SECTION 40 63 43
PROGRAMMABLE LOGIC CONTROLLERS (PLC)

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all programmable logic controllers (PLC), with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 23 – Signal Coordination Requirements

C. Section 40 62 00 – Control and Information System Hardware - General

D. Section 40 62 63 – Operator Interface Units

E. Section 40 62 26 – Laptop Computers

F. Section 40 66 00 – Network and Communication Equipment

G. Section 40 67 63 – Uninterruptible Power Systems

H. Section 40 67 00 – Control System Equipment Panels and Racks

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 40 61 22 – Tools, Supplies, and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. One of each type and size of module for PLC equipment furnished under this Contract.

2. One of each type and size of PLC and equipment power supply furnished under this Contract.

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PART 2 – PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLERS - GENERAL

A. The instrumentation subcontractor shall furnish programmable controllers (PLCs) as specified herein and as shown on the Drawings. PLCs shall be provided complete with backplane, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein. No substitutions will be permitted.

B. All components of the PLC system shall be of the same manufacturer; who shall have fully tested units similar to those being furnished in an industrial environment with associated electrical noise. The PLC system shall have been tested to meet the requirements of NEMA Standard ICS 2-230 (Arc Test) and IEEE C37.90.1 (SWC). The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.

C. Programmable controllers shall be designed to operate in an industrial environment. The PLC shall operate in an ambient temperature range of 0□-60□C and a relative humidity of 5-95 percent, non-condensing. The PLC shall operate on supply voltages of 90-132 VAC at 47-63 Hz or 24 VDC if provided with a battery backup system. An integral fuse shall be provided on the power supply for short circuit protection and shall be front panel accessible. Integral overcurrent and undervoltage protection shall be provided on the power supply.

D. Where applicable, the minimum PLC backplane size shall be 7 slots, not including power supply slots.

E. System configuration shall be as shown on the Control System Architecture Drawing. PLC types shall be designated on the Control System Architecture Drawing and correspond to the specifications herein. Only a single type of processor shall be supplied for all PLCs of a designated type. Memory and processor shall be adequate for all control functions specified. PLCs shall be as manufactured or equal to the following:

1. Allen-Bradley CompactLogix with 5380 processor

2.02 PROCESSORS

A. The processor and its associated memory shall be enclosed in a modular enclosure. A multiple-position selector switch or equivalent shall be used to select processor operating mode. LED-type indicating lights shall be provided to indicate processor, memory, and battery status. Errors in memory shall be recognized and shall activate the memory error indicating lights. The PLC processor shall monitor the internal operation of the PLC for failure and provide an alarm output. Nonvolatile memory in the form of a manufacturer supplied industrial CompactFlash card or equivalent technology shall be required to maintain the entire current program and firmware of the controller in the event of power loss. The program shall be updated onto the flash memory each time a

program change such as an online edit or tag value is changed. When nonvolatile memory (flash memory) is not available for certain controller models as offered by the PLC manufacturer, lithium batteries shall be used to maintain process RAM memory for at least one year in the event of power loss. The lithium battery unit shall be an externally mounted battery assembly with the highest available capacity. The PLC shall send an alarm to the plant control system if battery level is low.

B. The instruction set for the PLC shall conform to the requirements of IEC 61131-3. Each PLC shall have the capability to run all five of the standard IEC 61131-3 languages simultaneously. These five languages shall be:

1. Ladder Diagram

2. Structured Text

3. Instruction List

4. Function Block Diagram

5. Sequential Function Chart

C. Additional co-processors or modules may be necessary and shall be furnished as required to meet the functions specified herein and in Section 40 61 96 – Process Control Descriptions.

D. PLC processors shall be provided with substantial user program, data and logic memory to allow for future expansion of the overall system. The total memory used on each processor shall be less than 60% of available memory at project completion.

2.03 COMMUNICATIONS

A. PLC communications shall be provided as specified in Section 40 66 00 – Network and Communication Equipment and as shown on the Control System Architecture Drawing.

B. In addition to a communications port for the control system network, communication ports shall be provided for any other devices required (i.e., operator interface unit) plus an additional communication port for connection to a notebook computer.

