be oil tight with square engraved display windows.

B. Operator: Provide knob type manual operator. Operator for "Jog" positions shall be spring return. Number of switch positions, operator type, and number and type of contacts for each position shall be as required for each individual application.

C. Contact Blocks: Provide stackable sealed heavy-duty contact blocks. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC. Provide NO and NC Contact blocks as required per individual application.

D. Lamp: Low voltage incandescent Lamp or multi-chip LED indicator with integral reduced voltage transformer. Lamp shall be field replaceable from front of the unit.

E. Lamp/Window Color: Color of Lamp(s) and/or display window(s) shall be as indicated on the instrument index.

F. Panel Mounting: Square Cutout, held to panel via assembly screw clamps from rear of panel.

G. Enclosure: Units shall be rated NEMA 13 for indoor panels.

H. Accessories: Provide display window engraved to indicate the switch position / required function of each device. Provide Color inserts in lieu of colored lamps as required.

I. Acceptable Manufacturers: Honeywell Micro-Switch CMC Series or approved equal.

2.06 POTENTIOMETERS

A. Type: Heavy duty, precision variable resistance device.

B. Specification: Three wire type Potentiometers with a total resistance of 1,000 ohms. Units shall be rated for at least 2 watts. Linearity shall be plus or minus 5 percent.

C. Mounting: circular mounting hole, inserts from rear of panel with octagonal mounting nut and lock washer.

D. Accessories: Provide a legend plate with resolution of 1 percent of entire span of potentiometer.

E. Acceptable Manufacturers: Allen Bradley, General Electric, Honeywell Micro-Switch, or approved equal.

2.07 ELAPSED RUN TIME METERS

A. Type: Six (6) digit, non-reset type electromechanical counter with quartz-crystal time base.

B. Specification: A six (6) digit, non-resetable elapsed time meter shall be connected to the 120VAC control circuit of each motor starter to indicate the total running time of each pump/motor in "hours" and "tenth of hours".

C. Mounting: Rectangular/Circular hole, Inserts in hole thru panel, held to panel front via screw clamps from rear of panel.

D. Enclosure: Units shall be rated NEMA 12 for indoor panels. Units located outdoors, and indoor process areas, or indicated to be weatherproof shall be rated NEMA 4X.

E. Accessories: provide gasket kit when mounting in NEMA 12 and NEMA 4/4X control panels.

F. Acceptable Manufacturers: ENM Company Series T50, or approved equal.

2.08 CIRCUIT BREAKERS

A. Type: Thermal Magnetic type circuit breakers to protect individual control circuits from shorts or device failures.

B. Specification: Molded case, finger safe, thermal-magnetic trip type. Provide visual indication of breaker position – ON/CLOSED and OFF/OPEN. Circuit breaker requires manual reset to the

ON/CLOSED position. All current carrying parts shall be copper. Provide type HACR circuit breakers for protection of circuits supplying heating, air-conditioning or refrigeration units. Provide type HID circuit breakers for protection of circuits supplying fluorescent, mercury vapor, metal halide, or high pressure sodium fixtures. Where ground fault interrupter or ground fault circuit interrupter circuit breakers are specified/required, they shall be of the type which provides protection for people; these shall trip on a fault of 6 milli-amperes or greater. Number of Poles, Voltage rating, and Current trip setting, and interrupting current rating per application. Circuit Breakers to be labeled in accordance with UL 489.

C. Mounting: Surface mount or Snap-on to "DIN" style mounting rail or as specified.

D. Enclosure: NEMA 1 where located inside a control panel or NEMA 3R if exposed to weather/rain.

E. Accessories: Provide auxiliary status contacts where required. Provide shunt trip where specified.

F. Acceptable Manufacturers: Allen Bradley, General Electric, Siemens, Schneider Electric (Square D), or approved equal.

2.09 HEAVY-DUTY INDUSTRIAL CONTROL RELAYS

A. Type: Heavy Duty, Machine tool type, continuous duty coil, suitable for switching inductive loads at up to 600 VAC.

B. Coil: 120VAC (or other voltage when specified) continuous duty coil. Provide Surge Suppressor across coil.

C. Contact Blocks: Provide convertible contacts (NO or NC contacts) rated for at least 10 Amps Continuous (6 Amps Break) at 600VAC (NEMA A600 Rating). Provide NO and NC Contact blocks as required per individual application.

D. Panel Mounting: Surface mounting relay base.

E. Enclosure: Vendor standard with screw type wiring terminals.

F. Accessories: Provide timing delays or latching attachments as required by the control schemes shown on the Drawings.

G. Time Delays: Pneumatic time delay relays shall be used on time delays less than 180 seconds and shall be adjustable. Solid-state time delay relays shall be used on time delays between 180 seconds and one hour.

H. Acceptable Manufacturers: Allen Bradley (700-P), General Electric (CR120 series), Siemens, Schneider Electric (Square D Class 8501 Type X), or approved equal.

2.10 GENERAL PURPOSE CONTROL RELAYS

A. Type: General Purpose, Industrial grade, suitable for switching low voltage AC or DC circuits.

B. Coil: 120VAC (or other voltage when specified) continuous duty coil with integral indicating light (LED preferred) to indicate if relay is energized. Unit shall be rated for at least 100,000 operations at rated loads.

C. Contact Blocks: Provide at least two form C contacts – DPDT relay contacts – as a minimum. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC.

D. Panel Mounting: Surface Mount Relay Base with relay hold-down spring.

E. Enclosure: Polycarbonate Dust Cover with 8 Pin (DPDT contacts) or 11 pin (3PDT contacts) plug-in socket style relay enclosure. Relay base shall have screw type wiring terminals.

F. Accessories: Provide pneumatic timing or latching attachments as required by the control schemes shown on the Drawings. Provide for push to test functionality.

G. Time Delays: Solid state time delays shall be provided with polarity protection (DC units) and transient protection.

H. Acceptable Manufacturers: Allen Bradley (700-HA), General Electric (CR420 series), IDEC, Potter & Brumfield (KAP or KUP series), Siemens, Schneider Electric (Square D Class 8501 Type K), or approved equal.

2.11 HEAVY-DUTY INDUSTRIAL TIMING RELAYS

A. Type: Heavy Duty, Machine tool type, continuous duty coil, suitable for switching inductive loads at up to 600 VAC. Relay contacts to be switched based on chosen timing function.

B. Coil: 120VAC (or other voltage when specified) continuous duty coil. Provide Surge Suppressor across coil.

C. Contact Blocks: Provide convertible contacts (NO or NC contacts) rated for at least 10 Amps Continuous (6 Amps Break) at 600VAC (NEMA A600 Rating). Provide NO and NC Contact blocks as required per individual application.

D. Panel Mounting: Surface mounting relay base.

E. Enclosure: Vendor standard with screw type wiring terminals.

F. Accessories: Provide visual indication (LED indicator preferred) that timing function is on going.

G. Time Delays: Pneumatic time delay relays shall be used on time delays less than 180 seconds and shall be adjustable. Solid-state time delay relays shall be used on time delays between 180 seconds and one hour. Time delay shall be adjustable within the specified timing range. Repeatability shall be plus/minus 1%.

H. Timing Modes

1. Provide Time Delay Function as specified in the Contract Drawings. Below is a summary of the timing functions to be supplied. To facilitate control logic changes and to minimize the Owner's inventory, provide multi-function type solid-state timing relays except when specifically specified otherwise. Provide instantaneous and/or time delay type relay contacts

as specified. If not specified, only time delay contacts shall be provided. Instantaneous contacts shall change position as soon as the timing function is initiated and time delay contacts shall change position only as dictated by the timing function.

2. ON Time Delay. Timing Contacts remain in shelf position, till control signal has remained "ON" (logic input = "true") for a specified, adjustable period of time, only after control signal has been "ON" for the full timing interval shall the timing contacts change "state". Timer resets to shelf position when control signal turns "OFF" (logic input = "false") or control power is removed.

3. OFF Time Delay. Once the control signal has been turned from "OFF" to "ON" (logic input = "true"), the timing contacts shall immediately change from shelf position and the timer shall running. The timing contacts shall not return to the shelf position until the control signal has been turned "OFF" (logic input = "false") for a specified, adjustable period of time. Resetting of control input ("ON" to "OFF" to "ON" transition) shall reset the timing period.

4. ONE-SHOT Time Delay (Latching Interval Time Delay). After the reset time (fixed delay before timer "resets" to self position) when the control signal has turned from "OFF" to "ON" (logic input = "true"), the timing contacts shall immediately change from shelf position. The timing contacts shall not return to the shelf position for a specified, adjustable period of time. Timer shall not reset till after the timing period has completed even if the control signal changes back to the "OFF" (logic input = "false").

5. Interval Timer: Once the control signal has been turned from "OFF" to "ON" (logic input = "true"), the timing contacts shall immediately change from shelf position. After the specified, adjustable time period of time, the timing contact shall return to its shelf position and the timer will automatically reset. Timer shall reset if control signal changes back to "OFF" (logic input = "false") or if the timing period expires.

6. Repeat Cycle Timer (ON and OFF Time Delay): Timing Relay switches from shelf to energized positions. ON and OFF time delays shall be individually adjusted or change be set independently depending on the relay – Provide the type specified on the Contract Drawings – Provide separate ON and OFF time delays as a default. During the OFF time delay, the timing contact remains in the shelf position. After the OFF time delay, the timing contact changes position and remains "energized" during the ON time delay period. The cycle will repeat till the control signal as long as the control signal (or power supply) remains "ON" (logic = "true"). The timing contact will return to shelf position when the control signal is switched "OFF".

I. Acceptable Manufacturers: Allen Bradley (700-PT or PS), General Electric (CR122 series), Siemens, Schneider Electric (Square D Type F or RE4), Tyco Electronics (Agastat 7000 Series, or approved equal.

2.12 GENERAL PURPOSE TIMING RELAYS

A. Type: General Purpose, Industrial grade, suitable for switching low voltage AC or DC circuits. Relay contacts to be switched based on chosen timing function.

B. Coil: 120VAC (or other voltage when specified) continuous duty coil with integral indicating light (LED preferred) to indicate if relay is energized. Unit shall be rated for at least 100,000 operations at rated loads.

C. Contact Blocks: Provide at least two form C contacts – DPDT relay contacts – as a minimum. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC.

D. Panel Mounting: Surface Mount Relay Base with relay hold-down spring.

E. Enclosure: Polycarbonate Dust Cover with 8 Pin (DPDT contacts) or 11 Pin (3PDT contacts) plug-in socket style relay enclosure. Relay to have pin or blade plug-in connections to the relay socket base. Relay base shall have screw type wiring terminals. Multi-function Solid State Timers are surface mounted with integral screw type wiring terminals.

F. Accessories: Provide visual indication (LED indicator preferred) that timing function is on going.

G. Time Delays: Provide Electromechanical or Solid State timing relays as specified on the Contract Drawings. If not specified, provide traditional electromechanical tubular relays with pin connections to relay socket. Time delay shall be adjustable and available in ranges from .1 second to 4.5 hours. Repeatability shall be plus/minus 1%. Reset time shall be less than 0.5 second.

H. Timing Modes

1. Provide Time Delay Function as specified in the Contract Drawings. Below is a summary of the timing functions to be supplied. To facilitate control logic changes and to minimize the Owner's inventory, provide multi-function type solid-state timing relays except when specifically specified otherwise. Provide instantaneous and/or time delay type relay contacts as specified. If not specified, only time delay contacts shall be provided. Instantaneous contacts shall change position as soon as the timing function is initiated and time delay contacts shall change position only as dictated by the timing function.

2. ON Time Delay. Timing Contacts remain in shelf position, till control signal has remained "ON" (logic input = "true") for a specified, adjustable period of time, only after control signal has been "ON" for the full timing interval shall the timing contacts change "state". Timer resets to shelf position when control signal turns "OFF" (logic input = "false") or control power is removed.

3. OFF Time Delay. Once the control signal has been turned from "OFF" to "ON" (logic input = "true"), the timing contacts shall immediately change from shelf position and the timer shall running. The timing contacts shall not return to the shelf position until the control signal has been turned "OFF" (logic input = "false") for a specified, adjustable period of time. Resetting of control input ("ON" to "OFF" to "ON" transition) shall reset the timing period.

4. ONE-SHOT Time Delay (Latching INTERVAL Time Delay). After the reset time (fixed delay before timer "resets" to self position) when the control signal has turned from "OFF" to "ON" (logic input = "true"), the timing contacts shall immediately change from shelf position. The timing contacts shall not return to the shelf position for a specified, adjustable period of time. Timer shall not reset till after the timing period has completed even if the control signal changes back to the "OFF" (logic input = "false").

5. Interval Timer: Once the control signal has been turned from "OFF" to "ON" (logic input = "true"), the timing contacts shall immediately change from shelf position. After the specified, adjustable time period of time, the timing contact shall return to its shelf position

and the timer will automatically reset. Timer shall reset if control signal changes back to "OFF" (logic input = "false") or if the timing period expires.

6. Repeat Cycle Timer (ON and OFF Time Delay): Timing Relay switches from shelf to energized positions. ON and OFF time delay settings shall be adjustable – both delays may be set for the same time delay value, total cycle time is adjustable as well as percentage ON Time, or both time delays can be set independently depending on the relay – Provide the type specified on the Contract Drawings – Provide separate ON and OFF time delays as a default. During the OFF time delay, the timing contact remains in the shelf position. After the OFF time delay, the timing contact changes position and remains "energized" during the ON time delay period. The cycle will repeat till the control signal as long as the control signal (or power supply) remains "ON" (logic = "true"). The timing contact will return to shelf position when the control signal is switched "OFF".

I. Acceptable Manufacturers: Allen Bradley (700-FS or HS), Cutler Hammer (TR Series), Danaher/Eagle Signal, General Electric, Potter & Brumfield (KAP or KUP series), Siemens, Schneider Electric (Square D Type JCK), Tyco Electronics (Agastat SSC Series), or approved equal.

2.13 INTRINSIC SAFETY RELAYS

A. Type: Specialty solid state protective relay to insure that the energy level associated with an electric circuit connecting thru an electrically "hazardous" area is always below the explosive limit of any potentially flammable gases or liquids that might be present in the area.

B. Design Criteria: Intrinsic Safety Relays shall be located in non-hazardous areas and shall be designed to provide personnel and equipment protection in accordance with National Electrical Code. See Contract Specification 13000 Section 2.03. Intrinsic Safety Relays shall be designed specifically for each individual circuit to be protected and shall be compatible with the circuit voltage and entity parameters of instrumentation and associated devices that are part of that circuit. Circuit Design Calculations to be submitted with each Intrinsic Safety Relay to be utilized.

C. Certification: Each Intrinsic Safety Relay to be certified by FM and UL as suitable for providing an auxiliary means of protection for the associated apparatus located in the specified electrically hazardous area classification associated with the electric circuit to be protected. Provide a copy of the Certification Information with each submittal.

D. Panel Mounting: Surface Mount or "DIN" style mounting rail.

E. Enclosure: Manufacturer Standard. Provide screw type wiring terminals.

F. Acceptable Manufacturers: Gems Sensor, MTL, Pepperl Fuchs, R Stahl, Turck, or approved equal.

2.14 ALTERNATING RELAYS

A. Type: General Purpose, Industrial grade, cycle timing relay, suitable for switching starting control circuit associated with two or more pumps in a common service. Running time associated with each pump shall be limited by the timer value to even the run-time for each motor/pump.

B. Coil: 120VAC (or other voltage when specified) continuous duty coil with integral indicating light (LED preferred) to indicate if relay is energized. Unit shall be rated for at least 100,000 operations at rated loads.

C. Contact Blocks: Provide two form C contacts – DPDT relay contacts – as a minimum (Duplex Pump Controls) or three form C contactors for Triplex Pumps, Quaternary Pump Alternators require four form C contacts. Contacts for 120VAC control circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for at least 5 Amps at

D. Panel Mounting: Surface Mount Relay Base with relay hold-down spring.

E. Enclosure: Polycarbonate Dust Cover with 8 Pin (DPDT contacts) or 11 pin (3PDT contacts) plug-in socket style relay enclosure. Relay base shall have screw type wiring terminals.

F. Time Delays: Solid state time delays shall be provided with polarity protection (DC units) and transient protection. Timer shall run continuous as long as the Pump Mode selector is left in the auto sequencing position.

G. Acceptable Manufacturers: ATC Diversified Electronics, Sta-Con, Time Mark, or approved equal.

2.15 PHASE MONITOR

A. Type: General Purpose, Industrial grade, protective relay to protect all motor starter circuits from damage from single phasing or other incoming power faults. Provide a Phase monitoring relay on each 480VAC power feed.

B. Protective Circuit: Three phase or single phase monitoring as appropriate. Three phase unites shall detect phase unbalance (adjustable setting), phase reversal, or low/high voltage. Phase monitoring relay shall be wired to the motor starter common trouble circuit to trip all associated motor starters when fault occurs.

C. Contact Blocks: Provide at least two form C contacts – DPDT relay contacts – as a minimum. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC.

D. Panel Mounting: Surface Mount Relay Base with relay hold-down spring.

E. Enclosure: Polycarbonate Dust Cover with 8 Pin (DPDT contacts) or 11 pin (3PDT contacts) plug-in socket style relay enclosure. Relay base shall have screw type wiring terminals.

F. Acceptable Manufacturers: ATC Diversified, General Electric, Schneider Electric (Square D Class 8430 Type MPS or RM3), Sta-Con, Time Mark, or approved equal.

2.16 FUSES – AC CONTROL POWER

A. Type: Non-renewable cartridge fuses; for short-circuit protection of AC power feeds to control panel components and wiring.

B. Fuse Type: Compatible with NEMA Standard FU 1, non-renewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit.

C. Fuse Applications:

1. For Incoming AC Power Feed service or Motor Branch circuit requirements see Division 16 Specification 16475 "Fuses".

2. Control Power Circuits (Motor starter controls): Class CC time-delay Bussmann CC-Tron FNQ-R or equivalent unless otherwise specified by the controls manufacturer or in the drawings.

3. General Purpose Instrumentation/Electronic Circuits: Fast Acting Bussmann AGC (¼" x 1-1/4" Glass Fuses) or Slow Blow Busmann MDL (1/4" x 1-1/4" Glass Fuses) where required or equivalent.

D. Installation: Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.

E. Accessories: Provide one fuse puller for each of the fuse sizes as necessary and recommended by the manufacturer.

F. Acceptable Manufacturers: Cooper Industries Inc., Bussman Div; General Electric Co, Wiring Devices Div; Gould Shawmut; Tracor Inc., Littelfuse, Inc. Subsidiary, or approved equal.

2.17 MISCELLANEOUS INSTRUMENTS AND CONTROLS

A. When required, miscellaneous panel mounted analog instrumentation, panel meters, controllers, timing relays, signal conditioners, and voltage/current switches shall be supplied as specified in Division 13 Specification 13300 "Instrumentation Specifications" or as specified elsewhere in the Contract Specifications.

2.18 RECEPTACLES

A. Provide duplex GFI (Ground Fault Interrupting) type convenience receptacle per Division 16 Specification 16141 "Wiring Devices" Paragraph 2.02. The convenience outlet shall be individually protected by a circuit breaker.

2.19 LIGHT SWITCH/DATA JACKS

A. Any internal AC power "wall switch" – i.e. for fluorescent light fixture - or Data Jack (telephone, Ethernet 10Base 2, Ethernet 10Base T, etc.) – wall type plug-in type receptacle - receptacle is to be supplied per Division 16 Specification 16141 "Wiring Devices".

2.20 MOTOR STARTERS

A. Any Manual or Magnetic Motor Starters included in Control Panels shall be supplied as specified in Division 16 Specification 16481 Section 2.04 (magnetic motor starters to be NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated). Provide individual flange mounted lockable disconnect to be located on the front of the associated control panel. Disconnect shall have (1) Provision to padlock unit disconnect handle in the OFF position, and (2) Mechanical interlock to prevent opening unit door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open. Additionally, for each motor starter, provide the following components on the front of the control panel as a minimum: (1) Run and Fault indicating lights, (2) fault reset pushbutton, and (3) non-resetable elapsed run time

meter. Provide laminated starter-wiring diagram and overload heater selection table adhered inside each control panel door.

2.21 CONTROL POWER TRANSFORMERS

A. Provide in accordance with Division 16 Specifications. Minimum Requirements: Two-winding type, 120 Volts AC secondary, fused in accordance with the NEC requirements. Control power transformers power transformers shall have two primary fuses and one secondary fuse. Control power transformers shall be sized to accommodate all loads within the control panel and shall have a minimum of 100 VA extra capacity for external relays, lights, etc.

2.22 LIGHTNING/SURGE SUPPRESSOR

A. All AC power feeds to control panels shall be protecting against lightning and power surge shall be required by the Contract Specifications including Division 13 Contract Specification 13270 "Surge and Lightning Protection". Additionally, Motor Starters furnished in Control Panels and/or other Cabinets furnished under this Specification shall additionally comply with the AC power surge protection requirements as specified in Division 16 Contract Specification 16445 "Surge Protective Devices for Low-Voltage Electrical Power Circuits."

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Components supplied under this section shall be installed and tested per the Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Controls – General Provisions" and Division 13 Contract Specification 13200 – "Control Panels".

B. Motor Starters located in Control Panels shall be tested per Division 16 Specifications including 16010 "Basic Electrical Requirements" and 16481 "Low Voltage Motor Control Centers".

END OF SECTION 13250

SECTION 13270
SURGE AND LIGHTNING PROTECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. The provisions and requirements of Division 13, Section 13000 "General Provisions" of this Specification shall apply to the work specified in this section.

C. The provisions and requirements of Division 16 Contract Specification 16445 "Surge Protective Devices for Low-Voltage Electrical Power Circuit" shall apply to the work specified in this section.

1.02 SUMMARY

A. This Section covers the provision for transient surge and lightning protective devices (surge protective devices) for all instrumentation and controls associated with this project.

B. Provide a surge protective device for each device that receives AC power and for each device that sends discrete or analog signals to/from the Control System and/or Telemetry System and for digital communication signals that interface to the Control System and/or Telemetry Systems.

C. Furnish all labor, supervision, materials, equipment and incidentals required to install, complete and ready for operation, the transient surge and lightning protection system described in this section and in accordance the Division 13, Section 13000 "General Provisions" of these Contract Specifications.

1.03 REFERENCE STANDARDS

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Reference Standards" and as specified herein.

B. The transient surge and lightning protection design, equipment, materials, and installation shall be provided in accordance with the Instrumentation Society of America (ISA) Standards and Recommended Practices, with the National Electrical Code (NEC), and with the latest edition of all codes and standards of the following organizations:

1. Federal Communications Commission (FCC), including (but not limited to):
   a. FCC Regulations Part 15 concerning radio frequency transmission and interference
2. Institute of Electrical and Electronics Engineers (IEEE), including (but not limited to):
   a. IEEE Standard C62.22- Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems.
   b. IEEE Standard C62.36 - Test Methods for Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits.
   c. IEEE Recommended Practice C62.41- Characteristics of Surges in Low Voltage AC Power Circuits.

d. IEEE Recommended Practice C62.45- Guide on Surge Testing for Equipment connected to Low Voltage AC Power Circuits.

e. IEEE Standard C62.64 - Specifications for Surge Protectors Used in Low-Voltage Data, Communications, and Signaling Circuits.

