

## SECTION 13452

### PLANT PROGRAMMABLE LOGIC CONTROLLER SYSTEM

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section Includes: Programmable controllers for plant control panels. The controllers purchased under this Section are purchased by the plant for installation in the plant, not for vendor-supplied equipment.
- B. Related Sections:
  - 1. Section 13410 - Basic Measurement and Control Instrumentation Materials and Methods.
  - 2. Section 13411 - Control Strategies.
  - 3. Section 16050 - Basic Electrical Materials and Methods.
  - 4. Section 13442 - Instrument and Control Panels.
  - 5. Section 13455 - Fiber Optics System.

##### 1.02 COST OF PRE-NEGOTIATED ITEMS

- A. Cost for some of the items in this Section of the Specifications has been pre-negotiated with the specified manufacturer and is included in one of the bid items in the bidding sheet. Refer to the bidding sheet and applicable pre-negotiated proposal included in Appendix B for more details. The CONTRACTOR shall provide additional items as indicated in the applicable pre-negotiated proposal included in Appendix B even if they are not included in the Specifications and/or Drawings. The CONTRACTOR is very strongly cautioned to carefully review the applicable pre-negotiated proposal because the pre-negotiated proposal does not include all the items included in the Specifications and Drawings. In addition to the cost indicated for the applicable bid item in the bidding sheet, the CONTRACTOR shall include in his bid the costs for the following:
  - 1. All items not specifically mentioned in the scope of supply of the pre-negotiated proposal but required per Specifications and Drawings and required to complete the installation to provide an operational system.
  - 2. All other items indicated in the pre-negotiated proposal to be provided by others, by customer, by DISTRICT, or any other similar designation.
  - 3. All freight and applicable taxes, unless specifically included in pre-negotiated proposal.
  - 4. All labor, materials, and all other associated costs not included in the pre-negotiated proposal but required per Specifications and Drawings and required to complete the installation to provide an operational system.
- B. Supplier of pre-negotiated items shall not package the pre-negotiated item(s) with any other items or services.

C. Schedule:

1. The manufacturer/supplier has agreed to the following schedule:
  - a. Deliver shop drawings 10 weeks following issuance of purchase order by CONTRACTOR and receipt of approved field hardware submittal and coordination with instrument and motor control center (MCC) suppliers.
  - b. The above CONTRACTOR responsibilities must be completed at least 2 weeks before Supplier submittals will be considered due.
  - c. Existing programmable logic controller (PLC) panel modifications will be completed 6 to 8 weeks after approval of shop drawings and notification from the CONTRACTOR that the panels are available for modification.
  - d. New PLC panels completed 8 to 10 weeks after approval of Shop drawings.
  - e. PLC and MMI software will be complete and installed when construction is complete and system is ready for commissioning.
  - f. Deliver equipment to site 8 weeks following receipt of approved Shop Drawings.
  - g. Commissioning and start-up will proceed when system complete and tested by CONTRACTOR.
  - h. Deliver as-built manuals within 2 weeks of project start-up.
2. The CONTRACTOR shall issue a purchase order no later than May 31, 2010.

D. Payment: Per Pre-Negotiated proposal. See below:

1. The manufacturer/supplier has agreed to the conditions for payment as outlined in General Conditions Section F - Payment to Contractor.
2. Upon approved submittals: 25 percent.
3. Upon completion of modifications to existing panels and delivery of new panels: 65 percent.
4. Upon completion of start-up and commissioning: 10 percent.

### 1.03 SUBMITTALS

- A. Shop Drawings and Product Data: Submit in accordance with Section 01300. Include description of components, methods of connecting components.
- B. Statement of Installation Engineer's Training and Experience: The Electrical Contractor will submit in accordance with requirements for and with Product Data.
- C. Operating and Maintenance Manuals: Include the following:
  1. Loop diagrams for all added analog loops.
  2. Panel mechanical and wiring diagrams for all modified panels.
  3. Ten sets Submittal and O&M (Drawings only when the hardware supplied is identical to existing).

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. PLC Hardware:
  1. Allen-Bradley, no equal.