C. The PLC shall be able to support various types of fieldbus communication systems for data links to field instruments (where specified) in addition to connected equipment such as power monitors, VFDs, motor protection monitors, etc. As a minimum, Profibus DP, Foundation Fieldbus, Modbus RTU Master and Slave, TCP/IP Ethernet shall be supported. The Contractor shall coordinate the efforts of the necessary parties (instrumentation subcontractor and equipment suppliers) to accomplish the required device and data table addressing between each PLC and the associated connected equipment.

D. Additional communication modules or protocol gateways may be required to support specific communication protocols required under this Contract and shall be supplied at no extra cost to the Owner.

2.04 INPUT/OUTPUT SUBSYSTEMS

A. Input/output hardware shall be plug-in modules in associated I/O backplane/chassis or DIN-rail mounting assemblies. Each unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active pre-wired spares for each I/O type furnished, plus a minimum of 20 percent spare I/O module space for the addition of future circuit cards or modules.

B. Discrete inputs shall be 24 VDC or 120 VAC signals (integral to the PLC) from dry field contacts. Discrete outputs shall be 24 VDC or 120 VAC outputs sourced from the PLC, or dry relay contacts (2A minimum) as required. Refer to Section 40 61 23 – Signal Coordination Requirements for further details of discrete signal type and voltage requirements. The PLC shall provide momentary and latched outputs as required to interface with motor controls and external devices. Interposing relays shall be provided where required to interface with field equipment. Interposing relays shall be as specified in Section 40 78 00 – Panel Mounted Instruments. Electrical isolation shall be provided where required. Maximum density for discrete I/O modules shall be 32 per input module and 16 per output module.

C. Analog input circuits shall be isolated, minimum 16-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC. In general, analog input modules shall be capable of receiving 4-20 mA signals. Where required, RTD input modules shall have a minimum resolution of 0.15□C and be capable of accepting signals from 100-ohm Platinum RTDs. Analog outputs shall be coordinated with the receivers but shall generally be isolated 24 VDC 4-20 mA outputs powered from the PLC. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Lightning/surge protection shall be provided as specified in Section 40 78 56 – Isolators, Intrinsically-Safe Barriers, and Surge Suppressors. Maximum density for analog I/O modules shall be 8 per module.

D. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms that can be disconnected to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. The process interface modules shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All DC output circuits to the field shall include fuses, either integral or at the terminal strip. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed either in the non-conducting mode or remain as were prior to failure. Light-emitting diodes shall be provided for status indication for each input and output point.

E. External power supplies shall be provided with the PLC as required to meet specified installed I/O power requirements plus spares. Power supplies shall be modular units, shall be fully redundant and shall alarm the PLC upon failure. Power supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein for the PLC.

2.05 REMOTE I/O SUBSYSTEMS

A. Remote I/O shall be provided as designated on the Control System Architecture Drawing. Remote I/O shall be either PLC backplane type I/O or field modules as manufactured by the PLC manufacturer. Field modules shall meet the requirements of Subsection 2.04, Input/Output Subsystems. Remote I/O processor or communication modules shall be modular and individually replaceable.

B. Remote I/O shall communicate with the PLC using the PLC manufacturer's standard protocol or an open standard network such as DeviceNet, Ethernet IP, ProfiNet, Foundation Fieldbus, Modbus TCP/IP, or equal.

2.06 INPUT/OUTPUT CIRCUIT ARRANGEMENT

A. Signal and control circuitry to individual input/output boards shall be arranged such that board failure shall not disable more than one half of the control loops within any group of controlled equipment (e.g., one pump out of a group of three pumps, two pumps out of four, etc.). Where possible, individual control loops and equipment shall be assigned to individual boards such that failure of the board will disable only one loop or piece of equipment.

2.07 PROGRAMMING SOFTWARE

A. The PLC programming and configuration software shall be the manufacturer's latest, full-featured version, Windows-based, and shall be fully compliant with IEC 61131-3 standards. The software package shall consist of all programming, configuration, and documentation software needed to place the control and information system in satisfactory operation. The software shall allow on-line and off-line program development and documentation. PLC programming software shall include documentation on optical media.

B. A minimum of one copy of the PLC programming software shall be purchased by the instrumentation subcontractor and registered to the Owner.

C. All configuration and programming software necessary shall be provided on the computer specified in Section 40 62 26 – Laptop Computers for connection to the PLC processor via a communications port. All necessary hardware required to allow the notebook computer to perform PLC configuration and programming shall be provided.