3. National Electrical Manufacturers Association (NEMA)
   a. ICS 1 - Industrial Control and Systems: General Requirements.
   b. ICS 2 - Industrial Control and Systems: Controllers, Contactors and Overload Relays, Rated Not More than 2000 Volts AC or 750 Volts DC.
   c. ICS 3 - Industrial Control and Systems: Factory Built Assemblies
   d. ICS 4 - Industrial Control and Systems: Terminal Blocks.
   e. ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   f. ICS 6 - Industrial Control and Systems: Enclosures.
   g. ICS 19 - Industrial Control and Systems: Diagrams, Device Designations, and Symbols.
   h. LS-1 - Low Voltage Surge Protection Devices.
   i. NEMA Standard 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

4. Underwriter's Laboratories (UL), including (but not limited to):
   a. UL 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
   b. UL 497 – Standard for Protectors for Paired Conductor Communications Circuits.
   c. UL 508 – Industrial Control Equipment.
   d. UL 698 – Industrial Control Equipment for use in hazardous areas.
   e. UL 1283 - Standard for Electromagnetic Interference Filters.
   f. UL 1363 – Standard for Relocatable Power Taps.
   g. UL 1449 – Standard for Transient Voltage Surge Suppressors.
   h. UL 1604 -Standard for Electrical Equipment for Use in Class I and II, Division 2, and Class III Hazardous (Classified) Locations.

5. All applicable state and local codes, amendments, regulations and practices.

6. Appropriate Authorities Having Jurisdiction.

C. Where codes and/or standards conflict, the most conservative document shall be followed.

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

A. The supplier of instrumentation and controls associated with this Division shall provide surge protective devices from a manufacturer that has been regularly engaged in the development, design, testing, and manufacturing of said devices for a period of five (5) years or more and whose products have been in satisfactory use in similar service. Upon request, suppliers or manufacturers shall provide a list of not less than three customer references showing satisfactory operation.

B. Actual installation of the equipment and materials specified by this Division need not be performed by employees of the supplier; however, the supplier shall be responsible for the on-site technical supervision of the installation.

C. The supplier shall furnish equipment and materials, which shall be the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.

1.05 SUBMITTALS

A. In accordance with the General Conditions and the Special Conditions of the Contract and with Contract Specification 13000, submit to the Engineering the following documentation to demonstration compliance with submittal requirements of the Contract:

B. Shop drawings including copies of all drawings, parts lists, product data, and other materials shall be submitted and shall include:

1. Installation Drawings and Details of surge protective devices to be installed in the field.
2. Complete Bill of Materials of all surge protective devices to be installed in the field. Bill of Materials shall reference installation drawings or details and shall include reference #, manufacturer, model number, description, and quantity for each item.
3. Project specific identified product data sheets for each component in the Bill(s) of Materials.
4. Instruction Manuals for each device containing device specifications and manufacturer installation and maintenance requirements.
5. Surge Protection Device certifications and test reports.
6. Complete list of Spare Parts, Expendables, and Test Equipment to be provided.

C. After Fabrication, Installation, and Testing are complete and approved, submit Record Documents per Contract Specification 13000 Section "Record Drawings".

D. After Record Drawings have been approved, submit Operation and Maintenance Manuals per Contract Specification 13000 Section "Operation and Maintenance Manuals".

1.06 WARRANTY

A. Provide a five (5) year replacement warranty for all materials supplied.

B. The surge protective device (SPD) and supporting components shall be guaranteed by the manufacturer to be free of defects in material and workmanship for a period of at least five (5) years from the date of substantial completion of service and activation of the system to which the suppressor is attached.

C. A Surge Protective Device (SPD) that shows evidence of failure or incorrect operation during the warranty period shall be replaced free of charge. Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPDs shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this section. That is, the warranty is to cover the effects of lightning, single phasing, and all other electrical anomalies. The warranty shall cover the entire device, not just various components,

such as modules only. Replacement of the surge protective device shall not be limited by the number of occurrences of failures during the warranty period.

D. The installation of surge protective devices (SPDs) in or on electrical distribution equipment and/or inline with or integral to instrumentation and controls shall in no way compromise or violate equipment listing, labeling, or warranty of the associated power distribution equipment and/or associated instrumentation and controls.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Transient Surge and Lightning protection shall be provided to protect all instrumentation and controls from induced voltages and power surges propagating along the discrete or analog signal and/or power supply lines or digital communication connection to the Control system and/or Telemetry system. The protection systems shall be such that the surge protective device shall not interfere with normal operation, but shall lower the induced voltage level or transient surge level to be less than the instrument's (or control device's) surge withstanding level, and shall be maintenance free and self-restoring.

B. The surge protection device (SPD) furnished under this Specification shall provide transient voltage surge suppression (TVSS) for the Instrumentation and Controls associated with or provided under this Division. The surge protective system device shall provide complete protection of all AC (power supply and discrete control signals) and DC (Control/Telemetry System discrete or analog signals or digital data communication signals) electrical circuits and associated electronic equipment from the effects of lightning induced voltages, external switching transients and internally generated switching transients.

C. All surge protection devices shall be suitable for the environmental conditions and electrical area classifications of the individual installation locations. Surge protective devices not inherently suitable for the environmental conditions and/or electrical area classification shall be mounted inside suitable enclosures to guarantee safe and long-term operation of said devices.

D. The supplier of instrumentation and controls associated with this Division shall provide with each instrument and control device the appropriate surge protective device as required by this Division. Instrumentation and Controls Subcontractor shall provide any additional surge protective devices, materials, supervision, installation, and testing if the supplier of any instrumentation and controls under the Contract Specifications does not satisfy the intent of this specification.

2.02 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with contract requirements, manufacturers offering Products that may be incorporated in the Work include, but are not limited to, the following:

1. AC Power Protection Devices (must comply with UL 1449):
   a. Emerson Electric/EDCO
   b. Advanced Protection Technologies.
   c. Eaton/Cutler-Hammer.
   d. Joslyn.

e. Innovative Technologies, Inc.
f. MCG Surge Protection.
g. MTL Surge Technologists (Telematic).
h. Northern Technologies or equal.

2. Discrete or Analog Signal Protection Devices (must comply with UL 497):
   a. Emerson Electric/EDCO
   b. Joslyn.
   c. MTL Surge Technologists (Telematic).
   d. Pepperl & Fuchs.
   e. Phoenix Contact or equal.

3. Digital (Data) Communication Line Protection Devices (must comply with UL 497):
   a. Emerson Electric/EDCO
   b. Joslyn.
   c. MCG Surge Protection.
   d. MTL Surge Technologists (Telematic).
   e. Northern Technologies.
   f. Pepperl & Fuchs.
   g. Phoenix Contact or equal.

B. City of Atlanta (COA) Preferred Applications: The following is a list of applications and default pre-approved transient surge protectors to be provided for the project (exceptions to these requirements shall be clearly noted and require prior approval before procurement and/or installation).

1. Field mounted transient surge protectors for analog signal circuits shall be EDCO SLAC Series suppressor for 4-wire analog signal transmitters mounted in the field.
2. Field mounted transient surge protectors for analog signal circuits shall be EDCO Series SS64/SS65 for field mounted 2-wire analog signal transmitters.
3. Panel mounted transient surge protectors for analog signal circuits shall be EDCO Series DRS din rail panel mounted.
4. Panel mounted transient surge protectors for AC power circuits shall be EDCO Model HSP121BT-1RU.

2.03 DESIGN

A. Remotely Mounted Protective Devices - Lightning and Transient Surge protection associated with in-line and field mounted instrumentation and controls shall be mounted within the instrument enclosure or within a separate external junction box closely-coupled to the instrument enclosure. Protective devices shall be as located as closely as possible to the instrument or control device being protected. External protective devices shall be housed in a suitable enclosure with proper grounding to ensure proper operation and personnel protection. External Enclosures for non-hazardous outdoors and wet locations shall be NEMA 4X rated. External enclosures for non-hazardous dry indoors locations shall be NEMA 12 rated. External enclosures for hazardous locations shall be NEMA 7 (Class 1 Indoors dry location), NEMA 8 (Class I Wet or Outdoors location), or NEMA 9 (Class II Indoors location) rated.

B. Protection of the AC Power Supply

1. Transient Surge / Lightning protection shall be provided for the AC power supplies to all instrument and controls. The surge protective device should meet IEEE C-62-41 Standards.

2. A dedicated isolation transformer shall protect the AC power feed to the Control System or Telemetry System equipment with individual surge protective devices associated with each individual piece of equipment or component. The isolation transformer shall be as provided by the Electrical Contractor as part of his scope of supply. AC isolation transformers shall have their neutral phase grounded per the National Electric Code to prevent damage to the instrumentation and controls from floating AC supply voltages.

3. The AC power feed to each inline or field mounted instrument or control panel, regardless of location (indoor or outdoor), shall be protected by series connected surge protective devices. Surge Protective Devices shall have external screw terminals for each phase, neutral, and ground and shall accept conductors size AWG #10 thru AWG #14.

4. Each surge protective device shall be a hybrid solid-state design that complies with UL Standard 1449 and that is maintenance free and auto-resetting. Each surge protective device may utilize metal oxide varistors (MOV's) or silicon avalanche diodes (SAD's). Each surge protective device should consist of more than one protective stage such failure of any protective stage shall not compromise the surge protection offered by the device. All internal components shall be hardwired utilizing low impedance connections.

5. The surge protective device shall include a high performance EMI/RFI noise rejection filter. The noise attenuation shall be no less than 45 dB at 100 KHz.

6. The surge protective device may contain have internal fusing for each suppression element. Failure of a single component shall not short-circuit or crowbar the power to connected loads.

7. Each surge protective device shall be designed to provide all modes of transient surge protections (i.e. for single phase AC, the surge protective device shall protect against surges from Line (L) to Neutral (N), from Line (L) to Ground (G), and from Neutral (N) to Ground (G)). The transient response of each device shall be less than 5 nanoseconds.

8. All surge protective devices shall be tested and certified to be in compliance with the IEEE 8x20 microsecond current wave surge suppression test per IEEE Standard C62.45. Surge protective device shall be rated for at least 18 kiloAmpere surge withstanding rating using the IEEE 8x20 microsecond current wave surge suppression test per IEEE Standard C62.45

9. The maximum let through voltage shall not exceed:
   a. 120/208 Volts Supply: 170/500 ANSI/IEEE Category B3/C3
   b. 277/480 Volts Supply: 300/900 ANSI/IEEE Category B3/C3

10. Maximum continuous operating voltage shall be greater than 115 percent of the nominal operating voltage.

11. The surge protective device shall monitor the online status of each stage of the surge protection system and power loss in any of the phases. Failure detection system shall monitor more than the status of each of the protective fuses, if provided. Long life individual component failure-indicators shall be provided on the front of the enclosure. Also provide remote failure alarm contacts – contacts shall be dry Form C type rated for 10 Amps at 120VAC.

C. Protection of Discrete and Analog Signal Lines

1. All discrete and analog signal lines wired to the control system (PLC, PC or DCS based I/O Cards) and any other new or reworked control panel shall be protected through the use of surge protective devices.
2. These surge protectors shall be provided at source and destination ends of these signal lines and as close to the instruments and controls as possible.
3. Each surge protective device shall be a hybrid solid-state design that complies with UL Standard 497 and that is maintenance free and instantly auto-resetting. Each surge protective design may include metal oxide varistors (MOVs) or silicon avalanche diodes (SADs), line to line and line to ground inductors, and Zener diodes or gas tube arrestors as appropriate. MOVs may only be utilized where the any MOV leakage current will not impair the receiving device's ability to accurately measure (within 0.1%) the signal being transmitted (especially when high input impedance I/O circuits are involved).
4. Surge protective device located in control panels shall be capable of being "DIN" railed mounted.
5. When plastic materials are used in the enclosures for surge protective devices, all plastics shall be tested for flammability per the UL flammability testing standard UL 94.
6. Each surge protective device shall be designed to provide all modes of transient surge protections (i.e. the surge protective device shall protect against surges from Line (L) to Line (L) and from each Line (L) to Ground (G)). The transient response of each device shall be less than 5 nanoseconds.
7. Surge protective devices with replaceable fuse and local disconnect shall be provided where called out on the Contract Drawings.
8. Field mounted Surge protective devices for 4 wire (analog) transmitters may utilize a single composite surge protective device that protects both the AC Power Source as well as the analog signal line.
9. All surge protective devices shall be tested and certified to be in compliance with the IEEE 8x20 microsecond current wave surge suppression test per IEEE Standard C62.45. Surge protective device shall be rated for at least 10 kiloAmpere surge withstanding rating using the IEEE 8x20 microsecond current wave surge suppression test per IEEE Standard C62.45.
10. Surge protective devices located in electrically hazardous areas shall be designed to be operated in the appropriate hazardous environment. Additional, such surge protective devices shall be certified as being acceptable to operate in the hazardous area per UL 1604 and shall be installed in full compliance with the National Electrical Code (NFPA 70).

D. Protection of Digital Communication Lines

1. All digital communication lines (telephone, RS-232, RS-485, Ethernet/LAN, coaxial RF – only applies to non-fiber optic connections) connected to the Control System and/or Telemetry system shall be protected through the use of transient surge and lightning protection devices.
2. These surge protectors shall be provided at source and destination ends of these digital communication lines and as close to protected device as possible.
3. Each surge protective device shall be a hybrid solid-state design that complies with UL Standard 497 and that is maintenance free and instantly auto-resetting. Each surge

protective design may silicon avalanche diodes (SADs), line to line and line to ground inductors, and Zener diodes or gas tube arrestors as appropriate. The surge protective device design shall not attenuate or misshape or limit the inherit frequency of any digital (data) communication signal being protected.

4. Each surge protective device shall be designed to provide all modes of transient surge protections (i.e. the surge protective device shall protect against surges from Line (L) to Line (L) (or Positive to Negative) and from each Line (L) to Ground (G)). The transient response of each device shall be less than 1 nanosecond.

2.04 MAINTENANCE REQUIREMENTS

A. Maintenance Requirements of all supplied control panels and cabinets shall be in full conformance with the Contract Specifications and with Division 13 Contract Specification 13000 Section "Maintenance Requirements" and as specified herein.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine equipment for compliance with contract documents and other conditions affecting performance of the transient voltage surge suppression and lightning protection system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install surge protective devices and connect or wire each surge protection device to the signal or power line being protected in according to manufacturer's written instructions.

B. Install surge protective device as close as physically possible to instrument or control device being protected for maximum protection and optimum performance. Remember that transient surge and lightning protection is required for both the signal-generating device (transmitter, etc.) and for the signal-receiving device (control panel or control system I/O card).

C. Grounding - Lightning and Transient Surge protection systems shall be properly grounded with ground wires for all surge protectors connected to a good earth ground. Where practical each ground wire shall be run individually and insulated from each other. All surge protective device grounds in common control panel or I/O cabinet shall be connected to the same grounding point. Grounding in such control panels or I/O Cabinets shall be individually run to dedicated isolated copper bus bar(s) before connection at a single point to a good earth ground.

D. If more than one surge protective device is connected in series, ensure that the final installation will not diminish the protection required (i.e. failure of one surge protective device will compromise the protection of the non-failed surge protective device(s), etc).

3.03 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to paint finishes with matching touch-up coating recommended by the manufacturer.

3.04 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture, unless moisture is permanently excluded from the junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.05 CLEANING

A. Upon completion of installation of system, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 13270

SECTION 13300
INSTRUMENTATION SPECIFICATONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. The provisions and requirements of Division 13, Section 13000 "General Provisions" of this Specification shall apply to the work specified in this section.

1.02 SUMMARY

A. This Section includes field instrumentation, analyzers and other controls components not specified in other sections of this Division.

B. Provide those instrumentation and controls as listed in the Drawings, P&IDs and Instrument Index that are not furnished by others.

C. Furnish all labor, supervision, materials, equipment and incidentals required to install, complete and ready for operation, the instrumentation and controls as described in this section and in accordance the Division 13, Section 13000 "General Provisions" of these Contract Specifications.

1.03 REFERENCE STANDARDS

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Reference Standards" and as specified herein.

1.04 QUALITY ASSURANCE

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Quality Assurance" and as specified herein.

1.05 SUBMITTALS

A. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. In accordance with the General Conditions and the Special Conditions of the Contract and with Contract Specification 13000, submit to the Engineer project specific and identified product data sheets for each component to demonstration compliance with submittal requirements of the Contract.

C. For all instruments and control devices, provide a complete Instrument Spec Sheet; vendor product information including Model Number breakdown; Product Data Cut sheets; Instruction Manuals; and sizing calculations where applicable.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Delivery, Storage, and Handling" and as specified herein.

1.07 PROJECT/SITE REQUIREMENTS

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Project/Site Requirements" and as specified herein.

1.08 WARRANTY

A. Supplier shall warrant all equipment provided under this Section to be free of defects in materials or workmanship for a period of at least one year starting on the date of substantial completion as defined in Section 7.3 of Archer-Western's Contract with Fulton County. In general, the substantial completion date will occur prior to commencement of the acceptance tests and 120-day Whole Plant Testing. Warranty periods will not start based on date of delivery of the equipment.

PART 2 - PRODUCTS

2.01 FIELD INSTRUMENTATION

A. Flow Transmitter – Magmeter

1. Type: Flow measurement utilizing the Farad principle for creation of an induced voltage when a moving conductor (process fluid) passes through a magnetic field. Induced voltage is proportional to the average velocity of the fluid.
2. Design Criteria: Provide low frequency Pulsed DC type electromagnetic induction type flow meter. Flow tube to be wafer style or flanged as specified. Flow meter to be factory pressure tested and flow calibrated (provide test report listing at least 3 test points). Transmitter shall be microprocessor based and shall provide linear output. Transmitter shall be field configurable (provide password protection). Transmitter shall have local display of level in Engineering Units. Transmitter shall be resistant to EMI/RFI interference. Transmitter can be integral to flow tube or remotely mounted (2" pipe mounting bracket) as specified. Provide grounding rings when utilized with lined or plastic pipe. Install grounding straps between flanges and flow meter body. Ground the flow meter body (and grounding rings if provided) as required by the manufacturer.
3. Materials of Construction: Flow tube to be epoxy painted carbon steel unless Stainless Steel is specified. Flow tube to be lined with a material recommend by the manufacturer for the intended service. The flow tube is typically lined with polyurethane for municipal water and

sewage service although other liners like neoprene rubber, Teflon, and ceramic may be required based on process conditions. Electrodes to be 316 Stainless Steel or other material selected for compatibility with process conditions and fluid. Transmitter enclosure to be NEMA 4X rated or as specified. Flow meter and transmitter to be suitable for operation in the associated area classification.

4. Process Connections: Wafer Body or Flanged per pipe spec. General Contractor or Mechanical Contractor to provide flange gaskets to prevent leakage.

5. Transmitter Output: 4 – 20 ma Current Loop (analog output) and/or pulsed DC when specified – provide HART Protocol or Foundation Fieldbus digital outputs when specified.

6. Accuracy: approximately +/- 0.25 % of reading for velocities above 3 feet per second. Flow Turndown: at least 10:1. Repeatability shall be greater than 0.25% of full scale.

7. Accessories: Remote transmitter mounting bracket and interconnect cabling (provide common spool of cable for all magmeter provided – include at least 30 feet of cable per flow meter – verify length with electrical contractor) when remote transmitter is specified. Transmitter shall provide pulsed DC output or remote input for driving output to 4 ma (zero) when specified. Where required, provide a continuous ultrasonic electrode cleaning system.

8. Mounting: Flow tube to be mounted between two pipe flanges. Provide liner protectors (grounding rings) when elastomers are used for liner material. General Contractor or Mechanical Contractor to provide flange gaskets to prevent leakage.

9. Acceptable Manufacturers: ABB Instrumentation, Endress and Hauser, Foxboro, Krohne, or equal.

10. Instrument Schedule:

Instrument Tag Number	Design Flow	Flow Units	Line Size	Process Connection	Area Classification	Notes
FE/FIT-210	0-45	MGD	36 inches	Flanged ?	Class 1 Div 2	Diversion Wet Well # 1 Discharge Flow
FE/FIT-310	0-45	MGD	36 inches	Flanged ?	Class 1 Div 2	Diversion Wet Well # 1 Discharge Flow
FE/FIT-503	0-40	MGD	48 inches	Flanged ?	Class 1 Div 2	Equalization Tank Discharge Flow
FE/FIT-510	0-2000	GPM	8 inches	Flanged ?	Class 1 Division 2	Equalization Tank Flushing Water Flow
FE/FIT-531	0- 7,000	GPM	16 inches	Flanged	Class 1 Div 2	Equalized Flow Return Pump # 1 Flow
FE/FIT-532	0- 7,000	GPM	16 inches	Flanged	Class 1 Div 2	Equalized Flow Return Pump # 2 Flow
FE/FIT-533	0- 7,000	GPM	16 inches	Flanged	Class 1 Div 2	Equalized Flow Return Pump # 3 Flow

11. Notes:
    a. Submit magmeter sizing calculations with instrument data sheet, instruction manual, installation guidelines, and dimensional drawing.
    b. Provide stainless steel tag with Tag Number.
    c. Consult with vendor to determine upstream and downstream straight run requirements depending on pipe arrangement.

B. Flow Transmitter –Open Channel – Flume

1. Type: Special ultrasonic level transmitter that has the ability to determine the flow rate thru a flume or weir by utilizing preprogrammed flow equations for the type and size of weir/flume whose liquid level is being measured.

2. Design Criteria: Flow transmitter shall be complete with ultrasonic transducer, transducer mounting hardware, ambient air temperature compensation, freeze protection (if required), transmitter, or other accessories required for continuous operation during all environmental conditions. Flow transmitter shall be a microprocessor-based design that is designed for open channel flow measurements and is pre-programmed to convert liquid level to volumetric flow rate for any associated standard weir or flume. Transmitter shall be able to compensate for false or intermittent echoes while providing transducer failure or loss of signal alarming. Transmitter shall have local display of level in Engineering Units. Transmitter shall be resistant to EMI/RFI interference.

3. Materials of Construction: Transducer body to be made from thermoplastic or similar material suitable for operating conditions. Mounting hardware to be 316 Stainless Steel or other material suitable for the operating environment. Display/Transmitter enclosure to be NEMA 4X rated or as specified. Complete flow transmitter installation including transducer, temperature elements (if provided), heaters (if provided), and transmitter shall be suitable for operation in the associated area classification.

4. Process Connections: Supplier shall mount transducer above flume's stilling well at a suitable height beyond the transmitter blanking distance. Complete details of the intended transducer installation and interconnect wiring shall be submitted for approval prior to actual installation.

5. Transmitter Output: 4 – 20 ma Current Loop (analog output) and/or discrete contact closures as specified – provide HART Protocol or Foundation Fieldbus digital outputs when specified.

6. Accuracy: approximately +/- 1 % of reading. Repeatability shall be greater than 0.25% of reading.

7. Accessories: Remote transmitter mounting bracket and interconnect cabling (include at least 30 feet of cable per flow meter – verify length with electrical contractor). Transmitter shall provide dry contacts or digital output when specified.

8. Mounting: Supplier shall mount transducer above flume's stilling well at a suitable height beyond the transmitter blanking distance. Transmitter shall be remotely mounted (2" pipe mounting bracket) from flume to provide local indication from an accessible location providing for routine maintenance.

9. Acceptable Manufacturers: ABB/Fischer & Porter, Siemens Automation (Milltronics Open Channel Meter OCM III or HydroRanger PLUS), Thermo Polysonics, or equal.