## **2.02 ACCEPTABLE PROCESSORS**

- A. Replacement of existing PLC-5 or SLC-500 processors will be accomplished using one of the following unless otherwise approved by the DISTRICT.
- B. PLC processors shall be of the Enhanced Allen-Bradley PLC-5 or SLC-500 Family:
  - 1. Acceptable Catalog Numbers:
    - a. 1785-L20E (PLC-5/20):
      - 1) 16K RAM.
      - 2) Capable of controlling 512 I/O directly or distributed over 12 remote I/O chassis.
      - 3) One Ethernet channel, one DH+, one DH+/Remote I/O port, one RS-232 Channel.
    - b. 1785-L40E (PLC-5/40):
      - 1) 48K RAM.
      - 2) Capable of controlling 2048 I/O directly or distributed over 60 remote I/O chassis.
      - 3) One Ethernet channel, two DH+/Remote I/O port, one RS-232 Channel.
    - c. 1747-L552 or 1747-L553 (SLC-5/05):
      - 1) 32K or 64K RAM.
      - 2) Capable of controlling 4096 I/O directly or distributed over three I/O chassis.
      - 3) One Ethernet channel, one RS232 communications port configurable to DF1 or DH-485 and RIO.

## **2.03 FIELD WIRING CONNECTORS AND TERMINAL BLOCKS**

- A. Field wiring to I/O modules shall be accomplished with manufacturer supplied Removable Terminal Blocks attached directly to I/O housings so that modules can be quickly and easily removed without disturbing or flexing the field wiring; with screw terminals.
- B. Low- and High-Density Removable Terminal Blocks capable of holding two 14- to 22-AWG wires or one 12-AWG wire will be acceptable.
- C. Analog Removable Terminal Blocks capable of holding two 16-AWG wires or one 14-AWG wire will be acceptable.

## **2.04 I/O RACKS**

- A. CONTRACTOR shall provide sufficient rack space to accommodate I/O for this project plus 20 percent installed spare.
- B. Mounting of I/O Racks shall conform to the manufacturers recommendations.

## **2.05 INPUT AND OUTPUT MODULES AND MISCELLANEOUS DEVICES**

- A. PLC-5 processors shall use the 1771 I/O structure unless otherwise approved by ENGINEER. Input and Output modules shall be of the following type and limited to:
  - 1. Allen-Bradley Analog Input module, Model 1771-IFE.
  - 2. Allen-Bradley Analog Output module, Model 1771-OFE2.
  - 3. Allen-Bradley Discrete Input module, Model 1771-IAD.

4. Allen-Bradley Discrete Output module, Model 1771-OAD.
  5. Allen-Bradley Power Supply, Model 1771-P4S.
  6. Allen-Bradley Remote I/O Adapter, Model 1771-ASB.
  7. Allen-Bradley Relay Output module, Model 1771-OW16.
- B. SLC-500 processors shall use the 1746 I/O structure unless otherwise approved by the ENGINEER. Input and Output modules shall be of the following type and limited to:
1. Allen-Bradley Analog Input module, Model 1746-NI16I.
  2. Allen-Bradley Analog Output module, Model 1746-NO8I.
  3. Allen-Bradley Discrete Input module, Model 1746-IA16.
  4. Allen-Bradley Discrete Output module, Model 1746-OA16.
  5. Allen-Bradley Power Supply, Model 1746-P2 or 1746-P4.
  6. Allen-Bradley Remote I/O Adapter, Model 1747-ASB.
- C. Absolutely no third party I/O modules will be used without approval of the ENGINEER.
- D. Terminals and fuses as referenced in Section 16050.
- E. Size the type and quantity of rack power supplies appropriately.

## **2.06 REMOTE I/O PANELS**

- A. Remote I/O Panel(s) shall be complete with Allen-Bradley hardware and miscellaneous devices to accommodate signals as shown on P&IDs per manufacturers recommended installation procedures.
- B. I/O additions to existing remote I/O panels will be permitted if a minimum of 20 percent of the I/O chassis I/O capacity is available as spares after the addition.

## **2.07 COMMUNICATIONS MODULES**

- A. MODBUS TCP/IP Communications modules provide a connection between Allen-Bradley's PLC processor and Modbus TCP/IP network application.
  1. Manufacturer shall be Prosoft Technology, no equal.
  2. Module shall be MV171-MNET. The module shall support for the storage and transfer of up to 5,000-word registers to/from the PLC processor.
    - a. Ethernet Port:
      - 1) 10/100M.
      - 2) 10Base-T Connector.
      - 3) Link and activity LED indicators.
    - b. Backplane Current Load: 800 mA at 5 V.
    - c. Module shall provide LED indicators for module status, backplane transfer status, application status, serial activity status, and error status.
    - d. Configuration Serial port:
      - 1) DB-9M PC compatible.
      - 2) RS-232.
      - 3) Hardware handshaking.
    - e. Application Serial port:
      - 1) DB-9M PC compatible.
      - 2) RS-232, RS-422, RS-485.
    - f. Power: 120 VAC, 60 Hz.

