

**SECTION 13400**  
**SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM**

**PART ONE – GENERAL**

1.01 SCOPE OF WORK

- A. This Section outlines requirements which are applicable to all process control, communication, and signal systems that are to be supplied and installed including programmable logic controllers for control of process equipment, process oriented machinery, and process systems.
- B. The contractor shall furnish and install a complete and fully functional Supervisory Control and Data Acquisition (SCADA) system. All local monitoring and control to be accomplished via the PLC described herein. Remote monitoring and control shall be provisioned by, and hardware installed with this work. All programming and interface development of the remote monitoring shall be done by FCSA's designated Process Control System Supplier (PCSS), Instrulogic LLC, Round Hill, VA, 540-338-2222.
- C. The SCADA System work for this project will include ONE Remote Terminal Unit (RTU) at proposed Pump Station, and integration of the new Pump Station into the existing FCSA HMI System.
- D. Network connectivity at each site will be by cellular modem provided by FCSA.
- E. The contractor shall provide (through the PCSS) all design, documentation, equipment, installation, integration, programming, testing, start-up, training, and warranty for the system.
- F. The system shall be configured to monitor all specified site's I/O points, and alarm for abnormal conditions as described in these Specifications.
- G. The system shall produce the operational conditions described in Part 3 of this section EXECUTION and conform to the requirements of the Drawings and this specification.

1.02 RELATED WORK

- A. Division **11** – Equipment
- B. Division **16** – Electrical

1.03 REFERENCE STANDARDS

- A. CSA Certification Class I, Division 2, Group A, B, C, D Hazardous or non-hazardous locations.
- B. IEC 60068-2.1 Environmental testing – Part 2-1: Tests - Test A: Cold, 2.2 Environmental testing - Part 2: Tests. Tests B: Dry heat, 2.3, 2.6 Environmental

testing - Part 2: Tests - Test Fc: Vibration (sinusoidal) and 2.27 Environmental testing. Part 2: Tests. Test Ea and guidance: Shock.

- C. IEC 61131-3: Programmable controllers - Part 3: Programming languages.
- D. IEC 801-3: RFI Immunity.
- E. IEC 801-5: Ground Continuity.
- F. IEC 801-2: Electrostatic Discharge.
- G. UL 508 and CSA Standard C22.2 No. 142 (Isolation Voltages)

#### 1.04 NOMENCLATURE AND IDENTIFICATION DEFINITIONS

- A. AI: Analog Input.
- B. AO: Analog Output.
- C. CPU: Central Processing Unit.
- D. DI: Discrete Input.
- E. DO: Discrete Output.
- F. HMI: Human-Machine Interface.
- G. I/O: Input and/or Output.
- H. ISA: The International Society of Automation
- I. LAN: Local Area Network.
- J. Master/Slave: Communication between devices in which one device, the master, controls all communications.
- K. MCP: Master Control Panel
- L. OIT: Operator Interface Terminal
- M. PID: Control action, proportional plus integral plus derivative.
- N. PLC: Programmable Logic Controller.
- O. Remote I/O: I/O that is located remotely from the processor.
- P. RTU: Remote Terminal Unit
- Q. SCADA: Supervisory Control and Data Acquisition
- R. UPS: Uninterruptible Power Supply

S. WAN: Wide Area Network

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components in packaging designed to prevent damage from static electricity and physical damage.
- B. Store equipment according to manufacturer requirements. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect PLCs from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the PLC from all forms of electrical and magnetic energy that could reasonably cause damage.

1.06 SUBMITTALS

- A. Refer to **Section 01300, SUBMITTALS AND SUBSTITUTIONS**.
- B. Parts List/Bill of Materials - indicating model numbers, locations, operating characteristics, accessories, and equipment details.
- C. Product Data Submittal - Provide manufacturer's catalog cut sheets for all specified and proposed equipment with project specific equipment highlighted. Any exceptions to these specifications must be listed and highlighted in the submittal.
- D. Panel Drawings – Panel Design and Drawings shall only be completed after an approved Product Data Submittal is received back from the Engineer. Pre-construction shop drawings to include panel elementary diagram, panel elevations (interior and exterior), and wire diagrams depicting full loop information from I/O module to field device. Panel Drawing submittal shall include heat generation calculations and UPS load sizing calculations.
- E. Programming and Display Submittal – The Programming and Display Submittal shall be completed after the approval of the Panel Drawings and shall contain the completed PLC programming consistent with this project's sequence of control. HMI/OIT screens may be example screens consistent with this project's configuration and operation. All tag addressing shall be completed in this submittal and tag convention shall be uniform across this project. Programming and Display Submittal shall include a full SCADA tag mapping spreadsheet which will list each tag; Description, ISA Tag Descriptor, Signal Source, Signal Type (including memory tags), Rack/Slot/Point Location, I/O Address, PLC Address, and HMI Address.
- F. Recommended Spare Parts List - list of manufacturer's recommended spare parts including any specific startup and operational/maintenance procedures recommended by the manufacturer.
- G. Operation and Maintenance Information - manual to include hard copies of all programming, HMI screens, user manuals, as-built wire/loop diagrams, general operation and troubleshooting guides, and sequence of operations.