10. Instrument Schedule:

Instrument Tag Number	Design Flow	Flow Units	Weir / Flume Type	Area Classification	Notes

11. Notes:
    a. Submit instrument data sheet, instruction manual, installation guidelines, and dimensional drawing.
    b. Provide stainless steel tag with Tag Number.

c. Match flume flow transmitter calibration with associated flume design.

d. Provide visual level gauge beside flume inside manhole.

C. Flow Transmitter –Open Channel - Surface Radar

1. Type: Non-contact open channel flow measurement utilizing high frequency microwave doppler RADAR signal to determine the surface velocity of a fluid in an open channel with an ultrasonic level sensors to determine fluid height in the channel.

2. Design Criteria: Flow sensor shall be mounted above the normal maximum level of liquid in the channel. Flow sensor shall be rated for submerged operation with surcharge pressure sensor and surcharge electromagnetic sensor provided to supplement the integral ultrasonic level sensor and doppler radar sensor when it is reasonable and customary for the sensor to be flooded periodically (or level can go above the ultrasonic level transducer "blanking distance"). Flow meter to be supplied with all transducers, mounting hardware, cabling, remote transmitter, and all required accessories. Transmitter shall be microprocessor-based design that is designed to provide continuous self-diagnosis and shall provide linear output over the specified flow range. Volumetric flow measurement shall be calculated from surface radar flow signal (velocity) times measured liquid level using pre-programmed open channel geometry. Transmitter shall have provision to offset the level measurement (manual adjustment by plant maintenance) to compensate for sedimentation build-up over time. Transmitter shall have local display of level in Engineering Units. Transmitter shall be resistant to EMI/RFI interference. Transmitter shall be remotely mounted (2" pipe mounting bracket) in a non-hazardous location unless otherwise agreed upon with the Engineer. Typically used for open channel flow measurements where the degree of suspended solids over time would vary widely (limitation of ultrasonic doppler/transit time flow meters) and where there is significant possibility of trash in fluid stream causing damage to contact type flow measurements and where there is a sufficient possibility of sedimentation build-up prevent the proper operation of head type flowmeters (flumes or weirs).

3. Materials of Construction: Flow sensor enclosure shall be compatible (in case of submergence) with the process fluid in the open channel including potential dissolved gases or liquids. Metallic wetted parts to be made from 316 Stainless Steel or other material suitable for the operating environment and selected for compatibility with the process conditions and fluid. Mounting Hardware to be 316 Stainless Steel or other material suitable for the operating environment. Cable connection to the flow sensor connection shall be sealed and suitable for continuous operation in damp or occasionally low-level submerged service. Transmitter enclosure w/local Display to be NEMA 4X rated or as specified. Plastic/Polymer type transmitter enclosures located outdoors shall be coated with UV resistant coatings (provide Rain/Shield Shields as required). Complete flow meter installation including transducers and interconnect cabling shall be suitable for operation in the associated area classification.

4. Mounting: Flow sensor shall be mounted above the normal maximum level of liquid in the channel. Provide a Manhole to allow access to sensor and to allow sensor to be located above normal maximum liquid height in the open channel. Complete details of the intended transducer installation and interconnect wiring shall be submitted for approval prior to actual installation.

5. Transmitter Output: 4 – 20 ma Current Loop (analog output) (4 wire AC powered unless DC powered option agreed upon with the Engineer).

6. Accuracy: approximately +/- 5 of reading (over range of 0.75 fps to 20 fps).

7. Accessories: Flow Sensor and Remote Transmitter Mounting brackets and interconnect cabling– include at least 30 feet of cable per flow meter – verify length with electrical contractor). Transmitter shall provide pulsed DC or digital output when specified. Transmitter to be factory calibrated for bidirectional flow measurement as required. Sun and/or Rain Shields shall be provided for outdoor installations as required by Specification 13900.

8. Acceptable Manufacturers: Marsh McBurney (Flo-Dar) or equal.

9. Instrument Schedule:

Instrument Tag Number	Design Flow	Flow Units	Open Channel Dimensions	Area Classification	Notes
FE/FIT-110A	0 – 100	MGD	x feet wide x xx feet Deep with Sloped Section at bottom	Class 1 Division 1, Group D	a,b,c,d, e
FE/FIT-110B	0 – 100	MGD	x feet wide x xx feet Deep with Sloped Section at bottom	Class 1 Division 1, Group D	a,b,c,d,e

10. Notes:
    a. Submit flow meter sizing calculations with instrument data sheet, instruction manual, installation guidelines, and dimensional drawing.
    b. Provide stainless steel tag with Tag Number.
    c. Consult with vendor to determine upstream and downstream straight run requirements depending on open channel configuration.
    d. Include Surcharge Velocity Sensor
    e. Verify open channel dimensions with General Contractor prior to factory calibration of the transmitter. Provide step-by-step transmitter calibration setting sheet as part of the as-built installation submittal.

D. Flow Switch – Thermal

1. Type: Flow measurement that measures the amount of cooling that results then the fluid passes over a heated element. Temperature differential is proportional to the flow rate.

2. Design Criteria: Heater shall be customized for each specific application including whether fluid is liquid or gas. Typically used to detect loss of cooling water or ventilation failure.

3. Materials of Construction: Wetted parts shall be made from 316 SS or a material suitable for the process conditions and compatibility with the process fluid. Flow switch assembly to be rated NEMA 4X or as specified. Flow switch to be suitable for operation in the associated area classification.

4. Process Connections: 1" NPT.

5. Switch Contacts: Provide general-purpose snap action switches contacts - SPDT or DPDT as specified. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC.
6. Accuracy: Switching accuracy shall be +/- 0.5% of setpoint. Switching action shall be repeatable with /- 1 % of full-scale flow.
7. Accessories: Totalizer and/or transmitter, or remote mounting bracket when specified.
8. Mounting: Flow switches are inserted into smaller pipeline thru a threaded pipe "tee" or elbow. In larger lines, a threaded coupling is attached to the process piping. Flow switches must be orientated in the indicated direction of flow.
9. Acceptable Manufacturers: FCI, Static-O-Ring (T21 Series), or equal.
10. Instrument Schedule:

Instrument Tag Number	Flow Setting	Switch Contacts	Process Connection	Area Classification	Notes
FSL-415	Open @ 2000 SCFM Decreasing	SPDT	1" NPT	Class 1 Division 2	NONE
FSL-515A	Open @ 11,000 SCFM Decreasing	SPDT	1" NPT	Class 1 Division 2	NONE
FSL-515B	Open @ 11,000 SCFM Decreasing	SPDT	1" NPT	Class 1 Division 2	NONE

11. Notes:
    a. Submit flow meter data sheet, Instruction manual, Installation Guidelines, and dimensional drawing.
    b. Provide stainless steel tag with Tag Number.
    c. Consult with vendor to determine upstream and downstream straight run requirements depending on pipe arrangement.
    d. Confirm that heater size is suitable for fluid to be measured especially whether Liquid or Gas. Check for changes/fluctuations in heat capacity of the measured fluid.

E. Level Transmitter – Radar

1. Type: Level transmitter that uses the reflection of pulsed microwave energy off the surface of a liquid or powered solid to determine the height of the material in a vessel.
2. Design Criteria: Level transmitter shall be complete with radar antenna assembly, antenna mounting hardware, transmitter, or other accessories required for continuous operation during all environmental conditions. Guided Wave Radar should be used in place of pulsed wave radar when the measured fluid has low dielectric constant (< 2.0) or presence of foam (especially when it can coat the antenna on high liquid level) or for those applications where

excessive reflections could occur because of the number of objects in the vessel (ladders, agitators, pipes, etc). Transmitter shall be able to compensate for false or intermittent echoes while providing transducer failure or loss of signal alarming. Transmitter shall have local display of level in Engineering Units. Transmitter shall be resistant to EMI/RFI interference. Contractor shall supply FCC license where FCC Part 15 does not apply. Commonly used for non-contact liquid level measurements (works with some solids measurements) especially where ultrasonic measurement is inaccurate due to the presence of foam, dust, vessels under vacuum, etc. Works best when measuring slightly conductivity materials and those substances with a dielectric constant > 2.0 to guarantee strong fluid reflections that are accepted over false echoes. 4 wire transmitters have more pulses per second and are thereby preferred for difficult applications.

3. Materials of Construction: Mounting flange and transmitting rod/cone/guide wave shall be made from a material suitable for the process conditions and selected for compatibility with the process conditions and fluid. Provide Teflon coating if the flange/transmitter cone/rod materials or antenna seals are not compatible with the process fluid. Display/Transmitter enclosure to be NEMA 4X rated or as specified. Remote antenna assembly (if separate) and Transmitter to be suitable for operation in the associated area classification.
4. Process Connections: Threaded (typical for Guide Wave applications) or Flanged as required. Conventional pulsed radar antennas should be mounted above maximum liquid level at a suitable height beyond the transmitter's blanking distance. Complete details of the intended transmitter installation and interconnect wiring shall be submitted for approval prior to actual installation.
5. Transmitter Output: 4 – 20 ma Current Loop – provide HART Protocol or Foundation Fieldbus digital outputs when specified.
6. Accuracy: approximately +/- 0.1 inch. Repeatability shall be greater than 0.25% of reading.
7. Accessories: Remote display and interconnect cabling (include at least 30 feet of cable per level transmitter – verify length with electrical contractor) where specified. Transmitter shall provide digital output when specified.
8. Mounting: Supplier shall coordinate the transducer location to minimize false echoes from vessel walls and other obstructions in the path of the radar beam in accordance with the manufacturer's recommendations. When specified, Remote display may be required (2" pipe mounting bracket) to provide local indication from an accessible location.
9. Acceptable Manufacturers: Endress and Hauser, Krohne, Ohmart Vega, or equal.
10. Instrument Schedule:

Instrument Tag Number	Level Range	Level Units	Temperature Compensation	Area Classification	Notes
LIT201	0 – 39 Bottom El. 785 to top of concrete at 824 feet EL	Feet	YES	Class 1 Div. 1	Diversion Wet Well # 1 Level
LIT202	0 – 39 Bottom El. 785 to top of concrete at 824 feet EL	Feet	YES	Class 1 Div. 1	Diversion Wet Well # 1 Level
LIT301	0 – 39 Bottom El. 785 to top of concrete at 824 feet EL Weir xxx Ft	Feet	YES	Class 1 Div. 1	Diversion Wet Well # 2 Level
LIT302	0 – 39 Bottom El. 785 to top of concrete at 824 feet EL	Feet	YES	Class 1 Div. 1	Diversion Wet Well # 2 Level
LIT501	0 – 61 Bottom El. 796.5 to 1 foot above overflowr 856 Ft EL	Feet	YES	Class 1 Div. 1	Equalization Tank Level (note about 75 Feet from bottom of tank to nozzle on top of tank)

11. Notes:
    a. Submit instrument data sheet, instruction manual, installation details, and dimensional drawing.
    b. Provide stainless steel tag with Tag Number.

F. Level Transmitter – Ultrasonic

1. Type: Level transmitter that used the reflection of high frequency sound waves off the surface of a liquid or powered solid to determine the height of the material in a vessel.

2. Design Criteria: Level transmitter shall be complete with ultrasonic transducer, transducer mounting hardware, ambient air temperature compensation, freeze protection (if required), transmitter, or other accessories required for continuous operation during all environmental conditions. Transmitter shall be able to compensate for false or intermittent echoes while providing transducer failure or loss of signal alarming. Transmitter shall have local display

of level in Engineering Units. Transmitter shall be resistant to EMI/RFI interference. Commonly used for non-contact liquid level measurements. Typically used to measure the level of liquids or powered solids in bulk storage tanks – non-contact measurement for corrosive environments.

3. Materials of Construction: Transducer body to be made from thermoplastic or similar material suitable for operating conditions. Mounting hardware to be 316 Stainless Steel or other material suitable for the operating environment. Display/Transmitter enclosure to be NEMA 4X rated or as specified. Complete level transmitter installation including transducer, temperature elements (if provided), heaters (if provided), and transmitter shall be suitable for operation in the associated area classification(s).

4. Process Connections: Supplier shall mount transducer above maximum liquid level at a suitable height beyond the transmitter's blanking distance. Complete details of the intended transducer installation and interconnect wiring shall be submitted for approval prior to actual installation.

5. Transmitter Output: 4 – 20 ma Current Loop (analog output) and/or discrete contact closures as specified – provide HART Protocol or Foundation Fieldbus digital outputs when specified.

6. Accuracy: approximately +/- 0.25 % of full scale. Repeatability shall be greater than 0.1% of full scale.

7. Accessories: Remote transmitter mounting bracket and interconnect cabling (include at least 30 feet of cable per level transmitter – verify length with electrical contractor). Transmitter shall provide dry contacts or digital output when specified.

8. Mounting: Supplier shall mount transducer above maximum liquid level at a suitable height beyond the transmitter's blanking distance. Supplier shall coordinate the transducer location to minimize false echoes from vessel walls and other obstructions in the path of the ultrasonic beam from the transducer in accordance with the manufacturer's recommendations. Transmitter shall be remotely mounted (2" pipe mounting bracket) from transducer to provide local indication from an accessible location providing for routine maintenance.

9. Acceptable Manufacturers: ABB, Siemens Automation (Milltronics MultiRanger PLUS or HydroRanger PLUS), Endress and Hauser, Magnetrol, Ohmart Vega, or equal.

10. Instrument Schedule:

Instrument Tag Number	Level Range	Level Units	Mounting Method	Area Classification	Notes
LIT-120A	0 – 90	Inches	YES	Class 1 Division 1	A,B, C
LIT-120B	0 - 90	Inches	YES	Class 1 Division 1	A,B,C

11. Notes:
    a. Submit instrument data sheet, instruction manual, installation details, and dimensional drawing.

b. Provide stainless steel tag with Tag Number.

c. Remote Level Monitoring Manhole application requires very narrow beam angle ultrasonic sensor (about 6 degrees) in order to fit two level sensors in the same existing manhole without interference between the two level measurements.

G. Level Switch – Float

1. Type: Level switch that uses the buoyancy of a float attached to the level switch mechanism to detect a rising or falling level of liquid in a vessel. At a pre-set liquid level, this level switch shall close/open a set of contact(s) to generate an alarm or initiate a process action.

2. Design Criteria: Float activated switch mechanism. Float material shall be buoyant in the liquid to be measured including normal variations in the specific gravity of the measured fluid. Wetted parts of the switch mechanism shall be compatible with the process fluid including any dissolved gases – 316 SS default. Switch mechanical shall operate smoothly and reliably under all process conditions. Provide Bellows seal where required in particularly dirty environments. Switch module shall be hermetically sealed. Switching mechanisms using mercury shall not be provided. Float level switches are a cheap and reliable method of measuring the level of liquids in sumps or tanks. Provide intrinsic safety barriers where located in hazardous locations.

3. Switch Contacts: Provide SPDT or DPDT switch contacts as specified. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC. Provide hermetically sealed contacts unless otherwise specified.

4. Switch Setting and Reset Dead band: Provide information on switch set and reset movement requirements. Dead band to be approximately 1 inch or less.

5. Materials of Construction: All wetted parts to be 316 SS or material compatible with the process fluid. Switch enclosure to be NEMA 4X rated or as specified. The float switch provided shall be suitable for operation in the associated area classification; although, auxiliary means of protection may be provided in hazardous locations.

6. Mounting: Top (suspended) or mounted to a vertical 316SS support pipe mounting methods are acceptable. Mounting Hardware to be 316 SS unless otherwise specified. Complete details of the intended level switch installation and interconnect wiring shall be submitted for approval prior to actual installation.

7. Accessories: Hermetically sealed switch mechanism with integral cable where the level switch can be submerged. Cable shall be heavy-duty PVC jacket that is sealed to prevent moisture penetration into switch mechanism. Provide all mounting hardware.

8. Acceptable Manufacturers: Gems Sensor, Magnetrol, Static-O-Ring, or equal.

9. Instrument Schedule:

Instrument Tag Number	Setpoint	Level Units	Switch Type	Area Classification	Notes
LSL203	788.33 Falling	Ft Elev	SPDT	Class 1 Div 1	See D3-301, XX-YYYYY – Stop Pumps P-201, 202, 203
LSL204	785.8 Falling	Ft Elev	SPDT	Class 1 Div 1	See D3-301, XX-YYYYY – Stop Pump P-204
LSL303	788.33 Falling	Ft Elev	SPDT	Class 1 Div 1	See D3-301, XX-YYYYY – Stop Pumps P-301, 202, 203
LSL304	785.8 Falling	Ft Elev	SPDT	Class 1 Div 1	See D3-301, XX-YYYYY – Stop Pump P-304
LSHH205	807.8 Rising	Ft Elev	SPDT	Class 1 Div 2	See D3-301, Detail 3 D0-501
LSHH502	867 Rising	Ft Elev	SPDT	Class 1 Div 1	See CU-101, G0-106
LSHH503	787.8 Rising	Ft Elev	SPDT	Class 1 Div 2	See D7-306

10. Notes:
    a. Submit instrument data sheet, instruction manual, installation guidelines, and dimensional drawing.
    b. Provide stainless steel tag with Tag Number.
    c. For Hazardous Locations, provide Intrinsic Safety Barrier to be located in unclassified location.

H. Level Switch – Capacitance/RF Admittance

1. Type: Level switch that uses changes in measured capacitance or RF admittance to electronically actuate the level switch mechanism in response to rising or falling level of a liquid in a vessel. At a pre-set liquid level, this level switch shall close/open a set of contact(s) to generate an alarm or initiate a process action.
2. Design Criteria: Level switch assembly shall be complete with measuring electronics, sensor probe, reference electrode (where required), mounting hardware, junction boxes, or other accessories required for continuous operation during all environmental conditions. The sensing element shall be unaffected by coatings, foam, or other materials that may build up on the probe. Sensing probe and all wetted parts shall be compatible with the process fluid including any dissolved gases. Measuring electronics shall be hermetically sealed and resistant to EMI/RFI interference and suitable for the intended measuring environment. Provide FM approval certifications and intrinsic safety barriers where located in hazardous locations.
3. Switch Contacts: Provide SPDT or DPDT switch contacts as specified. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC. For DC circuits provide hermetically sealed contacts unless otherwise specified.

4. Switch Setting and Reset Dead band: Measuring accuracy shall be approximately 1% - provide information on measuring dead band and repeatability.

5. Materials of Construction: All wetted parts to be Teflon coated and/or 316 SS or material compatible with the process fluid. Switch enclosure to be NEMA 4X rated or as specified. The level switch provided shall be suitable for operation in the associated area classification; although, auxiliary means of protection may be provided in hazardous locations.

6. Process Connection: Typically Top or Side of Vessel mounted by attachment to ¾ inch or 1 inch threaded connections or flanged mounted to a nozzle attached to the vessel. Complete details of the intended level switch installation and interconnect wiring shall be submitted for approval prior to actual installation.

7. Accessories: Provide remote level switch electronics enclosure and sensor interconnecting cabling where required. Provide all mounting hardware.

8. Acceptable Manufacturers: Magnetrol, Drexelbrooke, or equal.

9. Instrument Schedule:

Instrument Tag Number	Setpoint	Level Units	Switch Type	Area Classification	Notes
LSH501	855 Rising	Ft Elev	DPDT	Class 1 Div1	See D8-102, 301
LSHH501	855.5 Rising	Ft Elev	DPDT	Class 1 Div 1	See D8-102, 301

10. Notes:
    a. Submit instrument data sheet, instruction manual, installation guidelines, and dimensional drawing.
    b. Provide stainless steel tag with Tag Number.
    c. Level Switch shall be FM approved for Hazardous Area Locations as noted above. Provide Intrinsic Safety Barrier to be located in unclassified location (PLC I/O Cabinet inside Electrical Room).

I. Pressure Switch with Diaphragm Seal

1. Type: Pressure sensing switch that has inlet pressure port connected to a metal diaphragm that opposes an adjustable spring. At a pre-set amount of the inlet pressure the diaphragm actuator overcomes the spring tension and operates an attached mechanical switch assembly to close/open a set of contact(s) to generate an alarm or to initiate a process action.

2. Design Criteria: Diaphragm style switch actuator with a single pressure sensing port. Diaphragm and switch mechanism must be able to withstand the maximum process pressure on the inlet port. Wetted parts suitable for process fluid – 316 SS default. Typically used for normal process gage pressure monitoring applications. Can be used with a Diaphragm seal to measure pressure on process fluids that might otherwise plug the pressure sensing port or to allow for less exotic wet parts on the pressure switch itself.

3. Process Connections: ½" NPT (default) or ¼" NPT as specified. 1 inch NPT or saddle seal mounting to be provided for pressure switch applications where diaphragm seals are specified.

4. Switch Contacts: Provide SPDT or DPDT switch contacts as specified. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be

made from silver or gold rated for 5 Amps at 125 VDC. Provide hermetically sealed contacts as specified.

5. Switch Setting and Reset Deadband: Single (default) or dual adjustable setpoint(s) with fixed (default) or adjustable deadband. Switch setpoint should be approximately 60% of the nominal differential pressure range provided.

6. Materials of Construction: All wetted parts to be 316 SS or material compatible with the process fluid. Diaphragm to be 316SS with viton o-ring unless other materials are required for process compatibility. Teflon coated metal diaphragms are only acceptable where the process fluid temperature will not damage the coating or affect the free movement of the diaphragm. Switch enclosure to be NEMA 4X rated or as specified. The pressure switch to be suitable for operation in the associated area classification.

7. Mounting: Remote mounted to be provided with 2 inch pipe stand Mounting Bracket. Mounting Hardware to be 316 SS unless otherwise specified. Pressure Switches with integral diaphragm seals can be process mounted via the diaphragm seal where process vibrations would not impede the proper operation of the pressure switch.

8. Accessories: Provide diaphragm seals where required for liquids with entrained solids or corrosive applications, as specified.

9. Acceptable Manufacturers: Dresser Industries (Ashcroft), Static-O-Ring, or equal.

10. Instrument Schedule:

Instrument Tag Number	Set point	Proces Conn.	Diaphragm Material	Switch Type	Area Classification	Notes
PSH-501	15 PSIG Rising	1" NPT	316 SS	SPDT	Class 1, Division 1	Provide Diaphragm Seal
PSH-502	15 PSIG Rising	1" NPT	316 SS	SPDT	Class 1, Division 1	Provide Diaphragm Seal

11. Notes:
    a. Submit switch data sheet, Operation and Maintenance manual, and dimensional drawing.
    b. Provide stainless steel tag with Tag Number.
    c. Provide diaphragm seals, where specified.

2.02 ANALYTICAL EQUIPMENT

A. Combustible Gas Detector

1. Type: Analytical transmitter that is calibrated to measure the lower explosion limit of the measured fluid or gas. Infrared gas detection is preferred over catalytic bead to minimize the frequency of recalibrations.

2. Design Criteria: Combustible Gas Detection system shall be complete with sensor(s), sensor to transmitter interconnecting wiring, mounting hardware, junction boxes, or other accessories required for continuous operation during all environmental conditions. Sensor supplied shall be compatible with the process fluid including any dissolved gases. Transmitter shall be resistant to EMI/RFI interference and suitable for the intended

measuring environment. Transmitter shall have automatic temperature compensation over the full operating temperature range of the measured process fluid. Multiple sensor transmitters are acceptable as long as individual sensor alarming is available where required. Provide FM approval certifications and intrinsic safety barriers where sensors and/or transmitters are located in hazardous locations. Where measurements for Gas Detection are inside pressurized (positive or negative pressure relative to atmosphere), provide sampling systems and associated controls required to guarantee a continuous and reliable measurement.

