SECTION 40 95 00

PROCESS CONTROL
10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.90	(2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C37.90.1	(2002) Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C62.41.1	(2002) IEEE Guide on the Surges Environment in Low-voltage (1000V and Less) AC Power Circuits
IEEE C62.41.2	(2002) IEEE Recommended Practice on Characterization of Surges in Low-voltage (1000V and Less) AC Power Circuits
IEEE Std 100	(2000) The Authoritave Dictionary of IEEE Standards Terms
IEEE Std 802.3	(2002) Information Technology - Part 3: CSMA/CD Access Method and Physical Layer Specifications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA C12.1	(2001) Electric Meters; Code for Electricity Metering
NEMA ICS 1	(2000; R 2005) Standard for Industrial Control and Systems General Requirements
NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 3	(2005) Standard for Industrial Control and

	Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC
NEMA ICS 4	(2005) Industrial Control and Systems: Terminal Blocks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007; AMD 1 2008) National Electrical Code - 2008 Edition

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 1059	(2001; Rev thru Dec 2006) Terminal Blocks
UL 508	(1999; Rev thru Jul 2005) Standard for Industrial Control Equipment

1.2 CONTROL SYSTEM DESCRIPTION

The process instrumentation and control system shall be used to monitor and control the operation of process equipment as specified and in accordance with the control strategies and Process and Instrumentation Diagrams (P&IDs) shown on the drawings. The control system shall provide for operator interaction, overall control system supervision, and process equipment control and monitoring. The Contractor shall provide hardware configured and sized to support expansion as specified and shown on the drawings.

1.2.1 Existing Control System

The Perris II Desalination Facility must be compatible with the existing Perris I and Menifee Desalination Facility SCADA systems, to allow interface between the systems. The existing SCADA systems utilize Allen Bradley Control Logix PLCs, and PC servers and workstations running FIX32 software by GE Fanuc.

1.2.2 System Integration

The Process Instrumentation and Control System (PICS) includes software to be provided by a SCADA SOFTWARE SUPPLIER through a separate contract. Integrate the PICS with the equipment and work provided by the SCADA SOFTWARE SUPPLIER, and with vendor-supplied packaged control systems. Provide all components necessary for a fully functional and integrated control system. Coordinate scope with the SCADA SOFTWARE SUPPLIER and vendor packaged systems. Coordinate all PICS related submittals, work, testing, training and documentation specified in this and related sections. The Specifications define the complete PICS System that includes work by the SCADA SOFTWARE SUPPLIER. The SCADA SOFTWARE SUPPLIER scope includes Application Software programming for PLC-200; all HMI software and licenses; HMI application development of data base, operator screens, alarms, and trending; modifications to existing SCADA system; software testing; and training for software functions. Contractor to provide all other software and hardware specified and shown for a fully functional instrumentation and control system.

1.2.3 Control System General Requirements

The control system shall consist of engineering, furnishing, testing prior to installation on site, installing, integrating, calibrating, adjusting, testing on site, documenting, starting up, and DISTRICT training for a complete Process Instrumentation and Control System for plant and supporting utilities. Major parts are:

a. Plant instrumentation including primary elements, transmitters, and control devices.

b. Control panels and programmable controller system.

c. Human-Machine Interface (HMI) computers (operator workstations).

d. Central station server computers for interfacing PLCs to HMI operator workstations.

e. Central station server computers for historical data collection and storage.

f. Network and fiber optic equipment.

g. Applications Software provided by SCADA SOFTWARE SUPPLIER.

h. Integrated monitor/control system for the RO System and its supporting systems as shown on the drawings. Supporting systems include:

   1. Cartridge filters.

   2. RO feed pumps.

   3. RO membranes.

   4. Chlorine contact tanks.

   5. Finished water pump station.

   6. Brine Station.

   7. Chemical facility.

i. Supervisory monitoring and control for the Iron and Manganese Removal System as shown on the drawings.

j. Completion of Detailed Design: PICS design as shown and specified includes functional requirements, performance requirements, generalized component specifications, typical drawings for installation details, control panel schedules, PLC I/O list, and equipment lists. Complete the detailed design of PICS.

k. Field services including:

   1. Verify the correctness of final power and signal connections (lugging and connecting). Verify readiness for operation.

   2. Adjusting and calibrating.

3. Starting up.

4. Testing and coordination of testing.

5. Training.

1.2.4 Control System Operation

The control system provided under this specification shall operate using direct digital control (DDC) algorithms or ladder logic type and supervisory control to provide the required sequences of operation. Input data to the controller shall be obtained by using instruments and controls interfaced to mechanical, electrical, utility systems and other systems as shown and specified. All required setpoints, settings, alarm limits, and sequences of operation shall be as noted in Control Strategies Supplement to this section. The number and location of control panels shown on drawings shall be provided as a minimum.

1.2.5 Control System Points

Inputs to and outputs from the control system shall be in accordance with the Input/Output (I/O) Summary Table Supplement to this section. Each connected analog output (AO), analog input (AI), digital output (DO), digital input (DI), pulse accumulator (PA) input and other input or output device connected to the control system shall represent a "point" where referred to in this specification.