## 1.07 SPARE AND REDUNDANT I/O

- A. Each I/O drop and I/O location shall include at least 20 percent spare points of each type used (AI, AO, DI, and DO) for future use. The spares shall be the same type of I/O modules supplied.
- B. Regardless of the spare requirement, all installed unused points on all I/O modules shall be wired to terminal blocks in the order that they occur on the I/O modules. Unwired spares shall not be acceptable.
- C. Where multiple sets of mechanical equipment and instruments are provided for process redundancy, arrange their field connections to I/O modules so that the failure of a single I/O module will not disable the redundant system. This applies to all I/O types. The acceptability of the I/O arrangement shall be at the discretion of the FCSA.

## 1.08 OPERATION & MAINTENANCE DOCUMENTATION

- A. The Contractor shall provide two (2) complete sets of hardcopy, bound Operation and Maintenance Manuals and two digital copies on CD or DVD including documents in PDF format and all programming files in native file type and PDF. O&M manual shall contain: final system drawings, I/O listings, as-built wiring diagrams, photos, and operating and maintenance information. The submitted manuals shall be sufficient to facilitate the operation, removal, installation, programming, configuration, adjustment, calibration, testing, and maintenance of each component and instrument. Each manual shall also include printed as well as electronic copies of programming for each site

## **PART TWO – PRODUCTS**

### 2.01 GENERAL

- A. Equipment shall consist of one RTU at the proposed Pump Station and all ancillary hardware and software designed to perform the functions specified in the system description.
- B. The RTU and all associated equipment such as battery backup, power supply, relays, indicator lights, etc., shall be mounted in an appropriately sized NEMA 4 enclosure.
- C. Equipment shall operate over a temperature range of -20 to +60 degrees Centigrade.
- D. Major system components are listed in this section but are not meant to be inclusive of all equipment required to deliver a complete and working system. It is the responsibility of the system provider to identify and provide all ancillary and industry standard parts as required to provide a quality system.
- E. Where specified on the Drawings, electrical equipment shall comply with the NEC requirements for Class 1, Group C and D, Division 1 or 2 locations. Wiring methods

and installations of equipment in hazardous locations shall be intrinsically safe, approved for the classified location, or safe for the classified location.

- F. All materials shall be new, free from defects, and of the quality specified. Each type of instrument, instrument accessory, and device shall be by the same manufacturer throughout the work.

## 2.02 PROGRAMMABLE LOGIC CONTROLLER (PLC)

### A. General

1. Provide PLC equipment with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.
2. Processor Systems shall include processor, power supply, input/output modules, communication modules, and remote interface modules as required to meet system requirements.
3. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.
4. All equipment and devices furnished hereunder shall be designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are current production models not scheduled for obsolescence.
5. All equipment furnished shall be designed and constructed so that in the event of power interruption the systems shall go through an orderly shutdown with no loss of memory, and resume normal operation without manually resetting when power is restored.
6. The PLC shall communicate between other PLCs on the system, the SCADA workstation, and field-mounted transducers, switches, controllers, and process actuators. Communications protocol shall be completely transparent to process operators at the HMI workstation.
7. The PLC shall be capable of stand-alone operation in the event of failure of the WAN communication link to the HMI workstation and other PLCs.

### B. Manufacturers

1. All PLCs shall be Allen Bradley's MicroLogix 1100 L24 or 1400 L32 series automation platform. No "or equal" or substitutions permitted.

### C. Central Processing Unit (CPU)

1. The CPU shall be a microprocessor that provides system timing and is responsible for scheduling I/O updates. It shall execute user logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a single module which resolves application logic, stores the application program,

stores numerical values related to the application processes and logic, and interfaces to the I/O.