3. Module: MVI46-MNET: module is a single slot and shall provide an interface between Allen-Bradley's SLC processor and Modbus TCP/IP network applications.
  - a. Ethernet Port:
    - 1) 10/100M.
    - 2) 10Base-T Connector.
    - 3) Link and activity LED indicators.
  - b. Backplane Current Load:
    - 1) 800 mA at 5V.
  - c. Module shall provide LED indicators for module status, backplane transfer status, application status, serial activity status, and error status.
  - d. Configuration Serial Port:
    - 1) DB-9M PC compatible.
    - 2) RS-232.
    - 3) Hardware handshaking.
  - e. Application Serial Port:
    - 1) DB-9M PC compatible.
  - f. RS-232, RS-422.
  
- B. MODBUS RTU communication gateway: The module allows serial MODBUS RTU to communicate and interoperates with MODBUS TCP/IP based controllers.
  1. Manufacturer:
    - a. General Electric (GE), Multinet, or equal.
  2. Ethernet:
    - a. Protocol: Modbus TCP/IP.
  3. RS485 Ports:
    - a. RS485 2-wire, half duplex, isolated.
    - b. Baud Rate: 300Bps to 115.2 Kbps.
    - c. Protocol: ModBus RTU.
  4. Power: 120 VAC, 60 Hz.
  
- C. MODBUS Master/Slave Communication Module allows Allen-Bradley PLC processors to interface with other Modbus protocol compatible device.
  1. Manufacturer shall be Prosoft Technology MVI71-MCM, no equal.
  2. The module shall support the storage and transfer of up to 5,000 registers to/from the PLC processor's data files.
  3. Protocol: RTU.
  4. Single Slot - 1771 chassis compatible.
  5. Backplane Current Load: 800 mA at 5 V.
  6. LED Indicators:
    - a. Module status.
    - b. Backplane transfer status.
    - c. Application status.
    - d. Serial activity and error LED status.
  7. Configuration Serial Port:
    - a. DB-9M PC compatible.
    - b. RS-232.
    - c. Hardware handshaking.
  8. Application Serial Ports (PRT1, PRT2):
    - a. RJ45 (RJ45 to DB-9M PC Compatible connector is supplied).
    - b. RS232/422/485 jumper selectable.
    - c. RS232 handshaking configurable.

- D. Remote I/O - Fiber Optic Communication Converters:
  - 1. Manufacturer: Phoenix Digital - or equal.
    - a. P/N OCM-DPR-13-D-ST-XX suggested, to be confirmed by vendor and approved by the ENGINEER.
    - b. They shall utilize din rail mount installation inside LCP panels (see spec 13455).
    - c. Utilize ST Mating Connector.
    - d. Operating temperature range of 0 to 60 degrees C (32 to 140 degrees F).
    - e. 1.5 to 1.8 Amps, 5VDC typical power usage.
    - f. Real Time Diagnostic Option, Required for UL rating.
    - g. Functions at up to 10 km apart in multimode operation (1,300 nm wavelength).
    - h. Multimode fiber optic cable, Wavelength: 1,300.
    - i. UL Listed for Class 1, Division 2 Groups A, B, C, and D Hazardous Locations.

## 2.08 HUMAN MACHINE INTERFACE

- A. Manufacturer:
  - 1. Allen-Bradley.
  - 2. Advantech.
  - 3. Xycom Automation, Inc.
- B. Human Machine Interface (HMI) shall be 15-inch Color Active Matrix TFT Flat Panel Display and provide a touch screen with resistive antiglare.
- C. HMI shall be a high-performance Pentium 4, 2.0-GHz processor with 512-MB DDR RAM and minimum 160-GB hard drive.
- D. HMI shall come standard with an extensive array I/O ports; three serial ports, one parallel port, two USB ports, PS/2 mouse and keyboard ports, one 10/100-Mbps Ethernet port, one VGA port, Audio line in/line out, and Microphone.
- E. HMI shall be provided with side accessible 1.44-MB floppy drive and CD/DVD-R/W.
- F. HMI shall be preloaded with Window XP or other operating system that is compatible with the Intellution Fix 32 application software.
- G. HMI shall be preloaded with the Intellution Fix 32 software.