3. Sensor/Transmitter Accuracy: approximately +/- 3% of full scale. Zero drift less than 5% per year, Span drift less than 10% per year..
4. Transmitter Output: 4-20 ma DC Output plus Switch Output as noted in Schedule - SPDT or DPDT switch output at adjustable setting
5. Switch Contacts: Provide SPDT or DPDT switch contacts as specified. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC.
6. Switch Setting and Reset Dead band: Provide information on adjustability (including method of making field changes) of switch ON and RESET settings available with device to be supplied. Default dead band shall be 5% of full scale.
7. Materials of Construction: All wetted parts to be 316 SS or material compatible with the process fluid. Sensor and Transmitter housing to be NEMA 4X rated or as specified. The Combustible Gas Detection system provided shall be suitable for operation in the associated area classification; although, auxiliary means of protection may be provided in hazardous locations.
8. Mounting: Sensors shall be 2" pipe stand or wall mounted or other method as appropriate. Mounting Hardware to be 316 SS unless otherwise specified. Complete details of the intended sensor installation and interconnect wiring shall be submitted for approval prior to actual installation.
9. Accessories: One extra sensor for each installation, mounting hardware, and any accessories as appropriate for installation. Provide sufficient cable length to reach below minimum liquid level and to connect to signal junction box – verify length with electrical contractor. Provide supplies required for period recalibration of all analyzers provided for the 1st year of operation. Transmitter shall provide analog or contact outputs as required.
10. Acceptable Manufacturers: MSA (Ultima X), Draegar, or equal.
11. Instrument Schedule:

Instrument Tag Number	Measurement Range	Reference Fluid	Switch Output	Location	Area Classification	Notes
AIT210	0-100% LEL	Methane	SPDT	Outdoors	Class 1 Div 1	a,b,c,d,e,f,g
AIT212	0-100% LEL	Petroleum	SPDT	Outdoors	Class 1 Div 1	a,b,c,d,e,f,g
AIT310	0-100% LEL	Methane	SPDT	Outdoors	Class 1 Div 1	a,b,c,d,e,f,g
AIT312	0-100% LEL	Petroleum	SPDT	Outdoors	Class 1 Div 1	a,b,c,d,e,f,g
AIT411	0-100% LEL	Methane	SPDT	Outdoors	Class 1 Div 1	a,b,c,d,e,f
AIT511	0-100% LEL	Methane	SPDT	Outdoors	Class 1 Div 1	a,b,c,d,e,f

12. Notes:
    a. Submit instrument data sheet, instruction manual, installation guidelines, and dimensional drawing.
    b. Provide stainless steel tag with Tag Number.
    c. Combustible Gas Detection Sensor and/or Transmitter shall be FM approved for Hazardous Area Locations as noted above. When any part of the analyzer is located in a hazardous area, provide an Intrinsic Safety Barrier to be located in unclassified location.
    d. Provide supplies required for period recalibration of all analyzers provided for the 1st year of operation.
    e. Transmitter to be located in remote location in Electrical Room outside of Hazardous Area
    f. Design sensor to operate in an atmosphere of 100 ppm of hydrogen sulfide for up to 24 hours with no more than 5% reduction in sensor response time.
    g. Provide Sampling System with sample pump – low flow/pump failure alarming

B. Hydrogen Sulfide Gas Detector

1. Type: Analytical transmitter that is calibrated to measure the concentration of hydrogen sulfide in the ambient air.
2. Design Criteria: Hydrogen Sulfide Gas Detection system shall be complete with sensor(s), sensor to transmitter interconnecting wiring, mounting hardware, junction boxes, or other accessories required for continuous operation during all environmental conditions. Sensor supplied shall be compatible with the process fluid including any dissolved gases. Transmitter shall be resistant to EMI/RFI interference and suitable for the intended measuring environment. Transmitter shall have automatic temperature compensation over the full operating temperature range of the measured process fluid. Multiple sensor transmitters are acceptable as long as individual sensor alarming is available where required. Provide FM approval certifications and intrinsic safety barriers where sensors and/or transmitters are located in hazardous locations. Where measurements for Gas Detection are inside pressurized (positive or negative pressure relative to atmosphere), provide sampling systems and associated controls required to guarantee a continuous and reliable measurement.
3. Sensor/Transmitter Accuracy: approximately +/- 3% of full scale. Zero drift less than 5% per year, Span drift less than 10% per year.
4. Transmitter Output: 4-20 ma DC Output – provide Switch Output if noted in Schedule (either SPDT or DPDT switch output at adjustable setting as noted).
5. Switch Contacts: Provide SPDT or DPDT switch contacts as specified. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC.
6. Switch Setting and Reset Dead band: Provide information on adjustability (including method of making field changes) of switch ON and RESET settings available with device to be supplied. Default dead band shall be 5% of full scale.
7. Materials of Construction: All wetted parts to be 316 SS or material compatible with the process fluid. Sensor and Transmitter housing to be NEMA 4X rated or as specified.
8. Mounting: Sensors shall be 2" pipe stand or wall mounted or other method as appropriate.

Mounting Hardware to be 316 SS unless otherwise specified. Complete details of the intended sensor installation and interconnect wiring shall be submitted for approval prior to actual installation.

9. Accessories: One extra sensor for each installation, mounting hardware, and any accessories as appropriate for installation. Provide sufficient cable length to reach below minimum liquid level and to connect to signal junction box – verify length with electrical contractor. Provide supplies required for period recalibration of all analyzers provided for the 1st year of operation. Transmitter shall provide analog or contact outputs as required.
10. Acceptable Manufacturers: MSA (Ultima X), Draegar, Sensidyne, or equal.
11. Instrument Schedule:

Instrument Tag Number	Measurement Range	Reference Fluid	Switch Output	Location	Area Classification	Notes
AIT211	0 – 30 PPM	H2S	4-20 ma Only	Outdoor	Class 1 Div 1	a,b,c,d,e,f,g
AIT311	0 – 30 PPM	H2S	4-20 ma Only	Outdoor	Class 1 Div 1	a,b,c,d,e,f,g
AIT410	0 – 30 PPM	H2S	4-20 ma Only	Outdoor	Class 1 Div 2	a,b,c,d,e,f,g
AIT412	0 – 30 PPM	H2S	4-20 ma Only	Outdoor	Class 1 Div 2	a,b,c,d,e,f,g
AIT413	0 – 30 PPM	H2S	4-20 ma Only	Outdoor	Class 1 Div 2	a,b,c,d,e,f,g
AIT510	0 – 30 PPM	H2S	4-20 ma Only	Outdoor	Class 1 Div 2	a,b,c,d,e,f,g
AIT512	0 – 30 PPM	H2S	4-20 ma Only	Outdoor	Class 1 Div 2	a,b,c,d,e,f,g
AIT513	0 – 30 PPM	H2S	4-20 ma Only	Outdoor	Class 1 Div 2	a,b,c,d,e,f,g

12. Notes:
    a. Submit instrument data sheet, instruction manual, installation guidelines, and dimensional drawing.
    b. Provide stainless steel tag with Tag Number.
    c. Hydrogen Sulfide Sensor and/or Transmitter shall be FM approved for Hazardous Area Locations as noted above. When any part of the analyzer is located in a hazardous area, provide an Intrinsic Safety Barrier to be located in unclassified location.
    d. Provide supplies required for period recalibration of all analyzers provided for the 1st year of operation.
    e. Transmitter to be located in remote location in Electrical Room outside of Hazardous Area
    f. Design sensor to operate in an atmosphere of 100 ppm of hydrogen sulfide for up to 24 hours with no more than 5% reduction in sensor response time.
    g. Provide Sampling System with sample pump – low flow/pump failure alarming

2.03 PANEL MOUNTED INSTRUMENTS

A. Panel Meter (Vertical Bar Graph Indicator)

1. Type: Electronic indicator, vertical bar graph type. Single or Dual display as required, multi-segmented gas discharge tube.
2. Display: High Visibility vertical multi-segmented bar graph, display the input measurement in Engineering Units.
3. Input: 4-20 ma DC or as specified below. Input Impedance to be less than 100 ohms.
4. Accuracy: Plus or minus 0.5 percent.
5. Power Supply: 120 VAC
6. Mounting - Flush panel mounting, provide gasket kit when mounting on NEMA 12 or NEMA 4/4X Control panel. Display enclosure shall match the environmental rating of the Control Panel.
7. Acceptable Manufacturers: Foxboro, Omega Engineering, or equal.
8. Notes:
   a. Provide Loop Power for field instrument when noted.

B. Panel Meter/Indicator (Digital Display)

1. Type: Electronic indicator, LED numeric display of single analog measurement.
2. Display: High Visibility Red (unless other color is noted below) LED display, provide at least 3-1/2 numeric digits, numeric display to be minimum ½ inch in height, field select selectable decimal point. Display the input measurement in Engineering Units. Display shall indicate over-range input.
3. Input: 4-20 ma DC or as specified below. Input Impedance to be less than 100 ohms.
4. Accuracy: Plus or minus 0.1 percent.
5. Power Supply: 24V DC or 120 VAC as required.
6. Mounting - Flush panel mounting, provide gasket kit when mounting on NEMA 12 or NEMA 4/4X Control panel. Display enclosure shall match the environmental rating of the Control Panel.
7. Acceptable Manufacturers: Action Instrument (Visipak Series), Foxboro (model 710), Newport, Red Lion, or equal.
8. Notes:
   a. Provide Loop Power for field instrument when noted.
   b. Provide two alarm contact outputs – Form C – rated at 5 amps at 120 VAC when noted.
   c. Provide Input Repeat Option, Output to be 4-20ma DC when noted.
   d. Provide hardcopy of any special alarm or signal conditioning configurations.

C. Electronic Single-Station Analog Controller

1. Type: Microprocessor based configurable Electronic analog Controller capable of acting as single or cascade loop controller.

2. Controller Configuration Options (Minimum requirements):
   a. Capable of Proportional (P Only), Proportional – Integral (PI Control), or Proportion – Integral – Derivative (PID Control) controller modes as required (field configurable)
   b. Single or Cascade (two measurement, one or two outputs) controller operation.
   c. Ability of controller to act as a differential gap controller (setpoint deviation control).
   d. Ability to provide adaptive gain control.
   e. Ability of use one or more of the inputs to implement ratio control.
   f. Ability to act as a Manual Loader (operator adjustable output).
   g. Input signal conditioning (biasing, square root, etc).
   h. Integral Mode shall include Anti-reset windup calculations.
   i. Bumpless transfer from/to Manual/Auto/Cascade Controller modes.
   j. Ability to use of one of the inputs as the controller remote setpoint.
   k. Ability to choose local/remote setpoint or auto/manual control from remote location or locally at controller.
   l. Provides indication of local/remote and auto/manual switch status.
   m. Ability to provide limit rate of change of Outputs or to provide high and low limits for controller outputs.
   n. Ability to set controllers for direct or reverse controller action.
   o. Absolute and Deviation Alarming of inputs. Absolute alarming of setpoints and outputs.
3. Display: Front Display of process measurement, setpoints, and controller outputs. Display of the input and setpoints to be in Engineering Units. Display shall indicate over-range of inputs and outputs.
4. Analog Inputs: 4-20 ma DC or 1-5 V DC. Minimum of two inputs required. Input Impedance to be 250 ohms maximum.
5. Analog Outputs: 4-20 ma DC. Minimum of two inputs required. Ability to drive up to 800 ohms maximum.
6. Discrete Inputs: Minimum of two inputs required.
7. Discrete Outputs: Minimum of two inputs required.
8. Input Accuracy: Plus or minus 0.1 percent of span.
9. Output Signal Accuracy: Plus or minus 0.2 percent of span.
10. Power Supply: 120 VAC or 24 VDC as required.
11. Mounting – Flush panel mounting. Enclosure shall match the environmental rating of the Control Panel.
12. Acceptable Manufacturers: ABB, Action Instrument, Foxboro (Models 761/762), Honeywell (UDC Series), Newport, Siemens Automation (Moore Products -Model 353), or equal.
13. Notes:
   a. Inputs can be individually selectable for loop or externally powered.
   b. Factory pre-configuration option available.
   c. Provide hardcopy of each controller's configuration.
   d. RS-232 or RS-485 interfaces for programming or communications.

D. Indicating Control Station

1. Type
   a. Electronic input and output.
2. Functional/Performance
   a. Operation - Provides a standard electronic setpoint signal to a remote controller or other equipment based on a manual or an automatic (remote) setting. Where indicated in Contract Documents, provide the following capabilities: bias adjustment (+/- 100% of signal), signal tracking.
   b. Input/Output - Microprocessor-based; Input - 4-20 mADC into 250 ohms (max); Output - 4-20 mADC into 640 ohms (min).
   c. Indication - LED Indication - Input and output values and manual/auto mode.
   d. Control - Touch-pad switches: selection of manual/auto modes and manual output setting.
   e. Bumpless, balanceless transfer.
   f. Accuracy - Plus or minus 0.5 percent of span.
3. Physical
   a. Case - Nominal 3 in. wide by 6 in. high by 20 in. deep, General Purpose Enclosure.
   b. Mounting - Flush panel or surface mount, suitable for high density mounting arrangement.
4. Manufacturer
   a. Moore Products
   b. Or equal.

E. Signal Relay Switches (Current Trips)

1. Type
   a. Solid state electronic type.
2. Functional/Performance
   a. Input - 4-20 mA
   b. Output - Isolated contact output, double pole double throw, rated 5 Amps at 120 VAC.
   c. Accuracy - 0.1 percent.
   d. Protection - Provide RFI protection.
   e. Deadband - Adjustable between 0.1 and 5.0 percent of span.
   f. Setpoint Adjustment - Provide graduated dial for each alarm set point from 0 to full scale. Alarms shall be adjustable to trip on rising or falling input signal.
   g. Repeatability – Trip point repeatability shall be at least 0.1 percent of span.
3. Physical
   a. Mounting - Suitable for mounting in an enclosure or high density instrument rack.
4. Options/Accessories Required
   a. Mounting rack or general purpose enclosure as required.

5. Manufacturers
   a. Rochester Instrument Systems
   b. Acromag Inc.
   c. Moore Industries

F. Signal Isolators/Boosters/Converters

1. Type
   a. Solid state electronic type.
2. Functional/Performance
   a. Accuracy - 0.15 percent.
   b. Inputs - Current, voltage, frequency, temperature, or resistance as required.
   c. Outputs - Current or voltage as required.
   d. Isolation - There shall be complete isolation between input Circuitry, output circuitry, and the power supply.
   e. Adjustments - Zero and span adjustment shall be provided.
   f. Protection - Provide RFI protection.
3. Physical
   a. Mounting - Suitable for mounting in an enclosure or instrument rack.
4. Options/Accessories Required
   a. Mounting rack or general purpose enclosure as required.
5. Manufacturers
   a. Rochester Instrument Systems
   b. Acromag Inc.
   c. Moore Industries

G. Signal Selectors, Computation, and Conditioning Relays

1. Type
   a. Solid state electronic type.
2. Functional/Performance
   a. Inputs - 4-20 mA
   b. Outputs - 4-20 mA
   c. Protection - Provide RFI protection.
   d. Operation - The relay shall multiply, add, subtract, select, extract the square root, or perform the specified conditioning/computation function required. All inputs shall be able to be individually rescaled and biased as required.
   e. Isolation - All inputs, outputs, and power supplies shall be completely isolated.
   f. Accuracy - 0.35 percent of span.
   g. Adjustments - Multiturn potentiometer for zero, span, scaling, and biasing.
3. Physical
   a. Mounting - Suitable for mounting in an enclosure or instrument rack.
4. Options/Accessories Required
   a. Mounting rack or general purpose enclosure as required.

5. Manufacturers
   a. Rochester Instrument Systems
   b. Acromag Inc.
   c. Moore Industries

H. Intrinsic Safety Relays

1. Type: Specialty solid state protective relay to insure that the energy level associated with an electric circuit connecting thru a electrically "hazardous" area is always below the explosive limit of any potentially flammable gases or liquids that might be present in the area.

2. Design Criteria: Intrinsic Safety Relays shall be located in non-hazardous areas and shall be designed to provide personnel and equipment protection in accordance with National Electrical Code. See Contract Specification 17000 Section 2.03. Intrinsic Safety Relays shall be designed specifically for each individual circuit to be protected and shall be compatible with the circuit voltage and entity parameters of instrumentation and associated devices that are part of that circuit. Circuit Design Calculations to be submitted with each Intrinsic Safety Relay to be utilized.

3. Certification: Each Intrinsic Safety Relay to be certified by FM and UL as suitable for providing an auxiliary means of protection for the associated apparatus located in the specified electrically hazardous area classification associated with the electric circuit to be protected. Provide a copy of the Certification Information with each submittal.

4. Panel Mounting: Surface Mount or "DIN" style mounting rail.

5. Enclosure: Manufacturer Standard. Provide screw type wiring terminals.

6. Acceptable Manufacturers: Gems Sensor, MTL, Pepperl Fuchs, R Stahl, Turck, or equal.

I. Uninterruptable Power Supplies (UPS)

1. Type: Battery backup type power supply for computer type systems that utilizes sealed no-maintenance type batteries and a inverter to convert DC power from the attached batteries to generate a AC true-sinusoidal power output to power attached devices should the incoming AC power source be interrupted for any reason. An included AC powered charger insures that the attached batteries are keep fully charged at rated voltage when the UPS is "on standby" monitoring the condition of the incoming AC power source for possible lose of feed.

2. Design Criteria: UPS systems shall be an on-line, computer-grade system. Transfer to battery power shall be instantaneous with no transfer time. Unit shall consist of charger, batteries, inverter unit, on-line ferroresonant transformer for complete line isolation, synchronizing equipment, protective devices (include surge protection on line side), and accessories required to provide regulated, uninterruptable electrical power to the protected device or devices. Units shall include all mechanical and electrical devices that will provide continuity of electrical power within specified tolerances without interruption upon failure or deterioration of the primary power. Use of static transfer switch shall be required as noted on the drawings to allow for maintenance.

3. Sizing: Units shall be sized to provide at least 30 minutes of full load backup power for all attached rated loads. Additionally units shall be sized to provide a minimum of 25 percent unused capacity after full load calculations.

4. Electrical Characteristics:

a. Input:
   i) Voltage : 115 VAC, +- 10%
   ii) Frequency: 57 to 63 Hz

b. Output:
   i) Voltage: 115 VAC +/- 3%
   ii) Frequency: Synchronized to ac input line when on ac operation. When on batteries frequency shall be 60 Hz +/- .5%.
   iii) Harmonic Content: Maximum 5% total harmonic distortion.

5. Status and Alarm Contacts: Manufacturer Standard. Provide screw type wiring terminals.
   a. Auxiliary contacts (SPDT) and all wiring and connections shall be provided for remote indication of the following UPS conditions:
      i) Main Power "On" Status (On/Off)
      ii) Inverter "On" Status (On/Off)
      iii) Battery Power "On" Status (On/Off)
      iv) UPS Trouble Alarm (Failure of UPS)

6. Accessories: Bypass Switches: A Bypass Switch shall be provided to manually bypass the UPS for Maintenance purposes. During bypass operation, the outlet load shall be directly connected to the primary power source..

7. Acceptable Manufacturers: Best Power Technology, Inc.; Tripp Lite; Liebert; or equal.

2.04 MAINTENANCE REQUIREMENTS

A. To permit operation during the warranty period – supplier shall provide One year supply of any reagents/consumables as listed by the manufacturer as required for the first year of normal operation or scheduled routine maintenance for each device provided under this specification.

B. In addition to the tools and test equipment specified elsewhere in the Contract Specifications, provide additional spare parts as specified in the individual device specifications.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Instrumentation and Controls supplied under this section shall be installed per the Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Controls – General Provisions", Division 13 Contract Specification 13270 – "Surge and Lightning Protection", and Division 13 Contract Specification 13900 "Instrumentation Installation Guidelines".

B. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of instrumentation and controls work and in case of any interference with other work, proceed as directed by the

Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

C. Instrumentation and Controls furnished under this specification shall be factory and/or "bench" calibrated prior to installation and testing.

D. Unless specifically shown in the Contract Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or pipe stands. All instrumentation process and instrument air connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing, and blow down service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

E. Instrumentation and Controls shall at all times during construction be adequately protected against mechanical injury, water damage, corrosion, dirt, dust and foreign material. Equipment equipped with internal electrical heaters shall have them energized to keep the equipment dry. Doors to control panels and cabinets shall be kept closed at all times when work on them is not being done. Control Panels, Analyzers, sensitive electronic or computer equipment and/or controls or other materials not sealed and/or suitable for continuous outdoors storage shall not be stored out-of-doors. Such Instrumentation and Controls shall be stored in dry permanent shelters. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner, the damaged units or systems shall remain on site and returned to the manufacturer after the replacement units or systems have been delivered to the site. Under no circumstances will instrumentation or controls equipment damaged by water be rehabilitated or repaired, new equipment shall be supplied, and all costs associated with replacement shall be borne by the Contractor.

F. Any damage to factory applied paint finish shall be repaired using touch-up paint furnished by the instrument or equipment manufacturer. The entire damaged enclosure panel or section shall be repainted per the field painting specification Section 09902, at no additional cost to the Owner.

3.02 INSPECTION AND TESTING

A. Instrumentation and Controls supplied under this section shall be inspected and tested per the Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Controls – General Provisions" and Division 13 Contract Specification 13270 – "Surge and Lightning Protection".

B. Test all instrumentation and control system components furnished under this Specification and repair or replace all defective equipment or work. Make all necessary adjustments and instruct the Owner's personnel in the proper operation of the instrumentation and controls provided.

C. Test grounding and verify any other safe operation concerns associated with all supplied control panels, PLC hardware, intrinsic safety equipment, and other sensitive electrical or electronic control system equipment prior to energization. Supplier shall certify that the grounding and installation is in conformance with the manufacturer's warranty requirements prior to providing temporary or permanent power to any supplied equipment. Submit copies of certified installation and grounding test reports.

3.03 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner or clean lint-free rags. Do not use compressed air.

3.04 TRAINING

A. Instrumentation and Controls supplied under this section shall be incorporated in the overall training plan as required by the Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Controls – General Provisions".

END OF SECTION 13300

SECTION 13400
PROGRAMMABLE CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. The provisions and requirements of Division 13, Section 13000 "General Provisions" of this Specification shall apply to the work specified in this section.

C. Work associated with the furnishing and fabricating of control panels associated with this Specification shall be as specified in Division 13, Section 13200 "Control Panels".

D. Programmable Controllers and associates components furnished under this Specification shall be provided with transient surge and lightning protection as required in Division 13 Contract Specification 13270 "Surge and Lightning Protection".

1.02 SUMMARY

A. This Section defines the requirements for the design, supply, assembly, configuration, testing, and delivery of programmable logic controllers (PLCs) associated with instrumentation and control system that are not provided under other sections of the Contract and as necessary to complete the instrumentation and controls as shown on the Contract Drawings and Contract Specifications.

B. Furnish all labor, engineering design including programming, supervision, materials, equipment, and incidentals required to complete and ready for operation, said programmable controller based process control system as depicted on the Contract Drawings or on the P&ID's or as listed on the PLC I/O List. Unless otherwise noted, the field installation of all programmable controller hardware, control panels, and/or I/O Cabinets furnished under this Specification shall be performed by the General Contractor and/or Electrical Contractor. The party responsible for the design and configuration of the programmable controller based control system shall be responsible to certify the proper installation and operation of all supplied equipment.