2. The CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU shall process the I/O with user programs stored in memory, then control the outputs based on the results of the logic operation.
3. The CPU family shall allow for user program transportability from one CPU model to another.
4. The power supply for the PLC shall accept 120vAC power from the RTU mounted uninterruptable power supply.
5. CPU shall be MicroLogix 1766-L32BWA or 1763-L16BWA, no others shall be accepted.

#### D. Memory

1. The PLC shall be supplied with an external memory module used to back up the user program, constants, symbols, and data.
2. Memory card shall be Allen Bradley 1766-MM1/1763-MM1, no others shall be accepted.

#### E. Programming Environment

1. Programming port: The PLC shall utilize an Ethernet port for programming.
2. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.
3. IEC 61131-3 programming languages supported: Ladder (LD).

#### F. Power Supplies

1. Power supplies shall have a clearly visible LED to indicate that the incoming power is acceptable and the output voltage is present.
2. Power supplies shall feature over-current and over-voltage protection and should be designed to operate in most industrial environments without the need for isolation transformers.
3. Power supply shall accept 120vAC as input voltage.
4. Power supply shall be sized to accommodate future I/O cards regardless whether or I/O is supplied under this contract.
5. Provide surge protection, isolation, and over current protection for the 24vDC system independent of 120vAC surge protection, UPS, and signal conditioning.

6. Power supplies shall be Phoenix Contact UNO line, Wago 787 line, or other approved equal.

#### G. Discrete Input and Output Modules

1. General
  - a. Digital input and output modules shall provide ON/OFF detection and actuation.
  - b. Modules shall have indicators to display the status of communication, module health and input / output devices.
2. Discrete Input Modules
  - a. Nominal Input Voltage of 24vAC.
  - b. Number of Points per Card: 8 or 16.
  - c. Discrete input modules shall be Allen Bradley 1762 family; no others shall be accepted.
3. Discrete Output Modules
  - a. Nominal Operating Voltage of 24vDC.
  - b. Number of Points per Card: 8 or 16.
  - c. Discrete output modules shall be Allen Bradley 1762 family; no others shall be accepted.

#### H. Analog Input and Output Modules

1. General
  - a. Analog input modules shall convert an analog signal that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal shall be transmitted to the CPU.
  - b. Modules shall have indicators to display the status of communication, module health and input / output devices.
  - c. Analog modules shall be software configurable through the I/O configuration portion of the programming software.
  - d. The 24vDC power for analog instrument loops shall be provided as a part of the system. The 24vDC power supply may be derived from the 24vDC input power circuit to the PLC or from the RTU 24vDC power supply.
  - e. The field side of the 24vDC power sources(s) shall have individual or grouped (of logically associated circuits) fusing and be provided with a readily visible, labeled blown fuse indicator.
  - f. The use of mixed analog I/O modules is strictly prohibited
2. Analog Input Module
  - a. Isolated high-level type inputs
  - b. Input Ranges of 0-20 mA and 4-20 mA.
  - c. Number of Points per Card: 4 or 8.
  - d. Analog input modules shall be Allen Bradley 1762 family; no others shall be accepted.
3. Analog Output Module
  - a. Isolated high-level type outputs.
  - b. Output Range of 0-20 mA and 4-20 mA.

- c. Number of Points per Card: 4.
  - d. Analog output modules shall be Allen Bradley 1762 family; no others shall be accepted
4. PLC Communication
- a. The PLC shall be equipped with the ability to communicate in either Ethernet/IP or Modbus TCP/IP over the LAN.
  - b. Communications shall be via Ethernet/IP network protocol for the SCADA system.

#### 2.03 SOFTWARE

- A. The PLC shall be programmed and configured using the latest version of Rockwell's RSLogix500 software.
- B. PLC configuration and application development software (including licenses) shall not be provided as part of the contract. The Contractor shall provide their own copy of the programming software and programming cables for the programming the PLC system.

#### 2.04 ENCLOSURES

- A. Enclosures shall be NEMA 4 for indoor and outdoor locations. Enclosure shall be fabricated from a minimum of 14-gauge cold rolled steel with a baked enamel finish in the manufacturer's standard color. Units shall include a single gasket front door. Continuous hinge with removable pin, locking hasp, and door clamping hardware shall be included. Enclosure shall include OIT, pilot lights, and switches as indicated on the plans. Outdoor mounted enclosures which incorporate an OIT shall have the OIT mounted on an interior, swing out, dead-front panel.
- B. The RTU Enclosure shall be no less than the dimensions shown on the plans. No side panels will be allowed.