## 2.09 PC FOR WORK STATIONS

- A. Manufacture: one of following or equal:
  - 1. DELL, Precision 390.
  - 2. Hewlett-Packard.
- B. System:
  - 1. Processor: Intel Core 2 Duo E6300 1.86GHz/1,066MHz/2MB L2/Dual-core/VT.
  - 2. Operating System: Genuine Window XP Professional, SP2 with Media, or most recent version of Windows for workstation applications that is compatible with the software to be installed.
  - 3. Memory: 2GB, 667MHz, DDR2 SDRAM Memory, ECC (2 DIMMS).

4. Keyboard: Entry level, USB, no Hot Keys.
  5. Mouse: USB 2-Button Optical Mouse with Scroll.
  6. Hard Drive Configuration: Non-RAID, 1 drive total configuration 500GB SATA, 3.0 Gb/s with NCQ and 8MB DataBurst Cache.
  7. CD-ROM, DVD, and Read-Write Devices: 16XDVD and 16XDVD+/-RW.
  8. Floppy Drive and Media Card Reader: Internal USB Media card reader.
- C. Multi-Media:
1. Graphics Card: 128MB PCIe x16 nVidia Quadro FX550, or FX560, or equal.
  2. Monitors: 21-inch Flat Panel.
- D. Internet/Networking:
1. Modem: Data/Fax PCI Modem.
- E. Software:
1. PC shall be preloaded with the Intellution Fix 32 software.
- F. Local UPS/Power Protection:
1. Provide Individual UPS for each PC Provided.
  2. Refer to specification Section 13427 for UPS specification.

## **2.10 APPLICATION SOFTWARE**

- A. Application software shall be of the same version used by the DISTRICT, unless approved by the DISTRICT.
- B. Programming will conform to the Process Control Strategies as described on the P&IDs unless otherwise approved by the ENGINEER.
- C. Supervisory control and data acquisition (SCADA) programming provided by the programmer for monitoring, alarming, data collection, and supervision to support the above-mentioned PLC programming and will follow the requirements of the P&IDs unless otherwise approved by the ENGINEER.
- D. A PDF CD-ROM or DVD-ROM of all PLC programming complete with documentation to include instruction comments, rung comments, analog I/O, dip switch settings and rack configurations shall be provided by the programmer.
- E. A PDF CD-ROM or DVD-ROM of all SCADA programming complete with documentation to include TAG comments, analog scaling, communications configuration, dip switch settings, screen printouts, and any specialty subroutine programming shall be provided by the programmer.
- F. CD or DVD-ROM in native programming format for all PLC and SCADA programming and configuration shall be provided by the programmer.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install the PLC and I/O hardware in accordance with the PLC manufacturer's instructions and recommendations, including grounding specifications.

- B. Analog signals leaving a building or entering a building from and outside source shall require isolation.
- C. Interposing relays will isolate all PLC outputs.
- D. Empty slot fillers (1771-N2, 1746-N2) to protect the I/O chassis from contaminants shall be provided.
- E. Modifications are required to existing PLC systems:
  - 1. Additional I/O will be installed as indicated on the P&IDs. Existing I/O will be modified as required to incorporate the new control algorithms.
  - 2. Processor(s) that are to be replaced will follow the above guidelines.

### **3.02 CONTRACTOR'S FIELD QUALITY CONTROL**

- A. Perform conducted susceptibility (RFI, EMI) test as outlined in NEMA ICS 2-230, NEMA ICS 3-304-42, Section 2 of IEEE 472-1974, and ANSI C37.90A-1974.

### **3.03 SERVICES**

- A. Modify existing panels to add all hardware as required to provide the functionality as described in the P&IDs. All signals will be wired to terminal blocks and identified on Drawings.
- B. 10 days for control system and loop acceptance testing, modification, and start-up assistance in coordination with CONTRACTOR. It is assumed that this will take place on no more than ten trips. If additional trips are required, they will be charged at our normal per diem rates for labor and travel.
- C. On-site training will consist of 8 hours for operators and 8 hours for control technicians. Note: No factory training has been included.

### **3.04 ACCEPTANCE TESTING**

- A. All basic functions shall be demonstrated, including I/O processing, communications, alarm handling, operator display functions, and alarm logging, as well as the specific functions listed herein.
  - 1. Hardware Test: The test shall demonstrate proper operation of each hardware device and communications among devices, and shall include verification of selected analog and discrete inputs and outputs.
  - 2. Software Test: All system software routines resulting from the process control descriptions as described per the P&IDs shall be demonstrated by CONTRACTOR and tested by DISTRICT's programmer. Software "patches" or changes to bypass failed or flawed modules during the test will not be acceptable.

END OF SECTION