C. All the Work in this Section shall be the sole responsibility of the designer of the programmable controller based process control. Components and enclosures may be provided by other suppliers and/or manufacturers, but the integration, coordination, packaging, wiring and testing of these components and the production of the final product shall conform to this specification and shall be the sole responsibility of the programmable controller based control system designer.

D. Programmable Controllers provided under this Section shall include the following:

1. Diversion FacilityPLC (Programmable Controller) to be located in the Diversion Facility Electrical Building Local Control Panel PLC-101.
2. Equalizaton Facility PLC (Programmable Controller) to be located in the Equalization Facility Electrical Building Local Control Panel PLC-201.

3. Remote Telemetry PLC to be located in a RTU Local Control Panel LCP-120 at the existing Level Monitoring Manhole located near the Cross Creek Housing Area. (this manhole is also referred to as the Peachtree Creek Trunk Relief Manhole (PCTRM) MH 23180203601)

1.03 TERMINOLOGY

1. PLC: Programmable Logic Controller. Can refer to the processor alone or to a system including processor, I/O racks, and Input / Output cards. Often shorted to be "Programmable Controller".
2. I/O: Input / Output. Input designates information sent to the processor from connected devices; Output designates information being sent to connected devices from the processor. The information referred to may be binary (on / off signals), analog, or encoded serial or parallel data.
3. Data Highway: Used in a generic sense to refer to any of the several supplier specific data communication links used to allow data transfer between 2 or more PLCs or other intelligent devices.
4. Scan Time: Time required to read all inputs, execute the control program, and update local and remote I/O. With today's technology specifications for permissible scan times can be complicated due to the fact that some PLCs allow organization of the program logic such that parts of the program may execute more frequently than others. Likewise, some processors permit some I/O to be updated more frequently than others. For purpose of this specification Scan Time refers to the maximum overall scan time.
5. MMI: Man - Machine Interface - The software/procedure that allows the operator to interact with the control system to set controller set points, controller modes, start/stop motors or verify the operational status of the process as monitored by the control system. The interface can be in form of graphical pictures with constantly updating process data, traditional controller type "faceplate" displays, graphical representations of trend or strip chart recorders or text only status or alarm "pages". Used in a generic sense refers to the software or philosophy used to interface the operator to the control system.
6. OIT: Operator Interface Terminal - a device that allows the operator to control or monitor a control system that is usually connected to a manufacturing process similar to MMI above. Specially refers to the hardware used to perform the MMI function. Terms are often used interchangeability when discussing the concept but have different specific intents.
7. Virtual I/O: discrete or analog information both of input or output nature that is communicated to the programmable controller over a non-physical virtual communication link from a remote vendor furnished control system to the project's control system.
8. For a more comprehensive list of applicable terminology and their conventional meanings, refer to IEEE (Institute of Electrical and Electronics Engineers) Standard 100-1984, Dictionary of Electrical & Electronics Terms.

1.04 REFERENCE STANDARDS

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Reference Standards" and as specified herein.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Quality Assurance" and as specified herein.

1.06 SUBMITTALS

A. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. In accordance with the General Conditions and the Special Conditions of the Contract and with Contract Specification 13000, submit to the Engineer the following documentation to demonstration compliance with submittal requirements of the Contract:

C. Shop drawings including copies of all drawings, parts lists, product data, and other materials shall be submitted and shall include:

1. List of all new Programmable Controllers, I/O Modules, Control Panels, and I/O Cabinets and/or new sub-panels associated with existing Control Panels to be furnished.
2. Definition of all rework to be performed on existing programmable controllers and/or I/O Cabinets including PLC or Cabinet name, location, and general description of work to be done in each programmable controller or I/O Cabinet.
3. PLC System Architecture Drawings showing all Programmable Controllers to be furnished, modified, and otherwise interconnected to the work being performed under this Specification.
4. General Arrangement (GA) drawing(s) of all new or modified Control Panels and I/O Cabinets. GAs shall include outline, dimensions, and estimated weight for each panel or cabinet.
5. Complete Identified Bill of Materials for each Programmable Controller, Control Panel, or I/O Cabinet. Bill of Materials shall reference General Arrangement drawing(s) and shall include ID #, manufacturer, model number, description, and quantity for each item.
6. Complete Identified component list of programmable controller hardware and software including all processors, programming software, memory modules, I/O Chassis, Power Supplies, Cables, interface hardware, and I/O Modules to be furnished.
7. Project specific identified product data sheets for each component in the Bill(s) of Materials and components list(s).

8. Interconnect wiring drawings for all internal panel or cabinet wiring. Interconnect drawings shall identify all terminal strips, wiring, and devices located inside the panel and shall note where external connections shall be made.

9. Where available, provide manufacturer instruction manuals containing manufacturer installation and maintenance requirements and troubleshooting guide.

10. PLC I/O Lists including all Real World and Virtual I/O Points. Where Virtual Communication Links are required – PLC Hardware submittal shall include all PLC communication gateways and details on the required data highway type communication links and interface connections to the remote non-Division 13 control systems. Similarly where Virtual Communication Links are required – PLC Software submittal shall include Virtual I/O lists and Virtual I/O addressing and project specific information on each required Virtual communication link as to the type of communication protocol being proposed, complete listing of all virtual I/O points available in each interfaced device, vendor specific internal address scheme, and the recommended/required points being proposed to be communicated over each Virtual I/O Link.Complete commented list of each programmable controller's program including Cross-Reference Table utilizing an approved, commercially available personal computer based PLC Programming development system.

11. Complete list of Spare Parts, Expendables, and Test Equipment to be provided.

D. After Fabrication, Installation, and Testing are complete and approved, Submit Record Documents per Contract Specification 13000 Section "Record Drawings".

E. After Record Drawings have been approved, submit Operation and Maintenance Manuals per Contract Specification 13000 Section "Operation and Maintenance Manuals".

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Identification, Storage and Handling of all supplied programmable controller hardware and software shall be in full conformance with the Contract Specifications and with Division 13 Contract Specification 13000 Section "Delivery, Storage, and Handling" and as specified herein.

B. Control Panels and I/O Cabinets shall be mounted on wooden skids at least four inches high suitable for movement via forklift truck. Control Panels and Cabinets shall be suitably wrapped or crated depending on the distance to be traveled and the amount of transfers to be made during shipment from point of origin to point of actual installation.

C. Control Panels and I/O Cabinets shall be only shipped via Air-Ride Van.

D. Control Panels and I/O Cabinets shall not be stored out-of-doors even if designed for outdoor installation until temporary or permanent sun and rain shields have been erected at the installation or storage location (assuming the enclosure is rating for outdoor installation).

E. Instruments and control devices inside control panels or cabinets shall be "blocked" and "tied off" to prevent damage during shipment. Front of panel instruments shall be removed and re-packed in their original containers for shipment. Similarly, all Control System processors, I/O Cards, and other sensitive electronic equipment shall be removed and re-packed in their original containers for shipment. All removed instruments and controls shall be properly labeled to facilitate re-assembly at the jobsite.

F. All programmable hardware and software shall BE stored in dry, permanent type indoor shelters. All storage locations shall be indoors with temperature and humidity controls per the manufacture's instructions and shall be adequately protected against mechanical injury. If any equipment has been damaged, such damage shall be replaced by the Contractor at his own cost and expense. Project delay costs associated with improper storage or replacement delays shall be the sole responsibility of the supplier and/or Contractor.

G. All mounting hardware, accessories, and at least one set of drawings and instruction manuals necessary to complete the field installation shall be shipped with the Programmable Controller Shipment.

1.08 SIZE OF EQUIPMENT

A. Investigate each space in the structure through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the structure.

B. The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passing through such restricted areas during transportation, the manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

1.09 WARRANTY

A. Provide a warranty for all programmable controller hardware and software in accordance with the general requirements of the Contract Specifications. Unless specified more stringently elsewhere in the general requirements, the components of the programmable controller system shall be warranted against defective materials, design, and workmanship for a period of one (1) year from the date of final acceptance.

B. During the warranty period, the Supplier shall furnish personnel to inspect, test, and take corrective action to correct all deficiencies in his "Scope of Work" such that the corrective action is consistent with the quality of materials and work of the original construction and is in conformance with the Contract Specifications, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Programmable Logic Controllers (PLCs) as defined in this Specification shall be provided to perform interlocks and process control logic associated with the Plant Process Control System. The Programmable Controllers provided under this Section shall be integrated into the overall (new and existing) Instrumentation and Control System for the Plant along with control panels and/or other new or existing PLC based hardware and software provided by other subcontractors or equipment manufacturer's.

B. All programmable controllers provided will interface and be fully integrated to the overall plant monitoring and control system

C. When designing a programmable controller (PLC) based Control Systems, the Supplier shall employ modern design concepts such as modular system design, multiple operational modes,

internal diagnostics, data collection, and peer and supervisory level connectivity. Modular design shall be implemented to facilitate incremental system expansion, graceful system failure, and software maintainability. Multiple operational modes shall be provided as noted on the Contract Drawings and Specifications (See Control Logic Descriptions in Contract Specification 13150) to allow for fully automatic, manual, or semiautomatic modes of operation in order to increase the maintainability and productivity of the system. Current and future needs for system coordination and higher level data collection and process supervision shall be accommodated by selection of products and features which support a high degree of connectivity.

D. Where programmable controllers are provided for small, low I/O Density (less than 100 I/O) applications like remote pump stations (usually associated with Telemetry Systems) or standard vendor packaged systems; fixed (non-modular) I/O style (Similar to Modicon Micro/Compact or A/B Micrologic or Siemens S3) programmable controllers can be utilized as dictated by Standard Industry Practices (allowable exception to requirement for Modular I/O type Programmable Controllers).

E. Transient Surge and Lightning protection shall be provided to protect all programmable controller hardware from induced voltages and power surges propagating along the discrete or analog signal I/O lines and/or power supply lines or digital communication connection to the Control system and/or Telemetry system. The protection systems shall be such that the surge protective device shall not interfere with normal operation, but shall lower the induced voltage level or transient surge level to be less than the instrument's (or control device's) surge withstanding level, and shall be maintenance free and self-restoring. Transient Surge and Lighting protection shall be provided in accordance with Contract Specification 13270 "Surge and Lighting Protection".

F. The scope of the Programmable Controller based control system will be as depicted on the Contract Drawings including the P&IDs with the approximate PLC I/O requirements as listed in Contract Specification 13120 "PLC I/O List". The party responsible for the design and configuration of the programmable controller based process control system shall be responsible for all programming, labor, and ancillary equipment and services required to achieve a fully integrated and operational system. This Subcontractor shall configure the control system for proper operation with related equipment and materials furnished by suppliers called out under other sections of these Specifications and with related existing equipment that includes existing and vendor furnished hardware and control system components. The Subcontractor shall design and configure the resulting process control system to guarantee full functionally and future expansion capability of the final process control system and to certify the proper installation and operation of all supplied equipment as well as integration with all existing and/or vendor furnished instrumentation and controls.

G. In additional to real world communication as shown on the Contract Specification 13120 "PLC I/O List", the PLC design may include the implementation of Virtual I/O Communication between the project's Control System and various non-Division 13 control systems that may contain other electronic controls like programmable controllers, embedded microprocessor based controllers, or vendor specific proprietary control systems. Required Virtual I/O Communication Links shall be shown on the project's Process and Instrumentation Diagrams (P&ID) and/or described in the project's control logic description specification 13150. Contractor is required to investigate all Virtual I/O Links and provide sufficient hardware, software, and configuration services to fully implement the required virtual communication so as to complete the functionality of the project's control system and to implement the intent of the additional functionality for virtual communication both in terms of monitoring and control that the Owner requires to properly operate his facility as described in the Contract Documents. Contractor is

fully responsible to recommend those Virtual I/O points that he feels provides for a fully functional and complete control system. Scope of work may include interfacing with the Engineer and/or Owner to insure that the Contractor proposed list of virtual I/O points is sufficient to provide the functionality required in the Contract documents.

H. All the Work in this Section shall be the sole responsibility of the designer of the programmable controller based process control system. Components and enclosures may be provided by other suppliers and/or manufacturers, but the integration, coordination, packaging, wiring and testing of these components and the production of the final product shall conform to this specification and shall be the sole responsibility of the programmable controller based process control system designer.

I. Design, furnish, fabricate, configure/program, test, and make ready for operation the programmable controller hardware and software required to integrate with instrumentation and control system design as required by the Contract Specifications including Contract Specification 13000 "Instrumentation and Controls – General Provisions" and as shown on the Contract Drawings.

J. Unless otherwise specified on the Contract Drawings, all control panels and I/O cabinets shall be of the fully enclosed type suitable for the mounting of the instrumentation and control devices as listed in the Contract Specifications and as shown on the Contract drawings.

K. All control panel and I/O cabinets shall be fully lockable with a lock installed in the door handle or by padlocking using a hasp and staple for padlocking. Locks for each control panel or I/O cabinet provided under this Contract shall be keyed alike.

L. For additional requirements associated with Control Panels and/or I/O Cabinets to be furnished with the Programmable Control System see Contract Specification 13200 "Control Panels".

2.02 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with contract requirements, manufacturers offering Products that may be incorporated in the Work include, but are not limited to, the following:

1. Allen Bradley (A/B) Programmable Controllers:
   a. Micro Logix (Mini-Fixed I/O base with Built-in Processor).
   b. SLC-500 (Medium Size Modular I/O System with a family of PLC Processors- SLC-5/4 Processors preferred for DH+ Communication Applications and SLC-5/5 Processors preferred for Ethernet Communication Applications).
   c. PREFERED - ControlLogix (Large Size Modular I/O System with a family of PLC Processors)

2.03 DESIGN OF PROGRAMMABLE CONTROLLER BASED CONTROL SYSTEMS

A. General Requirements

1. The Programmable Controller Supplier shall design, fabricate, and deliver a complete PLC system with hardware and software including the following:
   a. CPUs (Central Processing Units) – PLC processors (including math coprocessors where required).

b. Communication Interfaces or Processors.
c. "Real World" I/O systems including I/O Scanners, I/O Cards, and I/O Racks.
d. Power Supplies for Processors and I/O Systems.
e. Outside World Interface Hardware and Software.
f. Special Interconnecting Cables.
g. Miscellaneous components and signal conditioners.
h. Mounting Hardware.
i. Enclosures and I/O termination Cabinets.
j. Local Operator Interfaces, where required.
k. Programming and Online Diagnostic Software
l. Portable Programming Computers complete with PLC Programming and Online Diagnostic Software (and Local OIT/HMI programming and diagnostic software where such hardwire is supplied as part of the project), where specified.

2. The Programmable Controller Supplier shall offer the following additional services:
   a. Factory inspection and testing (to be witnessed by Engineer and/or Owner at their discretion).
   b. Installation supervision.
   c. On site testing and startup
   d. Operator and maintenance training

B. Design Criteria

1. The PLC Control System shall be designed for at least 99.9% availability through selection of reliable components, conservatively applied in accordance with the manufacture's specifications; through serviceable equipment arrangement and distribution of control functions and I/O points; utilizing detailed system diagnostics; and through quality of workmanship in assembly and installation. Complicated and costly redundant or fault tolerant configurations shall be employed only with the Engineer's or Owner's written approval.

2. The PLC Control System shall be inherently designed for reliability by distribution of process control functions across multiple PLC Processors and I/O Cards. Care shall be taken in implementing the PLC Control System design such that single component failures should not disable the entire PLC Control System. Consideration should be given to division of control logic according to process systems and/or equipment packages. To minimize process interruptions due to PLC failures, where redundant process equipment exists, each piece of redundant equipment shall be controlled by I/O points on separate I/O cards (to the maximum extent possible).

3. The PLC Control System as commissioned shall provide generous room for system expansion and optimization. No more than 60 percent of the available PLC system memory shall be used. Modular I/O racks shall be sized for 20 percent unassigned card slots. I/O terminal strips shall be sized to provide 30 percent unused terminals, including fused terminals. At least 20 percent spare I/O points shall be supplied, fully installed and wired to field terminal strips.

4. All PLC Control Systems shall be design and implemented in accordance with the PLC manufacturer's recommendations. This shall include recommended techniques for voltage and power separation, grounding, and surge and noise suppression.

5. All Emergency Stop and other personnel safety (and critical equipment, where noted) interlocks should hardwired utilizing conventional relays. Except for these safety interlocks, all other process interlocks should be implemented in software using the supplied programmable controllers.

6. Separate PLC inputs and outputs shall be used for connection of each device to the PLC Control System. The use of parallel or series wired circuit applications will require written approval from the Engineer's or Owner's. An exception to this requirement would be the application of pilot lights for indicating the status of an input device, which need not be connected to an output module.

7. Field device terminations and wiring will be routed to the field terminal strips located in the associated Control Panel or I/O Cabinet where the PLC I/O points will be located. Different voltage levels will be segregated and clearly labeled to prevent personnel injury and damage to instrumentation and controls.

8. The scan time of the PLC program shall be sufficiently fast to support the normal and emergency operation of the attached equipment. Under no circumstances shall the overall scan time exceed 300 millisecond.

9. Except for safety interlocks, all electrically operated equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored. Upon loss of electrical power, all PLC outputs shall "de-energize" due to loss of electrical power but shall resume their previous states when the power is restored. "Failed to Start" and "Failed in Operation" alarming shall be provided to warn the operator of the loss of power conditions that may be due to Utility power failures, wiring faults, breaker or fuse trips, or equipment malfunction.

10. The PLC System shall be designed for ease of maintenance. All configuration dipswitches and jumpers on the PLC Processors, I/O Racks, I/O Modules, and Interface modules shall be set appropriately by the PLC Supplier. The PLC I/O System shall be configured to group like I/O modules together with appropriately labeling and "keying"to minimize the potential for improper placement of replacement modules.

11. PLC Processors and I/O Modules shall be provided with Conformal Coatings when it is expected that they will be located in highly corrosive or high humidity environments.

C. PLC Hardware Requirements

1. Central Processing Unit – PLC Processor
   a. The central processing unit shall have sufficient instructions to perform all data manipulation, arithmetic functions (+, -, X, /, =), function block operations, and binary logic required or reasonable anticipated for each application. The ability to perform PID type Control shall be supplied where continuous analog process control functions will be required or may be utilized in the future. Where extensive floating point mathematics will or could be utilized, a built-in or separate Math Coprocessor shall be supplied.
   b. The central processing unit shall support Relay Ladder Logic. The use of Relay Ladder Logic to implement interlock and process control in each programmable controller is recommended. Other languages (for example, BASIC, Statement Lists, Function Blocks, Sequential Function Charts, or Boolean) may be used only with the Engineer's or Owner's written approval.

c. The basic functionally (PLC programming instructions) of each central processor shall be implemented utilizing permanent non-volatile memory (firmware). The preference is for each PLC processor would be to utilize flash memory so that PROM or EPROM memory modules will not have to be "swapped out" to upgrade the functionality of each processor. The supplier shall state each PLC processors' firmware upgrade method in his submittals.

d. The User/Application program for each PLC processor shall be stored in low power CMOS type RAM memory, EEPROM, or flash memory modules as appropriate for each application and the type of PLC processor chosen. Sufficient User/Application program memory shall be supplied with each PLC Processor in accordance with the Contract Requirements and with the PLC Design Criteria as listed in Paragraph 2.03B above. All PLC programs shall be retained during power outages through the use of battery backed up RAM or EEPROM (or flash memory modules). Wherever batteries are used, lithium batteries shall be utilized and the PLC processor shall be programmed for low battery alarming. The supplier shall state list the amount and type of memory supplied with each PLC processor. The anticipated memory use in each application (PLC Program memory requirement is usually provided as feature of the PLC programming package) shall be provided as integral part of his PLC submittals.

e. The PLC processor shall be furnished with the ability to communicate with the following external devices:

   i) Personal Computer – for programming/troubleshooting

   ii) Local Operator Interface, if required

   iii) Remote I/O Modules

   iv) Networking connection to other PLC Processors or Plant Control System utilizing the vendor's standard communication protocol or ModBus RTU protocol as agreed with Engineer or Owner.

2. PLC Power Supplies

   a. Supplier shall furnish all power supplies and line filtering equipment required for continuous operation of the PLC system. AC power may be feed from a central or distributed (local to each PLC or Control Panel) Uninterruptible Power Supply (UPS) System as determined by the Contract drawings and as defined in Section 2.03D below.

   b. Each individual power supply and separately powered component of the PLC system shall be capable of operating from an external AC power source. Typically, this will be a 120VAC Power source from the plant electrical system. Consult with the Engineer and Owner, if alternate DC or AC power sources can be utilized. Units that receive a 120VAC power source, shall be capable of operating under the following conditions without degrading performance of any component of the PLC system:

      v) Input Voltage of 120 VAC +/- 10 percent

      vi) Input Frequency of 60 Hz +/- 2 Hertz

      vii) Ambient Temperature: See Site Operating Conditions as stated in Contract Specification 13000 Section "Project/Site Requirements".

3. I/O Racks

   a. I/O Modules associated with each PLC processor can be mounted local or remotely to the PLC processor depending on I/O density and individual application. Smaller capacity PLC processors are often packaged together with a small amount of I/O in a compact mounting base. For applications where more than several dozen I/O points are to be located at a particular location, the preference will be for I/O points to be

implemented utilizing plug-in I/O modules in a modular of I/O Cabinet/Rack. This approach will allow for greater expansion and flexibility in the quantity and type of I/O available now and at the future at each I/O location.

b. In addition to the current I/O requirements, PLC I/O racks shall be chosen to allow for the required percentage of future I/O expansion in terms of I/O points and I/O Module spare slots (to allow for other types of I/O modules as well as addition of additional existing I/O module types). Multiple I/O racks may be needed at each location to accommodate the current and future I/O requirements. I/O racks shall be distributed to minimize cable runs and accordingly to the distribution of process control functions by process systems.

c. All PLC I/O points whether provided as plug-in modules or in Fixed I/O mounting bases shall be supplied with all installation and maintenance, mounting hardware, interconnect cabling, and associated remote I/O and "Outside World" interfaces. Modular I/O Racks shall be mounted and wired such that individual I/O modules can be removed without disconnection of field or interconnection wiring.

d. All dipswitches or jumpers shall be configured and set for proper operation on all PLC Hardware including PLC Processors, I/O Racks, I/O Modules, and External Interfaces. Modular I/O Racks shall be mounted and wired such that individual I/O modules can be removed without disconnection of field or interconnection wiring.