D. If available, the configuration and programming software shall support communication over the network specified in Section 40 66 00 – Network and Communication

Equipment to implement its functions remotely from an operator workstation. All configuration and programming software necessary to implement this functionality shall be provided on the HMI Server operator workstations specified in Section 40 62 16 – Operator Workstation Computers. All necessary hardware required to have the operator workstation perform PLC configuration and programming shall be provided.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. PLC programming shall be furnished to perform all functions described in Section 40 61 96 – Process Control Descriptions, including global functions. In addition, PLCs shall be programmed to provide additional functions described in other Sections of this Division.

B. PLC programming shall make use of the various IEC languages as appropriate to the specific task and shall be performed in a modular style making extensive use of program blocks (subroutines) and program variables to be passed to the program blocks for specific equipment. It is the intent of this requirement to allow for enhanced readability and ease of modification of the program code through the elimination of multiple instances of repeated code for the same function in a “hard-coded” style.

C. Extensive comments shall be placed in the program code to describe the functions of all elements of the program code. PLC code that does not contain comments shall be rejected.

D. Refer to Section 40 61 13 – Process Control System General Provisions, Part 3 for additional requirements.

3.02 REQUIREMENTS FOR MANUFACTURER-SUPPLIED PLCS

A. PLCs that are supplied for equipment local control panels by individual equipment manufacturers or suppliers shall, where so indicated on the Control System Architecture Drawing, be integrated into the plant control system. The manufacturer-supplied PLC shall be furnished, installed and programmed by the manufacturer. The PLC shall continuously monitor and control the associated system and at the same time shall provide all the required alarms, indications of system parameters, equipment status, etc. to the main control system at the plant.

B. Where required as described above, each manufacturer-supplied PLC shall be connected to the Ethernet process control network for access from the plant control system HMI servers, as specified in Section 40 66 00 – Network and Communication Equipment, and shall contain a fiber optic Ethernet switch identical to those provided for the rest of the network-connected PLCs.

C. Each equipment manufacturer shall provide all monitoring and control data to be transferred between the PLC and the plant control system in contiguous blocks of PLC

registers to facilitate block read and write commands for efficient scanning by the control system SCADA servers. These contiguous registers shall be arranged in a single data transfer area, which shall be divided into eight distinct areas with an emphasis on flexibility and future expansion. The distinct areas shall be arranged by data type (analog or discrete), transfer direction (server to PLC or PLC to server), and, where applicable, implementation schedule (current or future). Where required, peer-to-peer communication between PLCs shall likewise be accomplished using separate blocks of contiguous registers. Where individual equipment PLCs are not required to be connected to the plant control system via the data highway network, they shall provide the individual hardwired signals as specified in the Contract Documents. Data and commands for connection to the control system are described in the Drawings, the Input/Output Schedule, the individual equipment Specification Sections, and in Section 40 61 96 – Process Control Descriptions.

D. The operator interface for control of each individual system shall be performed by local operator interface units as specified in Section 40 62 63 – Operator Interface Terminals or individual pilot devices on the equipment local control panel, as specified in the associated equipment Specification Section. Additional operator interface functions shall be provided through the plant control system as specified in the respective equipment specifications and in Section 40 61 96 – Process Control Descriptions.

E. Where operator interface and control functions are required to be provided through the plant control system, the individual system supplier shall be responsible for coordination with the instrumentation subcontractor to provide a complete and working equipment control system. The individual equipment supplier shall also be responsible for limiting the access of the plant control system to the equipment PLC code so as to prevent malfunctions of the equipment and any failure to continuously perform its intended functions. The equipment supplier shall be responsible for ensuring that no actions by the plant control system can damage or otherwise adversely affect the operation of the associated equipment or the safety of personnel working on or near that equipment. The equipment supplier shall also provide direction in the configuration of the SCADA software's security system by the instrumentation subcontractor to limit access to the control functions of the equipment control system to authorized personnel only. The equipment supplier shall coordinate testing of the completed system with the instrumentation subcontractor, which shall conform to the requirements of Section 40 61 21.72 – Field Testing.

F. The Contractor, equipment supplier and instrumentation subcontractor shall coordinate testing and startup of the equipment provided by the equipment supplier with the plant control system, including but not limited to the following tasks:

1. Provide assistance with control system testing of inputs, outputs, and control strategies as needed.

2. Provide support or interface work necessary to perform physical checkout and field testing to the final field devices. The schedule may require the instrumentation

subcontractor and equipment manufacturer personnel to perform loop checks simultaneously, as directed by the Engineer.