#### 2.05 BATTERY BACK-UP SYSTEM

- A. Included with the RTU shall be a UPS battery backup system with a minimum of 1500 VA capacity. Output voltage regulation, PWM sine wave 115V +/- 5%, with frequency regulation to 60hz +/- 10%, surge suppression to 480 joules with instantaneous response time. Minimum run time on battery power to be 30 minutes at typical RTU load.

#### 2.06 MANAGED NETWORK SWITCH

- A. Industrial grade switch sized for the project. The switch shall be provided with 10/100-TX ports; sized per the required number of connections. Minimum of 5 - 10/100-TX ports, with a minimum of one active spare port shall be provided.
- B. The switch shall be housed in a ruggedized, metal din-rail enclosure
- C. Acceptable Manufacturers



1. Moxa
2. Phoenix Contact
3. Hirschman

#### 2.07 NETWORK FIREWALL

- A. Each installation shall be connected behind a network firewall.
- B. The firewall shall allow for VPN connection between the FCSA Operations Building and the remote sites. Minimum 5 simultaneous connections.
- C. The device shall have a maximum throughput of 25 Mbps in Full DPI (All UTM services running).
- D. Firewall shall be Dell Sonicwall SOHO or ZT105. No exceptions.

#### 2.08 LIGHTNING ARRESTOR & SURGE PROTECTION

- A. All field signal circuits, including all wiring outside of buildings and between buildings, shall be protected by lightning arresters, at the non-equipment end of each field wire run, which are mounted in control panels, termination panels, or inside of outdoor enclosures for field instruments or analyzers. All signal wires which run outdoors from building to building shall have lightning protection on both ends of the cable.
- B. AC line lightning arresters shall be provided for all indoor cabinets and enclosures and for all field instrumentation devices and analyzers, which require AC power. These arresters shall be enclosed in moisture-proof housings. The arresters shall be mounted inside the enclosure of the field equipment where practical for field devices. In other locations, the arrester shall be mounted immediately adjacent to the protected device. Each arrester shall have the capability to withstand repeated surge currents of at least 20,000 amps peak at 8 x 20 microsecond waves. Performance shall be equal and reliable for surges of either polarity.

#### 2.09 COMMUNICATION CABLE

- A. ETHERNET CABLE: All Ethernet cable shall be Category 6 rated for plenum installation. No Ethernet cable shall be used for building to building connection or other outdoor use.

#### 2.10 SPARE PARTS

- A. The following PLC spare parts shall be furnished:
  1. I/O Cards: Provide a minimum of 10 percent of installed quantity of each type of card; minimum of 1.
  2. PLC Power supplies: Provide 1 spare power supply for each unique power supply installed.

## **PART THREE – EXECUTION**

### **3.01 GENERAL INSTALLATION**

- A. Install system components in accordance with manufacturer's installation instructions.
- B. System control is to come from the PLC under normal conditions or from the HMI workstation when desired by the operator.
- C. Testing and Start-up: All elements of the SCADA system shall be tested by the PCSS in accordance with the Testing procedures of these Specifications to demonstrate that the total system satisfies all of the requirements of this specification. The System Integrator shall coordinate and schedule all of the testing and start-up work with the FCSA.
- D. Training: Provide an integrated training program to meet the specific needs of FCSA. Training shall be conducted at the end of system startup and will be held at the FCSA facility. All training sessions will be hands-on and will include time for each participant to navigate and actively engage with the system.
- E. Maintain area free of dirt and dust during and after installation of programmable controller products.

### **3.02 COMPLETE SYSTEM RESPONSIBILITY**

- A. The system shown on the drawings and described herein represents minimum criteria for the system. The System Supplier shall provide all additional equipment and services not shown or described, which are required for a fully functional system.
- B. The listing of specific products in these Specifications in no way relieves the System Supplier from furnishing equipment that meet the performance and quality criteria specified herein.

### **3.03 PANEL LAYOUT**

- A. Coordinate size and configuration of enclosure to meet project requirements.
- B. Comply with indicated minimum clearances, or with PLC vendors required distances if they are greater than the distances indicated.
  - 1. Provide spacing around PLC as required by the PLC manufacturer to insure adequate cooling. Insure that the air surrounding the PLC has been conditioned to maintain the required temperature and humidity range.
  - 2. Wires entering and exiting PLC components shall be sized to comply with the PLC manufacturers requirements. Doors on all components shall be able to be fully closed when all the wires are installed.