4. I/O Modules
   a. Digital (Discrete) Inputs
      i) The discrete input modules shall be able to accept inputs from field devices such as limit switches and pushbuttons. Each discrete input point shall be optically isolated (provide at least 1,000V isolation) from the internal electronics of the I/O card. The energized state of an each PLC input shall be indicated with light emitting diodes.
      ii) The discrete input modules shall be able to detect and eliminate relay chattering or contact bouncing.
      iii) High density digital inputs utilizing 16 points per card shall be used whenever a large number of devices of a given signal level are required. Higher density modules utilizing 32 points per module shall not be used without the Engineer's or Owner's approval.
   b. Digital (Discrete) Outputs
      i) The discrete output modules shall be able to activate solenoids, motor starters (up to size 3 preferably), and coils with loading of up to 2 amps per output point. Each discrete output point shall be optically isolated (provide at least 1,000V isolation) from the output card electronics. The individual outputs shall have light emitting diodes to indicate when the output is energized.
      ii) The current rating of most PLC Outputs usually prevents the interfacing to motor starter coils above NEMA Size 3. When interfacing to larger inductive loads, the PLC supplier shall be responsible to coordinate the use of Interposing relays to be located at the PLC I/O Card (in this case to be supplied by the PLC Supplier) or to located at the external load (provided by others). In disputes over scope of supply, the PLC supplier shall provide the appropriate relays or other interfacing hardware to implement the control of the external load(s).
      iii) Internal suppression shall be provided to prevent false triggering. External surge suppressors shall be provided for large inductive loads. External loading characteristics including minimum loads for Triacs and maximum inductive loads

shall be stated. These loading characteristics shall be observed in the selection and interfacing to contractor supplied instrumentation and controls.

iv) When digital outputs that contain TRIACs are utilized, care shall be taken when interfacing with high input impedance loads like PLC Inputs or VFD Control Circuits. The high leakage current of some TRIAC's outputs may prevent the device from detecting that the PLC output has turned "OFF". In such cases, the PLC supplier shall be responsible to add interposing relays or change the type of PLC Output card to allow proper operation of the controlled device.

v) High density digital outputs utilizing 16 points per card shall be used whenever a large number of devices of a given signal level are required. Higher density modules utilizing 32 points per module shall not be used without the Engineer's or Owner's approval.

c. Analog Inputs

i) The analog input modules shall receive analog signals (low voltage or low current) from field instrumentation (transmitters, transducers, etc). The received analog signals shall be converted to a digital signal inside the Analog Input Module. The analog to digital conversion shall be implemented by A/D converters that are optically isolated from the field inputs (provide at least 1,000V isolation).

ii) Analog Inputs shall be continuous converted to a digital value with detection of under-range and over-range signals. Preferably, each analog input point shall be connected to a separate A/D converter (not more than 8 analog inputs should be connected to a single A/D converter). The A/D conversion resolution shall be at least 12 bits.

iii) Use of single ended input cards is prohibited – all analog inputs shall be individually isolated relative to each other point on the same I/O card or PLC Cabinet. When interfacing to non-isolated devices, the PLC supplier shall be responsible to provide signal isolators or isolated input modules (differential mode inputs) to prevent ground loops and to insure that accurate and repeatable signals are received from the transmitting device. Analog inputs associated with the use of surge protection or intrinsic safety barriers may require isolated (differential mode) input modules. Careful consideration shall be taken before mixing 2 wire and 4 wire transmitters on the same I/O Card or series'ing 2 wire and 4 wire devices together as a common analog input.

iv) Whenever appropriate for the given application, analog signals shall be standardized on 4-20 ma DC. However, for a large number of thermocouple and RTD inputs (sufficient to justify the non-standard cable type required), a dedicated purpose temperature input module is preferred over the use of transmitters for the sole purpose of signal conversion to 4-20 ma DC. Thermocouple inputs shall have cold junction compensation and RTD inputs shall ambient temperature compensation and lead wire length compensation. Temperature modules shall automatically convert the measurement to temperature measurement in terms of degrees Celsius or Fahrenheit as selected.

v) When interfacing to smart transmitters (especially those that utilize carrier wave signals like HART Protocol), the PLC Supplier shall choose I/O Modules that are compatible with the transmitted signal and/or shall utilize signal conditioning devices to prevent interference to the I/O module's input circuitry.

vi) Multi-point analog input modules utilizing 8 points per card shall be used whenever a large number of devices of a given signal level are required. Higher

density modules utilizing 16 points per module shall not be used without the Engineer's or Owner's approval.

d. Analog Outputs

i) The analog output modules shall send analog signals (low voltage or low current) to field instrumentation (panel meters, metering pumps, VFDs, etc). Discrete output signals inside the Analog Output Module shall be converted to analog output signals. The Digital to Analog conversion shall be implemented by D/A converters that are optically isolated from the field inputs (provide at least 1,000V isolation).

ii) All Analog Output signals shall be 2 wire type isolated regulated outputs. Preferably, each analog output point shall be connected to a separate D/A converter (not more than 8 analog outputs should be connected to a single D/A converter). The D/A conversion resolution shall be at least 12 bits.

iii) Whenever appropriate for the given application, analog signals shall be standardized on 4-20 ma DC. All analog outputs shall be PLC powered (2 wire) and individual isolated. Preference is for voltage outputs to be generated via adding a voltage dropping resistor to current type analog output signals. Current regulated analog outputs shall be capable of driving at least at least a 600 ohm load utilizing a nominal 24V volt power supply. Voltage regulated analog outputs shall be capable of driving at least a mega ohm load.

iv) When interfacing to smart devices (especially those that utilize carrier wave signals like HART Protocol), the PLC Supplier shall choose I/O Modules that are compatible with the smart device and/or shall utilize signal conditioning devices to prevent interference to the I/O module's output circuitry. Loop Isolators may be required when outputting to more than one smart device or to a smart device in series with a non-smart device.

v) Multi-point analog output modules utilizing 8 points per card shall be used whenever a large number of analog outputs are required. Higher density modules utilizing 16 points per module shall not be used without the Engineer's or Owner's approval.

e. Frequency (High Speed Counter) Inputs

i) Where required provide special high speed counter modules to accept frequency type inputs from devices such as flow meters, motion detectors, and other pulse generating equipment. Each input shall be locally counted integral to the I/O module such that current setting of the PLC Scan time will not cause any inaccuracy in measuring the pulse count. Each input shall be selectable for local or external power and shall have the ability to accept a range of voltage inputs. The energized state of an input shall be indicated with light emitting diodes. Internal protection shall be provided to protect against external voltage transients.

ii) Multi-point frequency input modules utilizing 4 points per card shall be used whenever a large number of frequency measurements are required. Higher density cards utilizing 16 points per module shall not be used without the Engineer's or Owner's approval.

f. Serial Data Ports

i) The PLC System shall have the ability to communication to programming terminals and/or other communication links utilizing Serial Data Ports where required for each application (see Contract Drawings). Serial Data Ports shall be supplied as part of the PLC Processor or as separate modules as required.

ii) The preferred interface for Serial Data Ports shall be EIA-422 (or EIA-485). However, whenever interconnecting devices support only EIA-232-C, the PLC Supplier shall take into account the cabling distances between the Serial Port at the PLC and the connection to any intelligent field device. For any applications requiring installed cable lengths in excess of 50 feet, the PLC Supplier shall furnish and install appropriate line driver modems.

iii) The PLC Supplier shall configure all serial data ports and furnish all communication drivers or protocol converters to reliably and efficiently communicate to specified systems as required for each application.

5. Data Highway Links
   a. The PLC System shall be furnished with the ability to communicate to other PLC Processors or to the overall (new and existing) Instrumentation and Control System for the Plant (Telemetry, SCADA or DCS monitoring and control system(s)).
   b. The PLC Supplier shall provide serial and/or network interfaces to facilitate the required communication in accordance with the network configuration requirements and data transfer rates required for each application. Provide all hardware components, standard communication drivers, and any application software required to satisfy these functional requirements.

6. Portable Programming Terminal – as Required
   a. Where shown on the Contract Drawings, the PLC Supplier shall supply a Portable Programming Computer (laptop) complete with PLC Programming (Offline) and Online Diagnostic Software (and Local HMI programming and diagnostic software where supplied).
   b. The portable PLC programming terminal shall be an IBM compatible personal computer (laptop) with the appropriate hardware interface module(s) to permit program downloading to, and program uploading from each type of PLC Processors supplied. The terminal shall provide a means of monitoring program execution and overall system status. Terminal interactions such as I/O forcing, data manipulation, and system initiation shall be supported by the programming terminal. Each terminal shall be furnished with the necessary software for on-line and off-line program development and off-line program documentation. Each programming terminal shall be provided with sufficient storage capacity to act as a programming terminal for the programmable controller as well as for the MMI/OIT, if supplied.
   c. Minimum Specifications for the portable PLC programming terminal:
      i) New Laptop Computer containing at least 2 Gigahertz CPU with at least one year manufacturer's warranty
      ii) Operating System: Microsoft Windows 7 Professional including the latest service packs
      iii) RAM Memory: at least 4 Gigabytes
      iv) DVD Drive
      v) Hard Drive: at least 500 Megabytes
      vi) 56K Modem
      vii) At least one Communication Port either as a RS-232 or USB port for external communications
      viii) Parallel or USB Port for Printer communication

7. Operator Interface Terminals (OIT) – as Required
   a. Where shown on the Contract Drawings, the PLC Supplier shall supply local Operator Interface Terminals (OIT) at each local Control Panel for each of maintenance and troubleshooting.
   b. The Operator Interface Terminals shall display graphical representations or schematics of the processes and equipment. Data shall be presented in the conventional overview, group, and point hierarchical display scheme. Formats shall be the Supplier's standard unless otherwise specified. A chronological alarm summary that displays the most recent points in alarm shall also be provided
   c. Each Operator Interface Terminal shall be equipped with an alarm annunciation horn that sounds when a new alarm is detected. A minimum of seven (7) dedicated function buttons at each Operator Workstation shall give the operator a single-button command to perform certain predetermined functions. Optionally, this may be accomplished by way of monitor touch screen targets or predefined callup keys. Under password security control, the operator shall also be able to adjust tuning constants and control parameters of modulating control loops.
   d. Operator Workstation shall utilize at least an INTEL 80486DX2-66 MHz or Pentium Central Processor Unit (CPU)-based IBM Personal Computer (PC) or 100% compatible alternative. The CPU shall operate at a clock rate of at least 66 MHz. A math co-processor, parallel communications port, and at least one serial communications port shall be provided.
   e. Random Access Memory (RAM) of at least 8 Mbytes and mass storage capacity of at least 512 Megabytes are required; however, the system provided shall be based upon the minimum requirements of the application software with appropriate allowance for future expansion. The video display driver shall provide 256 colors at 640 x 480 resolution and 512 Kbyte Video RAM.
   f. Removable mass storage shall be provided by an internal CD or DVD drive. A network interface compatible with IEEE 802.3 Ethernet CSMA/CD protocol will be provided if specified on the Contract Drawings. Physical connection via 10Base2 "thin wire" coaxial cable is preferred.
   g. Real-time, multi-tasking Operating System (OS) such as VMS, UNIX, MS Windows XP, or MS WINDOWS 7 is required with WINDOWS 7 being preferred.
   h. A LCD type color monitor of at least 12" inches diagonal is required. A keyboard or sealed touch screen incorporating environmental protection for switch contacts and active electronic components is required. A cursor control device or touch screen shall be provided; a track ball is preferred over a mouse and touch screen preferred over trackball. Each Operator Workstation shall be integrated into a NEMA 3R/4-rated industrial cabinet with work space area and good ergonomical design. All operator consoles should include at least one PLC I/O rack to minimize the number of control panels.
   i. For each type of OIT hardware provided for the project, the supplier shall include a fully licensed and fully functional copy of the programming and diagnostic software (capable of offline and online operation) for said furnished device. This software will be installed on the programming laptop furnished with the project for PLC programming and troubleshooting. As approved copies of all configuration files relative to the configuration of the furnished OIT's and/or HMI interface terminals shall also be stored on the hardwire of the furnished PLC Programming laptop and made available to the Owner for his use prior to the start of Substantial Completion and if possible during the Continuous Operations Testing phase of the project proceeding

Substantial Competition. In all other aspects this OIT/HMI programming and diagnostic software and associated configuration files shall comply with the requirements of the PLC Software Development section below as far as scope of supply and submittal and approval of what is furnished by this requirement.

D. Power and Grounding Requirements

1. External power connections (AC or DC) to PLC Equipment shall be installed in accordance with the manufacturer requirements and shall have surge and lightning protection in accordance with Contract Specification 13270 "Surge and Lighting Protection".

2. AC Power feeds to PLC Equipment and associated instrumentation shall be supplied from Isolation Transformers that are properly grounded in accordance with the National Electrical Code and the PLC Manufacturer's recommendations (typically this would required a Grounded Neutral on the transformer secondary side that is connected thru a dedicated grounding conductor to each connected AC power load).

3. For those projects where the voltage tolerance of the AC power feed exceeds the requirements of the connected PLC Equipment, a constant voltage transformer of sufficient size shall supply power to each PLC processor and remote I/O power supply. Additionally, this transformer shall be sized to accommodate all powered Digital inputs to the PLC System.

4. To minimize the impact of momentary power interruptions (loss of operating state of process equipment, need to reload PLC programs, loss of diagnostic information, etc.), the AC Power feed to the PLC System shall be feed from a central or distributed (local to each PLC or Control Panel) Uninterruptible Power Supply (UPS) System. Failure of the UPS System shall be alarmed locally at each unit with remote status via input to the PLC System.

5. When Control Panels and/or I/O Cabinets are provided, a dedicated circuit breaker protected outlet connected to the PLC power source shall be provided for use by a portable PLC programming terminal. Conventional convenience outlets and panel lighting shall be powered from a separate miscellaneous power panel circuit.

6. Since solid state circuits (especially for PLC processors and Analog I/O points) associated with Programmable Controllers utilize low voltage signals, it is critical that the PLC System be properly grounded to a low impedance earth ground in accordance with National Electrical Code and the PLC Manufacturer's recommendations. The Supplier shall coordinate the grounding of the PLC System with the Electrical Contractor and submit his Power and Grounding design to the Engineer for approval prior to Installation.

7. PLC Outputs connected to motor starters or VFD's should be powered externally from the control power associated the individual starter or drive. This will require Isolated Output cards for such motor control. Status Contacts from the motor starter or VFD should be powered via the normal power distribution at the PLC I/O Card.

8. AC Power distribution to I/O Cards shall be distributed thru dedicated circuit breakers. Power distribution shall be designed to minimize the potential for the loss of a power feeder (tripping circuit breaker or melting feeder cable or distribution wiring) when one or more connected PLC I/O Points are shorted. An example of this design would be that a single power feeder (20 Amp Circuit Breaker) should not feed more than 16 PLC Outputs (Max Output of 2 Amps each). Similarly, a single power feeder should not feed more than 32 PLC Inputs.

9. Additionally, AC Power Distribution should be fused protected to limit the loss of PLC information due to wiring shorts. An example of this requirement would be to provide power distribution fuses (via fused terminal blocks with blown fuse indication) for every individual discrete PLC outputs and every four (4) discrete PLC inputs. Additionally, all 24V DC distribution to individual analog I/O points should be individually fused (with blown fuse indication).

10. Power distribution wiring should be "doubly feed" such that the loss of one jumper wire or the removal of one terminal block will not affect the other I/O points being feed. This applies to both the 120 VAC Hot and Neutral jumper'ing for AC Power distribution and for +24V DC and Neutral (-24V DC) for DC Power Distribution.

E. PLC Software Development

1. PLC software documentation shall be developed on an approved, commercially available, personal computer based PLC program development system. Except for standardized vendor equipment packages, all custom PLC Programming shall attempt to utilize the program development package currently preferred by the Owner. Should there be no Owner preference; the supplier shall confirm his choice of PLC program development package with the Engineer. Should the package chosen be non-standard for the Owner, the supplier shall include furnish one fully functional and licensed copy of the package with his PLC equipment. In all cases when a portable programming terminal is furnished with the PLC equipment, a copy of the PLC program development software shall be loaded on and supplied with the terminal. This software package shall be fully functional and capable of online and offline programming of the supplied PLC Processors. All instruction manuals shall be included and the program shall be registered to the Owner with license/registration fees paid for support and program updates thru the one-year warranty period after substantial completion.

2. PLC Software submittals shall consist of 2 hard copies of fully commented source code (with detailed Rung and Element comments). After substantial completion and approval of the PLC Software submittal, the PLC supplier shall furnish two hard copies of the fully commented source code and three sets of all source code and executable code in machine-readable format (CD-ROMs). The PLC Supplier shall retain a record copy of all as commissioned software media for a period of at least 1 year after substantial completion.

3. The PLC program when loaded on each PLC processors shall be password protected to prevent modification of the program by unauthorized personnel. If possible, multiple levels of passwords shall be implemented. Maintenance functions like forcing contacts and changing timer values shall be protected by a different password than full program change access.

4. Upon substantial completion in agreement with the Owner, the PLC Supplier shall reset the final password(s) for all PLC program furnished to those preferred by the Owner.

5. The PLC Program shall include monitoring of PLC diagnostic information (PLC memory errors, Low Battery Alarm, PLC Faults, Communication errors). PLC Diagnostic errors shall be time stamped and logged to facilitate troubleshooting of non-catastrophic PLC failures.

6. PLC serial or network interfaces to external monitoring and control systems – Telemetry, SCADA, DCS, etc shall be coordinated with the respective supplier. Additional programming to detect external communication failures and/or loss of data shall be implemented by the PLC Supplier. This may include adding Watchdog Timers to be reset

by the external system(s) or the sending of periodic "heart-beat" type communications to external system(s). Communication failures shall be logged and alarmed. Additional control actions may be required as a result of loss of communication.

2.04 MAINTENANCE REQUIREMENTS

A. Maintenance Requirements of all programmable controller hardware and software shall be in full conformance with the Contract Specifications and with Division 13 Contract Specification 13000 Section "Maintenance Requirements" and as specified herein.

B. Maintenance Requirements of all associated Control Panels and/or I/O Cabinets shall be in full conformance with the Contract Specifications and with Division 13 Contract Specification 13200 Section "Maintenance Requirements".

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. PLC Equipment supplied under this section shall be installed per the Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Controls – General Provisions" and Division 13 Contract Specification 13270 – "Surge and Lightning Protection".

B. All PLC Equipment and associated instrumentation and controls shall be installed in accordance with the manufacturer's instructions. The locations of PLC processors, control panels, and I/O Cabinets shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of instrumentation and controls work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

C. PLC Equipment and associated instrumentation and controls furnished under this specification shall be factory tested prior to shipment. Field installation shall consist only of setting the equipment in place and making necessary electrical and pneumatic external connections.

D. The supplier shall be responsible for checking out grounding and other safe operation concerns for all supplied control panels, PLC hardware, and other sensitive electrical or electronic control system equipment prior to energization of temporary or permanent power supplies.

E. All furnished equipment shall at all times during construction be adequately protected against mechanical injury, water damage, corrosion, dirt, dust and foreign material. Equipment equipped with internal electrical heaters shall have them energized to keep the equipment dry. Doors to control panels and I/O cabinets shall be kept closed at all times when work on them is not being done. Control Panels, Analyzers, sensitive electronic or computer equipment and/or controls or other materials not sealed and/or suitable for continuous outdoors storage shall not be stored out-of-doors. Such Instrumentation and Controls shall be stored in dry permanent shelters. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner, the damaged units or systems shall remain on site and returned to the manufacturer after the replacement units or systems have been delivered to the site. Under no circumstances will instrumentation or controls equipment damaged by water be rehabilitated or repaired, new equipment shall be supplied, and all costs associated with replacement shall be borne by the Contractor.

F. Any damage to factory applied paint finish shall be repaired using touch-up paint furnished by the instrument or equipment manufacturer. The entire damaged enclosure panel or section shall be repainted per the contract field painting specifications, at no additional cost to the Owner.

3.02 INSPECTION AND TESTING

A. PLC Equipment supplied under this section shall be inspected and tested per the Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Cotnrols – General Provisions" and Division 13 Contract Specification 13270 "Surge and Lightning Protection".

B. Test all instrumentation and control system components furnished under this Specification and repair or replace all defective equipment or work. Make all necessary adjustments and instruct the Owner's personnel in the proper operation of the instrumentation and controls provided.

C. All PLC Equipment supplied shall have a 100 % point to point wiring checkout prior to being shipped from the supplier or panel fabricator. All PLC I/O shall be "real world" simulated from I/O card to/from the panel mounted devices or field terminal blocks. Virtual I/O communication links shall be tested and verified for fully functionality per approved PLC or DCS Software Submittals. All Virtual I/O points shall be tested or simulated to demonstrate functionality and demonstration failure diagnostic functions. Engineer and/or Owner shall have to opportunity to witness all testing.

D. Test grounding and verify any other safe operation concerns associated with all supplied control panels, PLC hardware, intrinsic safety equipment, and other sensitive electrical or electronic control system equipment prior to energization. Supplier shall certify that the grounding and installation is in conformance with the manufacturer's warranty requirements prior to providing temporary or permanent power to any supplied equipment. Submit copies of certified installation and grounding test reports.

E. Prior to plant operation, test all instrumentation, controls, and interlocks to verify that the instrumentation and control systems will function properly and as indicated by the Contract Drawings and as noted in the approved shop drawings. Verify wiring installation against loop sheets and interconnect wiring Verify software I/O addressing and configuration against detailed software engineering documents. Virtual I/O communication links shall be tested and verified for fully functionality per approved PLC Software Submittals.

F. All testing shall be scheduled and coordinated by the Contractor. Notify the Engineer and Owner at least two (2) weeks in advance of conducting tests. The Contractor or Subcontractors under this Division shall have qualified personnel present during all testing.

G. All test data and procedures followed during testing shall be logged, and certified copies of the logs shall be provided to the Engineer and Owner.

3.03 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner or clean lint-free rags. Do not use compressed air.

3.04 TRAINING

A. Programmable Controller Equipment and associated instrumentation and controls supplied under this section shall be incorporated in the overall training plan as required by the Contract Specifications including Division 13 Contract Specification 13000 "Instrumentation and Controls – General Provisions".

END OF SECTION 13400

SECTION 13500
DISTRIBUTED CONTROL SYSTEM (DCS)

PART 1 - GENERAL

1.01 SCOPE

A. Work described in this Section includes furnishing all labor, material, and software required to furnish, install, test, calibrate, place in operation, and document an extension to the existing Foxboro Distributed Control System (DCS) at RM Clayton WRC to serve as a remote communication and monitoring link to the new Plant Control System at the North Fork Peachtree Creek project site and configured by the DCS system integrator as required by the Contract Drawings and in this Section. This virtual communication link shall be complete and fully function and shall display all process information present at the remote site with limited remote control functionality. New Foxboro Graphics shall be added to the existing Foxboro DCS System at the RM Clayton WRC for the Liddell Drive Equalization Facility. Graphics shall be similar to other COA Deep Well Pump Stations and shall follow all COA graphics standards. Note that due to the project design there will be two separate PLC control systems for the project – one housed in a Local Control Panel in the Diversion Facility Electrical Building and a separate one housed in a Local Control Panel in the Equalization Facility Electrical Building.