3. Coordinate and assist as needed to maintain I/O connectivity throughout the system.

4. Ensure personnel safety while equipment is exercised via the plant control system.

5. Ensure that process, instrumentation, and control equipment are not damaged while equipment is exercised via the plant control system.

6. Provide temporary modifications to field devices and their terminations, if needed.

7. Providing labor and supervision, which may include, but is not limited to, the following: electricians, instrument technicians, manufacturer's representatives, and individual(s) knowledgeable about process startup and operation.

8. Operation of process equipment for verification of each plant control system input and output.

END OF SECTION

Hazen *Addendum No. 2*

November 20, 2023

Felix C. Davis – Request for Proposals for Blower Pre-Selection

To All Proposers:

Manufactures submitting proposals for the above named Request For Proposal (RFP) shall take note of the following changes, additions, deletions, clarifications, etc., in the RFP, which shall become a part of and have precedence over anything contrarily shown or described in the RFP, and as such shall be taken into consideration and be included in the Manufacture's Proposal.

Refer to the attached sheets.

The return receipt requested with this communication will be deemed evidence that the proposer has received this Addendum and has followed the instructions outlined herein. Please sign, date, clearly print company name, and email to tdarms@hazenandsawyer.com immediately upon receipt. Manufacturer shall also indicate receipt, where appropriate, on the Proposal Form.

_____
Company Name

_____
Acknowledgement of Receipt

_____
Date

HAZEN AND SAWYER, P.C.
735 Johnnie Dodds Blvd.
Suite 102
Mt. Pleasant, SC 29464
Tel. (843) 744-6467

Questions

Question 1: Please provide specification 01 33 00 – Submittal Procedures for review.

Response: The above requested specification has been provided as part of Addendum No. 1

Question 2: Please provide specification 46 00 00 – Equipment General Provisions for review.

Response: The above requested specification has been provided as part of Addendum No. 1

Question 3: Please provide specification 40 61 96 Process Control Description.

Response: As this is a preselection, we have not developed process control descriptions. These will be developed and furnished to the selected manufacturer as design is progressed.

Question 4: Please provide specification 40 63 43 – Programmable Logic Controllers for review

Response: The full specification package has not yet been prepared. A draft of Specification 40 63 43 – Programmable Logic Controllers has been attached to Addendum No. 2.

Question 5: Please provide drawings showing discharge check valve for blowers.

Response: Design drawings will be developed and furnished to the selected manufacturer as design is progressed. For purposes of the preselection pricing discharge check valves furnished shall be 20 inches for the five blower alternative (9,000 scfm per blower) and 24 inches for the four blower alternative (12,000 scfm per blower).

Question 6: Please provide drawings showing discharge isolation butterfly valve for blowers.

Response: Design drawings will be developed and furnished to the selected manufacturer as design is progressed. For purposes of the preselection pricing discharge isolation butterfly valves furnished shall be 20 inches for the five blower alternative (9,000 scfm per blower) and 24 inches for the four blower alternative (12,000 scfm per blower).

Question 7: Please provide specification 40 05 64 – Butterfly Valves for review.

Response: The above requested specification has been provided as part of Addendum No. 1

Question 8: Please clarify if the "preliminary Performance Test" as specified in 43-11-11 paragraph 3.02A can be eliminated.

Response: Preliminary performance test is specified to ensure blower performance is adequate prior to scheduling witnessed PTC-13 Factory Performance tests. Final specification language will be coordinated with the selected blower manufacturer.

Attachments

Attachment No. 1: Felix WWTP Aeration Upgrades Blower RFP.docx

Attachment No. 2: 01 33 00 – Submittal Procedures

Attachment No. 3: 09 90 00 – Painting

Attachment No. 4: 26 05 61 – Medium Voltage Electric Motors

Attachment No. 5: 40 05 57 – Valve Operators and Electric Valve Actuators

Attachment No. 6: 40 05 64 – Butterfly Valves

Attachment No. 7: 40 61 23 – Signal Coordination Requirements

Attachment No. 8: 40 67 63 – Uninterruptible Power Systems

Attachment No. 9: 46 00 00 – Equipment General Provisions