- C. Control panel designer shall provide independent line fuses or circuit breakers, per the PLC manufacturer recommendation, for each power supply, input module, output module, and other modules with separately derived power requirements.
- D. Control panel designer shall insure that communication signals, 4-20mA signals (including those with embedded HART), are properly conditioned for the PLC and protected from all sources of radiated energy or harmonics.
- E. Each PLC (including all I/O) shall be powered from the UPS power conditioning system.

3.04 SITE DESCRIPTION

A. SITE 1 – TYPICAL PUMP STATION

- 1. RTU Hardware: PLC controller with adequate I/O to accommodate I/O list below in addition to the specified spare I/O. 24vDC panel power supply and PLC power supply, cellular data modem (supplied by FCSA), managed Ethernet network switch, UPS, NEMA 4 enclosure to house PLC and other hardware.
- 2. Site Installation Narrative: The RTU shall communicate to all field devices using hardwire connections. All FCSA Network communication shall be Modbus TCP/IP or Ethernet/IP. All local communication, programming, and commissioning to be by the System Supplier.
- 3. TYPICAL PUMP STATION RTU I/O LIST

<b>Signal</b>	<b>Type</b>	<b>Signal Origin</b>
<i>INCOMING POWER STATUS (PRE UPS 120VAC)</i>	DI	RTU Incoming Power
<i>WET WELL LEVEL HIGH</i>	DI	Field Device
<i>WET WELL LEVEL (IF AVAILABLE)</i>	AI	Instrument Transmitter
<i>DISCHARGE EFFLUENT FLOW RATE</i>	AI	Instrument Transmitter
<i>DISCHARGE EFFLUENT FLOW TOTAL</i>	DI	Instrument Transmitter
<i>PUMP RUN PERMISSIVE (IF REQUIRED BY FCSA)</i>	DO	PLC Panel
<i>DISCHARGE PUMP 1 RUN CMND</i>	DO	PLC Panel
<i>DISCHARGE PUMP 1 STATUS</i>	DI	Equipment Panel
<i>DISCHARGE PUMP 1 HOA IN AUTO</i>	DI	Equipment Panel
<i>DISCHARGE PUMP 1 FAULT</i>	DI	Equipment Panel
<i>DISCHARGE PUMP 2 RUN CMND</i>	DO	PLC Panel
<i>DISCHARGE PUMP 2 STATUS</i>	DI	Equipment Panel
<i>DISCHARGE PUMP 2 HOA IN AUTO</i>	DI	Equipment Panel
<i>DISCHARGE PUMP 2 FAULT</i>	DI	Equipment Panel
<i>DOOR SWITCH (IF APPLICABLE)</i>	DI	Field Device

### 3.05 FACTORY TEST

- A. Factory tests shall be performed at the place of fabrication upon the completion of manufacture or assembly. All costs and expenses for such tests shall be included in the original Contract Price. The FCSA shall be notified of the Factory Test at least two weeks in advance to allow the FCSA and Engineer the option of witnessing the test.
- B. The Factory Test shall only be scheduled after approval of the Programming and Interface Submittal.

### 3.06 FINAL ACCEPTANCE TEST

- A. The Final Acceptance Test will be scheduled only after all punch list items have been corrected, the site has been in operation for a minimum of three days with no abnormal operation, and after all training and project documentation has been completed and accepted.

### 3.07 WARRANTY

- A. The System Manufacturer/Supplier shall warrant to the FCSA each product of its manufacturer to be free from defects in material and workmanship for the period, whichever comes first, of twelve (12) months from the date of start-up, not to exceed eighteen (18) months from the date of shipment, provided the product is properly maintained and operated under normal conditions according to the manufacturer's instructions.
- B. The obligation under this warranty is limited to correction without charge of any part or parts thereof which shall upon examination disclose to the manufacturer's satisfaction to have been originally defective. Correction of such defects by repair or replacement shall constitute fulfillment of the warranty.
- C. Systems which include a personal computer and associated software specified herein shall be warranted as stated above. The obligations under this warranty are limited to hardware and software provided as specified herein. Damage or lack of proper function caused by hardware or software added after installation of system is not the responsibility of the System Supplier unless express written permission to add specific hardware or software is attained from the system supplier.

**END OF SECTION**