B. Provide DCS training of the City's personnel at the DCS Supplier's facility and at the job site.

C. Update the existing City systems to the latest level of software consistent with the new system.

D. Provide a DCS maintenance contract.

E. Provide DCS guarantees and warranties.

F. The following DCS system integrators are pre-qualified to perform the work specified in Section 13500 without the need to provide Evidence of Experience:

1. Foxboro Company
   Patrick Young
   678-421-2325
   706-407-8038 (cell)
2. Feedforward, Inc.
   Craig Mercer
   770-426-4422
   cmercer@feedforward.com
3. Contractor-proposed DCS Systems Integrator shall be evaluated based on submittal of the following Evidence of Experience:
   a. Submit evidence of experience in performing three similar successful projects in the last five years with one project currently in progress or competed within the last two years.
   b. Submit project descriptions with contact names, addresses, and telephone numbers from the project Owner, General Contractor, and Principal Design Firm.
   c. Submit organization chart and resumes for proposed project personnel.
   d. Submit Training and Certification information. Completion of the following training courses or appropriate portions thereof or possession of the following certifications

included with the Systems Integrator's personnel experience requirements described above:

i) Project manager: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.

ii) Systems engineer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Engineering Skills Training program.

iii) Programmer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.

iv) Field instrument technician: Certified Control Systems Technician (CCST) registration or completion of the relevant core courses in the Technical Skills Training program.

v) Certified training programs, as offered by ISA.

e. Submit financial data for Systems Integrator division when subsidiary to a parent corporation. Include two years of financial data.

i) Financial Statement.

ii) Balance Sheet.

iii) Dun & Bradstreet Report.

f. This submittal is due no later than two (2) weeks prior to bid date. Bidders will be advised of approval or rejection in writing no later than fourteen days prior to Bid Date. Rejected submittals may be supplemented with additional information and resubmitted no later than one (1) week prior to the Bid Date. Bidders making supplementary submittals will be advised of approval or rejection in writing no later than three (3) days prior to Bid Date.

4. Approval of a completed Evidence of Experience by the Engineer is dependent on his determination that the proposed system integrator has sufficient company experience, company expertise, and experienced qualified personnel in new and remodeling work of municipal instrumentation and control systems, has the ability to understand and perform the Work specified, has sufficient financial resources and has not had a detrimental impact to the scope on prior construction projects.

G. Related Work Specified Elsewhere:

1. Division 1 General Requirements
2. Section 13000 Instrumentation and Controls - General Requirements

H. Liddel Drive Equalization Facility Plant Control System configuration as described in the Specification Section 13150 Instrumentation and Controls - Control Logics Descriptions and shown on the P&IDs.

1.02 TESTING

A. Factory Testing:

1. The complete DCS including all hardware, software, and interconnections shall be staged and tested at the factory prior to shipment. The Factory Test shall verify that the configured DCS conforms to requirements. The test shall conform to Section 8, Recommended Tests for Interacting Systems, established by the Instrument Society of America under Standard

RP 55.1, unless otherwise required. The test shall simulate all operating conditions including steady-state, start-up, shutdown, and power failure. Testing shall not relieve the Contractor or the DCS supplier from requirements herein.

2. Preparation: The test may be witnessed by the Engineer. Provide written notice of start date twenty (20) days prior to beginning the test. Submit procedures thirty (30) days prior to beginning the test. Procedures shall include a schedule of each step, the expected results, and the method for discrepancy resolution.

3. Configuration Audit: Audit the hardware and software provided. Verify conformance of the staged hardware to the approved configuration. Verify cabling, module configuration (including spare slots and connectors), spare components, expandability, physical appearance, and workmanship. Audit software by title, revision identification and date, and other identifying information. Verify availability of all necessary test equipment.

4. Human Interface: Verify the operation of each human interface device including hardcopy generators, monitors, touch screens, function panels, keyboards, mice, and trackballs. Verify displays including environment configurations, passwords, security, etc. Verify operator navigation within the overall display structure. Verify each display for layout, symbols, colors, etc.

5. Data Acquisition: Test the system database using module configuration data sheets as a guide. Verify analog inputs at three points rising and falling (0, 50, and 100 percent). Verify each alarm function. Verify scan rate, offset or gain, filtering, delta band, and engineering units. Toggle digital inputs to verify functions and scan rate.

6. Loop Functions: Verify the automatic and manual functions of each loop using I/O simulation. Verify interfaces to other systems using communication emulators. Test or simulate all virtual communications links to verify functionality and demonstration failure diagnostic functions.

7. Data Management Testing: Verify Application Processor and Historian data collection, retrieval, display, and reporting periodically during the test using manually entered data and real time data collected by simulation.

8. Failure Mode Testing: Test all failure modes including loss of primary power source, loss of communications (Fieldbus, Nodebus, or LAN), loss of primary fault tolerant processors, loss of system communications (Fieldbus, Nodebus, or LAN), and loss of primary hardcopy devices.

9. For redundant communication links, verify that no single point of communications failure results in loss of function. Disconnect the primary communication cable (Fieldbus, Nodebus, or LAN), and verify that the automatic switchover to the redundant link is transparent to operation with no degradation of data transfer. Verify proper operation after reconnecting the cable.

10. Shut down or physically remove fault tolerant devices and verify no degradation of operation.

11. Verify the transfer of functions among hardcopy devices upon device failure.

12. Diagnostics: Verify the network diagnostics provided using the System Management Display Handler (SMDH). Alarms generated during the previous phase shall be observed, investigated as to the cause, and acknowledged through SMDH displays. Review performance information statistics. Verify on-line diagnostics.

13. Documentation: Provide evidence that each step has been satisfactorily performed. Include itemized check lists for each step and a witness signature area. Indicate any unresolved concerns. Provide all hardcopy information generated during the test.

14. The DCS shall not be shipped until the Factory Test and associated documentation has been satisfactorily completed as determined by the Engineer. Factory Testing shall also conform to the Pre-operation Testing requirements of the General Conditions Specifications including Section 01650 Facility Startup.

15. The cost of travel, meals, and lodging for the City's personnel while witnessing the test shall be paid from the travel and subsistence allowance.

B. Operational Field Testing:

1. Check and approve the installation and connection of all DCS components prior to placing them into operation.

2. Repeat the following steps of the Factory Test:
   a. Configuration Audit.
   b. Human Interface.
   c. Failure Mode Testing.
   d. Diagnostics.

3. Assist with the Installed Tests and Inspections of Section 13000 - Instrumentation and Controls – General Provisions. Provide all test equipment necessary to perform the DCS testing.

C. Functional Field Testing:

1. Perform a complete system test to verify that all equipment and software is operating properly as a fully integrated on-line system. Verify that the intended monitoring and control functions are fully implemented and operational. Tune control loops as required.

2. Functional Field Testing shall also include all testing and documentation required for Functional Testing requirements of the General Conditions Specifications including Section 01650 Facility Startup.

3. The system guarantee and warranty period shall begin upon successful completion of the 30 days Acceptance testing as described in Spec Section 01650..

1.03 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions and Special Conditions Sections of the Contract Documents and with Contract Specification 13000. In addition, the following specific information shall be provided:

1. Preliminary loop drawings in general accordance with ISA S5.4. At the DCS end show FBM connections and as a minimum the I/O block definition. Make provisions to show all components and associated connections required including the following information:

2. Tag numbers of each item.

3. Functional name of each item.

4. Manufacturer's model or catalog number for each item.

5. Location of each item.
6. Loop wiring drawings for panels and field components provided under Section Instrument Panels
7. Prior to the Operational Field Testing, provide updated loop drawings with all information as required above.
8. Field signal input/output (I/O) list with each point individually listed and cross-referenced to the loop drawings. Include updated versions of all additional or revised I/O points for this contract.
9. Virtual PLC I/O lists for each interfaced stand-alone control systems. Submitted Virtual Communication information shall include a complete list of all PLC I/O points that are being communicated virtually to and from each furnished PLC and shall provide project and vendor specific information on the type of communication protocol being proposed, complete listing of all virtual I/O points available in each interfaced device, vendor specific internal addressing, and the recommended/required points being proposed to be communicated over each required Virtual Communication Link.
10. Legend and abbreviation list.
11. DCS interconnection drawings showing all equipment, equipment locations, interconnecting cables and connectors with lengths indicated, and communication links. For Virtual Communication Links provide details on the DCS Foreign Device gateways and associated connections to remote Division 13 Control Systems (Plant Control System at the Liddell Drive Equalization Facility provided under Division 13 Specifications including Specification 13400) and any new hardware required to interface to existing DCS data highways. If non-division 13 virtual communication links are required for the project – provide similar information for those links.Enclosure layout drawings including the following information:
    a. Front, side, and plan views.
    b. Dimensions.
    c. Nameplate legend including text, letter size, and colors to be used.
    d. Terminal block designations cross referenced to the I/O list.
12. Complete material and software list. Identify software components by title, functional description, revision identification and date, and other appropriate identifying information.
13. Provide the following product information for each component provided.
    a. Manufacturer's product name and number.
    b. Tag number (if applicable).
    c. Functional name.
    d. Description of construction and features.
    e. Performance data.
    f. Service requirements (power, environment, etc.).
    g. Dimensions.
14. Drawings shall be prepared using latest version of AutoCAD and shall be provided on hardcopy and CD-Rom media.

1.04 FINAL DOCUMENTATION

A. Provide the following Operation and Maintenance Manuals:

1. In printed form supplied in indexed, 3-ring binders (2 sets), and as electronic documentation on CD-ROM:
   a. Complete and detailed operating instructions for each hardware and software product.
   b. Complete and detailed maintenance instructions.
2. A list of all components to the module level.
3. All drawings.

B. Provide updated versions of all submittal information showing as-built conditions.

1.05 TRAINING

A. Provide operation and maintenance training for all hardware and software provided. Coordinate in accordance with the Contract Requirements including those included in General Conditions Specification -01664 "Training".

B. Training at the Manufacturer's Facility:

1. An allowance shall be provided for City personnel to attend standard courses.
2. The cost of travel, meals, and lodging for the city's personnel while attending training shall be paid from the travel and subsistence allowance.

C. Site Training: Provide two (2) five day training periods for up to eight City personnel for each period.

1.06 MAINTENANCE CONTRACT

A. At the end of the warranty period, the system will be added to the City's existing Alliance Maintenance agreement. An allowance for the full 12 month cost of this addition is included. Prior to final acceptance, the final cost will be prorated to coincide with the period of the existing agreement and paid as part of the final payment.

1.07 GUARANTEE AND WARRANTIES

A. Equipment, software, and materials that do not achieve design requirements after the installation shall be replaced to attain compliance at no addition cost to the City. Following replacement or modification, the Contractor shall re-test the component or loop and perform any additional procedures needed to place the complete system in satisfactory operation and attain approval from the Engineer.

B. The system shall be warranted for 12 months following acceptance. The warranty shall provide Foxwatch coverage which includes labor, material, and 24-hour technical support

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide all hardware and software necessary to meet the product and functional requirements of this Section and of the DCS requirements on the Drawings.

2.02 HARDWARE

A. A new remote communication module shall be added to the existing Foxboro DCS System at RM Clayton WRC. This module shall be added to existing DCS Cabinet as directed by the City of Atlanta. The intent of this addition is to provide a fully functional and complete communication link to the PLC inside the Local Control Panel at the North Fork Peachtree Creek project site (Electrical Building). The DCS system integrator shall field verify the availability of panel space prior to bidding.

B. The DCS system integrator shall include in the bid any additional hardware to facilitate communication between the existing Foxboro Plant Network and this new remote PLC communication interface. The DCS system integrator shall field survey the existing Foxboro DCS System at RM Clayton to determine the need for any additional communication hardware prior to bidding.

C. The DCS system integrator shall provide any additional DCS hardware as necessary to provide the functionality and performance as showing on the P&IDs and the specifications.

D. Provide all cables, connectors, and wire taps necessary to meet the requirements of this Section.

2.03 SOFTWARE

A. General:

1. Provide all software necessary for the required functions.
2. All software shall be completely debugged and operable prior to shipment. The City shall not be required to provide any programming effort to achieve a fully operational system.
3. System parameters (e.g., setpoints, alarm limits, and loop tuning constants) shall be entered or modified using a Workstation with a modular key board.

B. Operating Software

1. The operating software shall include the operating system and other standard software that supports the complete process control system.
2. No additional software packages are required for this project.
3. Provide all necessary licenses for required software packages for this project.

PART 3 - EXECUTION

3.01 GENERAL

A. In addition to other requirements herein, coordinate with others to effect the following.

1. Preliminary Submittals: Prepare loop wiring drawings based on the drawings provided as part of Specification Section 13200 – Control Panels.
2. Submittals and Final Documentation: Incorporate additional loop wiring drawing and I/O list information provided by the Section 13200 – Control Panels including wire and terminal numbers for signals and power. Incorporate additional loop wiring drawing and I/O list information provided by the Section 13200 Supplier including component calibration and connections to process and wire. Incorporate additional loop wiring drawing information provided by the Division 16 Electrical Supplier including wire connections, terminal numbers, and terminal junction boxes.
3. Product Delivery: Provide equipment handling and storage instructions.
4. Enclosure Installation: Provide enclosure installation instructions.
5. Enclosure Inspection: Verify proper enclosure installation.
6. DCS Component Installation: Install all DCS components including modules, cables, connectors, wire taps, operator interfaces, and fiber optic converters.
7. DCS Field Wire Installation: Provide signal cabling and power connection instructions.
8. DCS Field Wire Inspection: Verify proper signal cabling and power connection installation. Coordinate, and witness with the Contractor, the application of electrical power to all electric powered DCS components.
9. DCS Communication Link Connection: Make final wire and fiber optic connections to DCS components.
10. DCS Communication Link Inspection: Verify proper test procedures and results. Verify proper installation.
11. Coordinate with the Contractor for the following field testing.
    a. Operational
    b. Functional
12. Operation and Maintenance Manuals: Incorporate all loop wiring drawing as-built information from associated specification section suppliers.

3.02 SOFTWARE CONFIGURATION

A. The Section 13150 Instrumentation and Controls - Control Logics Descriptions are provided as functional requirements. Provide all software, programming, and configuration necessary to affect the required functions.

B. Standard function requirements are those required by article STANDARD FUNCTIONS hereafter.

C. Special function requirements are those required by the loop functional descriptions as supplemented by article SPECIAL FUNCTIONS hereafter and by standard functions.

D. The requirements herein shall be provided as configured functions. Creation and modification of the following items shall be effected with software directed (using menus, instruction displays, etc.) procedures and without code modification.

1. Input/output (I/O) configuration, assignments, and functions.
2. Content and functions of displays, reports, logs, and other hard copy items.
3. Manual entry changes including all manually entered values.
4. Automatic control functions.

E. DCS Graphics Conventions:

1. The DCS Graphics provided for remote monitoring of the Liddel Drive Equalization Facility shall be designed to be compatible with the existing graphical standards at the RM Clayton Plant. The DCS System Integrator shall generate a set of new DCS graphics to display a hierarchical sequence of displays including Equalization Facility Overview Graphic, individual Process Graphics, Process Alarm Summaries (can link to the standard Foxboro Current Alarm Display), Text Information Pages (Elapsed Motor Run Times, for instance), and update the existing Foxboro System Maintenance Graphics (can link to the standard Foxboro System Management Display). To facilitate the paging thru the hierarchical displays, a "display menu bar" shall be located on the left side of each graphic. Each graphic shall have a customized "display menu bar" to allow paging to the Overview Graphic, related Process Graphics, related Text Information Pages, or "previous display". The Foxboro configuration menu will be display at the top of the Operator Displays. Operator controls for PID controllers and motor control shall be implemented by utilizing pop-up Faceplate Overlays. Each Analog Measurement shall be configured for historical trending. On the Process Graphics, Historical Trends will be implemented as pop-up quarter- and half-screen Overlay Windows.
2. Each Process Graphic shall supply the operator with schematic representations of a specific process system, with live dynamic data displayed on top of a static background. Each graphic shall include dynamic text and graphical symbols that may be configured to change color, shape, or blink, given different states of the associated process variable. Indications of alarm conditions, safe conditions, and device status shall be accomplished by the use of color distinction and blinking attributes for each dynamic element on the display.
3. Standard COA Color conventions for Process Graphics are listed in the table below:

COLOR	MEANING
BLACK (0) TEXT	Static Text Information
BLACK (0) TEXT ON WHITE (15) BACKGROUND	Analog Measurement/Parameter
RED (1)	Running, On, or Open
RED (1) BACKGROUND	Value is Bad or Out-of-Range
GREEN (2)	Stopped, OFF, or Closed
CYAN (14)	System communication error
WHITE VALVE SYMBOL(15)	Intermediate (Between open and closed)
YELLOW (11)	Measurement in Alarm; Valve with 2 limit switches (open/closed) has both discretes true(1,1).
YELLOW FLASHING (27)	Unacknowledged Alarm
WHITE FLASHING	Previous Alarm Cleared but Unacknowledged
ORANGE	Hand/OFF/Auto Indication Lead/Follow/Standby Indication Switch Selection
BLUE RECTANGLE with a T	Trend Selection
INVISIBLE	Alarm not active
MAGENTA	Two Speed Motor - Running at low Speed
RED	Two Speed Motor - Running at High Speed
GREEN	Two Speed Motor - Stopped

4. The requirements herein shall be provided as configured functions. Creation and modification of the following items shall be effected with software directed (using menus, instruction displays, etc.) procedures and without code modification.

F. DCS Alarming:

1. All DCS generated alarms shall be displayed on the respective Process Graphic by the use of the Display Conventions listed above. These alarms shall be grouped in agreement with the City of Atlanta. Indication of active alarms in each alarm group shall be displayed at the top of the Operator displays and shall enable the Alarm LED on the associated annunicator keyboard graphic call-up button. High Priority alarms shall be audibly alarmed. The Operator can acknowledge the alarms by selecting the Alarm ACK button on the "display menu bar" or by pressing the predefined ACK button on the annunicator keyboard. Alarms shall be configured so that when selected from the standard Foxboro Current Alarm Display, the primary related Process Graphic will be "called up". Alarms shall be targeted for printing at Console A in the RM Clayton Administration Building or as otherwise directed by the City of Atlanta.

3.03 STANDARD SOFTWARE FUNCTIONS

A. Local/Remote/Enabled Terminology: The following convention is used for this project. "Local-remote" denotes proximity or distance from a point of control or indication. "Enable(d)" denotes the ability to control. If control is enabled at some location, conditions at that location may still disable manual or automatic control (for example, if the device has failed or is out-of-service). Provide a convenient method to determine the reason for each disabled mode. "Out-of-service" denotes that manual and automatic control of a device is manually disabled.

B. Out-of-Service: Provide manual out-of-service mode selecting for all control outputs.

C. Input/Output Lists: Standard and special function requirements apply equally for new equipment, existing equipment, and pseudo input points.

D. Process Graphic Displays:

1. Display the current status of discrete inputs. Indicate elapsed run time for motors with an on-off discrete input.
2. Digitally display the current value of analog inputs and outputs.
3. Display level analog inputs as a color level in a structure outline.
4. Provide manual control of outputs. Provide manual selection of manual or automatic mode where automatic control is required. Indicate the mode (enabled, disabled, manual, automatic, lead, lag, etc.) of outputs and other control functions. Indicate if equipment is out-of-service.
5. Display process related alarm conditions near, or as part of, a corresponding graphic symbol.
6. As a minimum, provide a sufficient number of process graphic displays to accomplish the control and monitoring of the processes as described in Specification Section 13150 Instrumentation and Controls - Control Logics Descriptions.
7. Notice that the process graphic displays do not include the following types of required displays.
   a. Process Tabular
   b. Alarm
   c. Trend
   d. Diagnostic
   e. System Configuration
   f. Help

E. Alarms:

1. Indicate the alarm source where there is more than one source; for example, a level alarm discrete input and an analog input alarm limit.
2. Where a fail discrete input alarm and a generated alarm are required for the same equipment, they shall be treated as separate alarms.

END OF SECTION 13500

Attachment A – New DCS Equipment

PART 1 - HARDWARE

3.01 DCS PANELS

A. DCS Panel XX:

DCS Panel Location	DCS Panel Name	IO Type	IO Module Model	# of Modules	# Points per module	Total Points Unused	Rail Location
RM Clayton WRC – specific location to be determining during Construction Phase	XX	Comm	FCM100E	1	2	0	A
Available Panel Space							
9" Rail Space							A
6" Rail Space							B
No available Space							C
No available Space							D

SECTION 13900
INSTRUMENTATION INSTALLATION GUIDELINES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. The provisions and requirements of Division 13, Section 13000 "General Provisions" of this Specification shall apply to the work specified in this section.

C. Installation and Fabrication of Control Panels shall be as specified in Division 13, Section 13200 "Control Panels".

D. Furnishing of Field Instrumentation and miscellaneous devices shall be as specified in Division 13, Section 13300 "Instrumentation Specifications".

E. Field Instrumentation and Control Panels and/or other Cabinets furnished under this Specification shall be provided with transient surge and lightning protection as required in Division 13 Contract Specification 13270 "Surge and Lightning Protection".

1.02 SUMMARY

A. This Section provides general guidelines for the mounting and installation of field instrumentation, analyzers and other controls components associated with this contract.

B. Where applicable, Contractor shall utilize the attached installation details (if provided) as a basis for his field installation design. Where installation details are not provided nor applicable, the Contractor shall furnish appropriate mounting and interconnection hardware in accordance with the manufacturer guidelines and standard industry practices.

C. Furnish all labor, supervision, materials, equipment and incidentals required to install, complete and ready for operation, the instrumentation and controls as described in this section and in accordance the Division 13, Section 13000 "General Provisions" of these Contract Specifications.

1.03 REFERENCE STANDARDS

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Reference Standards" and as specified herein.

1.04 QUALITY ASSURANCE

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Quality Assurance" and as specified herein.

1.05 PRIORITY OF THE CONTRACT DOCUMENTS

A. Provide in accordance with Division 13 Contract Specification 13000 Section "Priority of the Contract Documents" and as specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials of the same type shall be the product of one (1) manufacturer.

B. The materials used shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or manufacturers product specifications shall be submitted for approval as required by the Engineer.

C. All current carrying cables, wires, buses, terminals, windings, parts, etc. shall be copper. Exception shall be made to this section is for circuits involving thermocouple circuits where the wiring, terminals and/or other current carrying parts shall be made from the same materials as that of the thermocouple.

D. Materials and equipment furnished shall be suitable in all ways for the intended application. Ratings shall match or exceed the requirements of the indicated Reference Standards, Drawings and Specifications.

2.02 ENCLOSURE TYPES

A. Unless otherwise specified herein or shown on the Drawings, instrumentation and control system enclosures shall have the following ratings.

1. NEMA 1 for dry, non-process indoor locations.
2. NEMA 12 for "DUST" locations.
3. NEMA 4X for outdoor locations, rooms below grade (including basements and buried vaults), "DAMP" and "WET" locations. Enclosure material shall be carbon steel with baked or electrostatically applied enamel finish, or stainless steel.
4. NEMA 4X for "CORROSIVE" locations. Enclosure material shall be stainless steel or fiberglass reinforced polyester (FRP). All FRP panels located in direct sunlight shall be provided with a protective coating to prevent discoloration and cracking.
5. NEMA 7 (and listed for use in the area classifications shown) for "Class I, Division 1"; "Class I, Division 2" and "Hazardous Locations". Enclosure material shall be cast malleable iron.
6. Refer to Division 16 Drawings for hazardous area classifications.
7. Installations in Outdoor areas require sun shields.

2.03 REQUIREMENTS FOR HAZARDOUS AREAS

A. All equipment, materials, and installation techniques used in areas designated as hazardous in the Specification Sections, or on the Contract Drawings shall be in strict accordance with National Electrical Code Articles 500, 501, 502, 503, and 504.

B. Unless auxiliary protective means as noted below are utilized, All equipment and materials that are supplied and intended to be safely operated and inheritable designed for used in hazardous areas shall be UL listed for the appropriate hazardous area classification.

C. Unless otherwise noted on the Contract Drawings, the Engineer intends that instrumentation and controls located in Electrically "Hazardous Locations" be inherently suitable (i.e. use of explosion proof NEMA 7 or NEMA 9 enclosures) to meet the electrical area classifications. Should the Contractor or Subcontractors provide instrumentation, auxiliary devices, or other control equipment that is not inherently suitable for intended environment; the design, implementation, or use of Intrinsic Safety barriers or other mechanical or electrical means of guaranteeing the suitability of the said instrumentation, auxiliary devices or other control equipment to safely operating in its intended environment shall only be implemented at the expense of the installer or supplier of said equipment. The supplier has the responsibility to coordinate with all other Contractors and Subcontractors affected to notify them of the impact and negotiate the sharing of the costs and other impact associated with the use of alternate designs.

D. The common engineering practice of the use of float level switches for monitoring the levels in sumps and other areas, which are often considered electrical hazardous, is an example of the implied intent of the Engineer in his design documents that the Contractor and/or his suppliers and/or subcontractors can be reasonably expected and required to provide additional materials and methods to make use of the specified device in what may well be a electrically "hazardous location". The Contractor and/or his suppliers and/or subcontractors may choose to use a more expensive device (that is inherently suitable for the intended location) in implementing the engineering design if he or she so chooses but at no time shall there be any additional cost or schedule impact to the Owner.

E. The use of Intrinsically Safety (IS) as an auxiliary protection means shall be designed, installed, and testing in compliance with the National Electrical Code Articles 500, 501, 502, 503, and 504. Additionally, the Intrinsic Safety design, installation, and testing shall comply with the following:

1. Devices utilized in Intrinsically Safe (IS) applications must be certified and stamped as being suitable for use in the intended area classification. Certifications of all IS devices shall be submitted along with the associated instrumentation and controls. Failure to submit proper certifications and/or IS Design calculations shall not constitute approval of the auxiliary protection means by the Engineer.
2. Zener Diode style IS Barriers must be grounded in compliance with National Electrical Code Article 504 and ISA Recommended Practice RP12.6. Provide at least AWG # 6 insulated Green Wire to a dedicated ground rod or grounding triad as necessary to get less than 1 ohm to ground resistance. Dedicated IS grounding system shall (and must) only be connected at one point to the plant ground grid (if grounding triad used, Connection to IS Barriers at one leg of triad and connection to plant ground grid from another leg of the triad should be used to guarantee a good and high quality path to earth ground).
3. Simple Apparatus (Switches, etc.) can be provided with Switch Amplifier type IS Barriers that do not require a dedicated IS Grounding connection to the IS Barrier.
4. Energy storing devices (i.e. transmitters, etc.), have Entity parameters that must be utilized in developing the IS Barrier design to ensure that installation will be suitable for the intended electrically "hazardous location". Vendor furnished Entity parameters and IS Barrier design calculations shall be submitted for approval in these applications.
5. IS Barriers should be located in an electrically non-hazardous area such that the incoming hazardous ISS wiring from field devices is electrical isolated at the IS barrier from the regular non-hazardous wiring leaving the IS Barrier.
6. IS wiring inside control panels shall be separated by 2 inches of air space from all regular non-hazardous wiring. All IS wiring inside enclosures shall be secured so that any

conductor that might come loose from a terminal cannot come in contact with another terminal. Grounded Metal or Isolated Partitions are permitted by NEC Code Article 504-30 with lesser distance requirements.

7. Wiring ducts in Control Panels containing IS circuits shall be colored light blue or identified with labels containing the wording "Intrinsic Safe Wiring" or the equivalent.
8. IS wiring shall be located in dedicated conduits separated from any non-hazardous wiring.
9. Conduits where above ground containing IS wiring shall be identified with labels containing the wording "Intrinsic Safe Wiring" or the equivalent per NEC Article 504-80.b. Spacing between labels shall be no less than every 25 feet.
10. IS wiring shall be color coded light blue where no other conductors colored light blue are used per NEC Article 504-80.c.
11. Conduits containing IS wiring where entering enclosures containing regular non-IS wiring shall be sealed to prevent possible transmission of gases from hazardous areas.

2.04 TRANSIENT SURGE AND LIGHTNING PROTECTION

A. General Requirements – Transient Surge and Lightning and protection shall be provided to protect all instrumentation and controls from induced voltages and power surges propagating along the analog or discrete signal and/or power supply lines or digital communication connection to the Control system and/or Telemetry system. The protection systems shall be such that the surge protective device shall not interfere with normal operation, but shall lower the induced voltage level or transient surge level to be less than the instrument's (or control device's) surge withstanding level, and shall be maintenance free and self-restoring, if possible. All connection points to be copper with nickel plating. The surge protective device should meet IEEE C-62-41 Standards.

B. Additional Requirements shall be as required in Division 13 Contract Specification 137270 – Surge and Lightning Protection.

C. The supplier of instrumentation and controls associated with this Division shall provide the appropriate surge protective device as required by this Division. Instrumentation and Controls Subcontractor shall provide any additional surge protective devices, materials, supervision, installation, and testing if the supplier of any instrumentation and controls under the Contract Specifications does not satisfy the intent of the Division 13 Contract Specification 13270 – Surge and Lightning Protection.

2.05 INSTRUMENTATION TUBING AND FITTINGS

A. All instrument air header takeoffs and branch connections less than 2-in shall be 316 stainless steel or copper as noted in the mechanical (piping) specifications.

B. All instrument shut-off valves and associated fittings shall be supplied in accordance with the Mechanical (piping) specifications and all instrument installation details. Instrument fittings and valves shall be match the predominant standard at the existing facility unless other specified in the mechanical (piping) specifications.

C. Unless otherwise specified in the mechanical (piping) specifications, all instrument tubing shall be fully annealed ASTM A269 Seamless 316 grade free of O.D. scratches having the following dimensional characteristics as required to fit the specific installation:

1. 1/4-in to 1/2-in O.D. x 0.035 wall thickness.
2. 5/8-in to 1-in O.D. x 0.049 wall thickness.
3. 1-in O.D. x 0.065 wall thickness.
4. 1-1/4-in O.D. x 0.065 wall thickness.
5. 1-1/2-in O.D. x 0.083 wall thickness.
6. 6. 2-in O.D. x 0.095 wall thickness.

D. All process connections to instruments shall be annealed 1/2-in O.D. stainless steel tubing, Type 316.

E. All tube track shall be supported by stainless steel and installed as per manufacturer's installation instructions.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Instrumentation and Controls Subcontractor, acting through the Contractor, shall coordinate the installation, the placing and location of system components, their connections to the process equipment, panels, cabinets, and devices; subject to the Engineer's approval. He shall be responsible to ensure that all field wiring for power and signal circuits are correctly done in accordance with best industry practice and provide for all necessary system grounding to ensure a satisfactory functioning installation. The Instrumentation and Controls Subcontractor hereunder shall schedule and coordinate his work under this section with that of the electrical work specified under applicable Sections of Division 16. Additionally, the Instrumentation and Controls Subcontractor hereunder shall schedule and coordinate his work under this section with that of the mechanical work specified under applicable Sections of Divisions 11 and 15.

B. The Instrumentation and Controls Subcontractor shall coordinate his work with the work of the different trades so that interferences between instrumentation, control panels, conduits, piping, equipment, and architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the Contractor and/or his subcontractors without additional expense to the Owner. In case interference develops, the Engineer is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.

C. Redesign of instrumentation, electrical, or mechanical work, which is required due to the Contractor or subcontractor's use of an alternate item, arrangement of equipment, and/or layout other than specified herein, shall be done by the Contractor or subcontractors at his own expense. Detailed plans of the redesign shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his own or others, caused by such redesign.

D. The Drawings are not intended to show exact locations of instrumentation, control panels, or other pieces of equipment. The Contractor, at his discretion, may relocate instruments to a more appropriate location within 5 feet of the location shown on the Contract Drawings. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of the instrumentation and controls work, and in case of any

interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

E. Verify with the Engineer the exact locations and mounting heights of any instrumentation, control panels or other furnished devices that requires regular maintenance or operator access for the safe operation of the process and associated equipment.

F. Unless otherwise directed by Engineer or Owner, Field instrumentation shall be mounted so that instrument is located between 48 inches (4 Feet) and 60 inches (5 Feet) above the finished surface of the floor or access platform. Instrumentation shall be mounted for ease of access without obstructing walkways or access to other equipment. Mounting locations shall be in agreement with the manufacturer installation guidelines to ensure normal and safe operation.

G. Surface mounted instrumentation, control panels, junction boxes, and other devices provided under this division shall be mounted to stainless steel channel (minimum 1 inch) to provide a clearance between surface/wall and equipment. Mounting hardware and brackets required to support this equipment shall be provided as part of the Contract. Installation shall be performed in a workmanlike manner and shall not interfere with the operation and maintenance of any other equipment.

H. Floor mounted instrumentation mounting stands, analyzer cabinets, control panels, and other devices provided under this division shall be anchored to and placed on top of housekeeping pads to prevent incidental damage to said equipment during normal operation and housekeeping of the facility.

I. Control Panels and mounting of Field Instrumentation shall be designed in accordance with the Seismic Zone associated with the project as noted in the Contract Drawings.

J. Instrumentation and Controls furnished under this Division shall be factory and/or "bench" calibrated prior to installation.

K. Instrument enclosures shall be provided and installed, with appropriate sunshields, heaters, cooling, insulation, etc., as needed to keep the equipment within its manufacturer's recommended operating conditions under all modes of operation and changing ambient conditions. As a minimum, sunscreens shall be provided for all enclosures which house microprocessor based electronics and are located out-of-doors.

L. All process, pneumatic, and electrical connections to furnished instrumentation and other controls shall be made as required, and in accordance with the manufacturer installation instructions and with the approved shop drawings.

M. Instrumentation and miscellaneous hardware and accessories shall be installed in accordance with the manufacturer's instructions and with the appropriate instrument installation details as provided with this Contract.

N. The instrumentation installation details on the Contract Drawings indicate the intended installation method for the instruments specified. Where specific installation details are not specified or shown on the Drawings, standard industry practices like the American Petroleum Institute (API) Recommended Practice 550 shall be followed as applicable.

O. Unless specifically shown in the Contract Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or pipe stands. All instrumentation process and instrument air connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing, and blow down service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

P. All field mounted instruments, analyzers or control panels having operator controls, local indicators, or recorders shall be installed and orientated to allow operator access and/or to make the indicator scale or chart visible from adjacent areas. Rotate indicating portions of instruments where necessary to improve visibility from adjacent areas. Operator access to control panels shall comply with industry safe operation practices and OSHA guidelines.

Q. Field Installations shall provide sufficient clearance for normal operation and maintenance access to all installations including dismantling of the instrumentation, disconnection of process and instrument air connections, and/or associated wiring.

R. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adaptors, and shut-off valves. All instrumentation tubing shall be rigidly mounted and supported using tubing raceways, supports and tie downs as required. Instrumentation tubing shall be indirectly mounted to walls or columns using stainless steel channel to provide a minimum of 1 inch spacing. Plastic tubing or rubber hoses can be utilized (when process conditions allow) for the last 5 feet of connection to instruments where excessive vibrations shall be found. Installation shall be performed in a workmanlike manner and shall not interfere with the operation and maintenance of the associated instrument or any other equipment.

S. Field instruments requiring AC power supply shall be provided with local electrical shutoffs and fuses as required.

T. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground point be employed for each shield.

U. Installation of Fiber Optic Cable. Refer to cable manufacturer's specifications for bend radius. Use cable breakout assembly as recommended by the cable manufacturer. Provide wire basket, strain relief as required to meet manufacturer's strain requirements.

V. Lifting rings from cabinets/assemblies shall be removed. Hole plugs shall be provided for the holes of the same color as the cabinet.

W. The P&IDs and Contract Drawings indicate the intent of the interconnection between the individual instruments. At the time of field installation, any corrections or exceptions should be noted. Two complete sets of approved shop drawings shall be kept at the job site during all on-site construction. Both sets shall be identically marked up to reflect any modifications made during field installation or start-up. All markings shall be verified and initialed by the Engineer or his designated representative.

X. Following completion of installation and the operational readiness testing, one set of the marked up drawings shall be provided to the Engineer, the other retained by the Supplier for incorporation of the mark-ups into final as-built documentation.

Y. All equipment used in areas designated as hazardous shall be designed for the Class, Group, and Division as required on the Electrical Drawings for the locations. All work shall be in strict accordance with codes and local rulings, should any work be performed contrary to said rulings, ordinances and regulations, the Supplier shall bear full responsibility for such violations and assume all costs arising there from.

Z. Instrumentation and Controls shall at all times during construction be adequately protected against mechanical injury, water damage, corrosion, dirt, dust, and foreign material. Equipment equipped with internal electrical heaters shall have them energized to keep the equipment dry. Doors to control panels and cabinets shall be kept closed at all times when work on them is not being done. Control Panels, Analyzers, sensitive electronic or computer equipment and/or controls or other materials not sealed and/or suitable for continuous outdoors storage shall not be stored out-of-doors. Such Instrumentation and Controls shall be stored in dry permanent shelters. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner, the damaged units or systems shall remain on site and returned to the manufacturer after the replacement units or systems have been delivered to the site. Under no circumstances will instrumentation or controls equipment damaged by water be rehabilitated or repaired, new equipment shall be supplied, and all costs associated with replacement shall be borne by the Contractor.

AA. Any damage to factory applied paint finish shall be repaired using touch-up paint furnished by the instrument or equipment manufacturer. The entire damaged enclosure panel or section shall be repainted per the field painting specification Section 09902, at no additional cost to the Owner.

3.02 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner or clean lint-free rags. Do not use compressed air.

END OF SECTION 13900

SECTION 13940
COMMUNICATION LINKS

PART 1 - GENERAL

1.01 SCOPE

A. Requirements of Section 13000 Instrumentation and Controls – General Provisions form a part of this Section.

B. Provide fiber optic and wire communication links to interconnect components of the Plant Control System – SCADA (Signal Conditioning and Data Acquisition) System. See the Plant Control Systems Network Drawing (Dwg, I-002) for additional communication link requirements, including equipment locations and quantities.

C. Items provided under this Section are installed in enclosures provided under Section 13200, Control Panels and in wire ways provided under Division 16, Electrical or existing.

D. Provide all cables, patch cords, connectors, terminators, wire labels and sleeves, network switches or repeaters, bridge devices, patch panels, and any other accessory or incidental as required for a complete and fully functional process control and monitoring system as described in the Contract Drawings and Specifications including functionality shown on the P&ID Drawings (I-101, I-102, I-103, I-104, I-105, I-106, I-107, and I-108) and Control System Network Drawing(s) (I-002).

1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. Manufacturer installation recommendations for all products. Provide complete installation procedures that will be followed for this work.
2. Test procedures prior to testing. Provide test documentation after testing.
3. Training procedures prior to training.
4. Catalog cut sheets.
5. Communication cable routing plans and cable termination schedule for approval by the Owner. Include location of all terminations including patch panels and protection method of cables that are located in conduit, duct banks, and/or cable tray. Routing information shall be included in final as-built drawings.

1.03 FINAL DOCUMENTATION

A. Provide final documentation required by Section 13000.

B. Provide all test documentation.

1.04 TRAINING

A. Provide one day of training for City personnel during installation. Provide one day of training for City personnel during post-installation testing.

PART 2 - PRODUCTS

2.01 FIBER OPTIC COMMUNICATION LINKS

A. Fiber Optic Cable:

1. Each cable shall contain a minimum of 12 functional fibers after installation, connection, and testing are complete.
2. Fiber shall be a multimode, graded index, solid glass waveguide, and shall be coated to preserve the intrinsic strength of the glass. Each fiber shall be color coded. Fiber shall have the following characteristics:

Core diameter:	62.5 microns
Cladding diameter	125 microns
Refractive index delta	2.0 percent
Numerical aperture (NA)	0.275
Attenuation at 1300 nm	1.0 dB/km maximum
Bandwidth at 1300 nm	500 MHz/km minimum
Attenuation at 850 nm	3.75 dB/km maximum
Bandwidth at 850 nm	160 MHz/km minimum

3. Cable shall include a buffer tube surrounding the fibers, one or more strength members, and an outer jacket. Cable components shall be of continuous material with no factory splices, holes, blisters, or other imperfections. Cable shall have the following characteristics:

Material	non-metallic
Tensile load rating	600 lb minimum, long term
Bend radius rating	5 inches maximum unloaded (0-180 lb); 10 inches maximum loaded (181-600lb)
Diameter	0.5 inches nominal

4. Buffer tube shall allow for free fiber movement and thermal expansion. Buffer tube shall be flooded internally with a gel compound to prevent fiber contamination and freezing stress from moisture.
5. Strength members shall protect fibers from mechanical stress during installation and required service.
6. Cable shall be for outdoor installation in conduit.
7. Fiber optic cable shall be AT&T, Type 3DNX-018-HXM; or equal.

B. Fiber Optic Connectors:

1. Provide a connector on each end of each fiber.
2. Type: ST (bayonet twist-lock keyed).
3. Typical attenuation: 0.2 dB.

4. Maximum attenuation: 0.4 dB.
5. Loss repeat: less than 0.2 dB per 1,000 reconnects.
6. Fiber optic connector shall be AT&T, model P2020C-C-125; or equal.

C. Fiber Optic Patch Panels:

1. Provide a patch panel at fiber optic cable termination as shown on the Drawings.
2. Patch panel shall include coupling panel(s), bayonet/threaded couplings, and a lockable door. Patch panel shall totally enclose the connectors and patch cords. Provide 19-inch rack mounting brackets.
3. Fiber optic patch panel shall be AT&T, model 200A LIU; or equal.
4. Coupling panel shall be AT&T, model 10A; or equal.
5. Couplings shall be AT&T, model C2000A-2; or equal.
6. Mounting bracket shall be AT&T, model 742A; or equal.

D. Fiber Optic Patch Cords:

1. Provide patch cords to interconnect two cable fibers between panels (pass through jumper) or to connect cable fibers to converters as indicated on the Block Diagram. Each patch cord shall have 2 fibers for 2 direction communication.
2. Patch cord fibers shall be 62.5-micron with associated attenuation and bandwidth parameters as specified. Each fiber shall have an individual thermoplastic tight buffer tube, strength member, and a thermoplastic jacket.
3. Provide a minimum of 20 percent spare or 2 spare patch cords, whichever is greater, of each type and length.
4. Fiber optic patchcords shall be AT&T, model FL2E-E; or equal.

E. Fiber Optic Splice Enclosures:

1. Fibers shall not be spliced except where specifically approved in writing by the Engineer. The following shall <u>not</u> be acceptable reasons for splicing fibers: cable length availability or cost; cable installation convenience or cost.
2. If used, splice enclosures shall protect spliced fibers from moisture, soil, strain, or other damage. At each splicing location, sufficient cable length shall be provided to properly rack and splice the cables and to allow for additional future splices.
3. Ground splice enclosures to earth per Division16, Electrical.
4. Fiber optic splice enclosure shall be AT&T, Model 2600LG; or equal.

2.02 WIRE COMMUNICATION LINKS

A. Foxboro Fieldbus Extension Cable:

1. Cable shall be 20 AWG, stranded, shielded (copper braid with 100% coverage) twin-axial cable with polyethylene insulation and PVC jacket.
2. Cable shall be Belden 9207; or equal.

B. Allen Bradley Data Highway Plus Cable:

1. Cable shall be 20 AWG, stranded wire, shielded (foil shield with copper drain wire giving 100% shield coverage) twin-axial cable with polyethylene insulation and PVC jacket.
2. Cable shall be Belden 9463; or equal.

C. RG-11 Ethernet Cable:

1. Cable shall be triax cable, RG-11/U type, 14 AWG solid bare copper wire, foam polyethylene insulated with polyethylene jacket, 2 bare copper shields with polyethylene insulation between shields, nominal O.D. of .475 inches.
2. Cable shall be Belden No. 8233; or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Provide all equipment, instrumentation, and supplies necessary for installation.
2. Remove wire from existing wire ways as required.
3. Install fiber optic communication links to ensure a minimum number of splices. Fiber splices shall be made only with written approval from the Engineer prior to implementation. Wire conductors shall not be spliced.
4. Provide a minimum of 5 feet spare cable (fiber optic and wire) coiled at each cable access point (manholes, handholes, and trenches).
5. Provide cable supports in manholes and hand holes according to requirements in Division 16, Electrical. Existing cable supports may be used where available and not damaged.
6. Tag all cables, fibers, and conductors according to Division 16, Electrical, Section 16120, Conductors. Provide tag documentation.
7. Pull a 200-pound tensile strength polyolefin cord through each conduit where cable is pulled.
8. Install all cable according to manufacturer recommendations. Pull all cable through conduit at the same time. Do not exceed the manufacturer recommended pulling tension. See Division 16, Electrical, Section 16120, Conductors for additional requirements.

B. Fiber Optics:

1. Demonstrate to the Engineer that manufacturer installation recommendations are strictly followed for all fiber optic components.
2. Fiber optic cable fibers shall be "fanned out" and each individual fiber shall be sleeved over with a Kevlar reinforced furcation tube. At the convergence point of all furcation tubes, provide fiber strain relief with a fan-out collar. Provide fiber strain relief at each connector. Provide cable gel blocking. Provide dust caps on each fiber connector until final assembly. Provide dust caps on each connector that is not coupled.
3. Attenuation for a single fiber optic connection point (connector through coupling through connector) shall be 0.7 dB maximum.

4. Where fiber optic splices are necessary and approved, fibers shall be fusion spliced. Attenuation for a single splice shall be 0.2 dB maximum. Test each splice with an Optical Time Domain Reflectometer (OTDR) bi-directionally to verify compliance at the time of splicing. Splices not conforming to these specifications shall be redone to meet specifications. Provide cable moisture protection during splicing operations.

5. Attenuation for each fiber optic link shall be 13 dB maximum, as required for a minimum gain margin of 4 dB. The gain margin is the decibel difference between the gain of the fiber optic converters and the loss budget of the fiber optic link (fiber optic cables, connectors, patch cords, and splices).

3.02 TESTING

A. Provide all equipment, instrumentation, and supplies necessary for testing. The Engineer shall have the option to witness and actively participate in the on-site tests.

B. Fiber Optic Pre-installation Testing: Prior to installing each cable, provide an Optical Time Domain Reflectometer (OTDR) test for each fiber at 1300 nm wavelength on the shipping spool. The OTDR test shall verify that each fiber meets the manufacturer attenuation specifications and that the cable was not damaged during shipping. Provide hard copy test documentation, including traces. Obtain approval from the Engineer prior to cable installation.

C. Fiber Optic Post-Installation Testing:

1. After cables and connectors are installed, OTDR test each fiber in both directions at 1300 nm wavelength. Provide hard copy and diskette test documentation.

2. After patch cords and couplings are installed, end-to-end attenuation test each fiber between transceiver connectors in both directions at 1,300 nm wavelength. Use a stabilized light source and an optical power meter. Provide test documentation, including reference power reading.

3. Provide test documentation relative to Specification Section 13400, Suppliers of Programmable Controllers shall including detailed specifications for all cables and connectors used.

4. Provide test documentation to the Section 13500, DCS supplier including detailed specifications for all cables and connectors used.

D. Fiber Optic Test Documentation: Test documentation shall include cable and fiber identification; fiber length; test direction; test wavelength; traces; fiber attenuation; attenuation breakdown for each fiber segment, connector, and coupling; and splice attenuation if applicable.

E. Wire testing: Test wire per Section 16999, Acceptance Testing and Calibration of Division 16, Electrical.

END OF SECTION 13940