1.2.6 Symbols, Definitions, and Abbreviations

Symbols, definitions, and engineering unit abbreviations shall conform to IEEE Std 100, as applicable.

1.3 ENVIRONMENTAL CONDITIONS

Capacity and design of the air moving equipment and accessories shall be suitable for 24-hour full load service and shall meet the following criteria.

a. Control Room, Air Conditioned:

1. Temperature: 60 to 80 degrees F.

2. Relative Humidity: 40 to 60 percent.

3. NEC Classification: Nonhazardous.

b. Inside, Air Conditioned:

1. Temperature: 60 to 80 degrees F.

2. Relative Humidity: 10 to 70 percent.

3. NEC Classification: Nonhazardous.

c. Inside:

1. Temperature: 20 to 120 degrees F.

2. Relative Humidity: 10 to 100 percent.

3. NEC Classification: Nonhazardous.

d. Inside, Corrosive:

1. Temperature: 20 to 120 degrees F.

2. Relative Humidity: 10 to 100 percent.

3. Corrosive Environment: Citric acid, sodium hypochlorite, aqueous ammonia, sodium bisulphate.

4. NEC Classification: Nonhazardous.

e. Outside:

1. Temperature: 0 to 130 degrees F.

2. Relative Humidity: 5 to 100 percent, rain.

3. NEC Classification: Nonhazardous.

f. Outside, Corrosive:

1. Temperature: 0 to 130 degrees F.

2. Relative Humidity: 5 to 100 percent, rain.

3. Corrosive Environment: Citric acid, sodium hypochlorite, aqueous ammonia, sodium bisulphate, fluoride.

4. NEC Classification: Nonhazardous.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Control Panels; G
Installation
Wiring; G

Detail drawings containing complete piping, wiring, schematic, flow diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Piping and Instrumentation (P&ID) drawings (prepared using industry recognized device symbols, clearly defined and describing piping designations to define the service and materials of individual pipe segments and instrument tags employing Instrument Society of America suggested identifiers). Drawings shall include, as appropriate: product specific catalog cuts; a drawing index; a list of symbols; a series of drawings for each control system using abbreviations, symbols, nomenclature and identifiers

as shown; valve schedules; compressed instrument air station schematics and ASME air storage tank certificates for each type and make of compressed instrument air station.

SD-03 Product Data

Instrumentation and Control System; G

Manufacturer's descriptive and technical literature, performance charts and installation instructions. Product specific catalog cuts shall be in booklet form, indexed to the unique identifiers, and shall consist of data sheets that document compliance with the specification. Where multiple components are shown on a catalog cut, the application specific component shall be marked.

Sensors and Meters; G

Manufacturer's descriptive and technical literature, catalog cuts, performance charts and installation instructions.

Training Manual; G

Instruction manual 30 days prior to Performance Verification Test.

Performance Verification Test (PVT); G

The performance verification test procedure; it shall refer to the actions and expected results to demonstrate that the control system performs in accordance with the control strategies. A list of the equipment to be used during the testing shall be included. The list shall also include manufacturer's name, model number, equipment function, the date of the latest calibration and the results of the latest calibration.

Factory Test Procedure; G

Documentation containing factory test methods and procedures.

SD-05 Design Data

Control Panels; G

Seismic anchorage and bracing data sheets and drawings as required by 26 05 48.00 10, SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

Radio Equipment; G

Seismic anchorage and bracing data sheets and drawings as required by 13 48 00, SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

SD-06 Test Reports

Factory Test Report
Testing, Adjusting and Commissioning
Performance Verification Test(PVT); G
Endurance Test

Test results in report format.

Calibration test data.

SD-07 Certificates

Control and Sensor Wiring

Certified test results for surge protection.

SD-10 Operation and Maintenance Data

Instrumentation and Control System; G

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include layout, wiring and control diagrams of the system as installed. The instructions shall include the manufacturer's name, model number, service manual, parts list and a brief description of all equipment and their basic operating features.

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs and trouble shooting guides.

1.5 QUALITY ASSURANCE

Process Instrumentation and Control work shall be provided by a qualified System Integrator. Company shall have a minimum of 7 years experience providing similar equipment for similar projects, including at least two projects with Reverse Osmosis water treatment. System Integrator's Project Manager shall have a minimum of 5 years experience managing process instrumentation and control system installations.

1.6 DATA TRANSMISSION SYSTEMS (DTS)

Data transmission systems for communication between PLCs and between PLCs and the central station shall be provided in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM and in Section 40 95 33.23 20 FIBER OPTIC (FO) OUTSIDE PLANT (OSP) MEDIA and as shown on the drawings.

1.7 EQUIPMENT REQUIREMENTS

1.7.1 Materials and Equipment

Materials and equipment shall be standard unmodified products of a manufacturer regularly engaged in the manufacturing of such products. Units of the same type of equipment shall be products of a single manufacturer. Items of the same type and purpose shall be identical and supplied by the same manufacturer, unless replaced by a new version approved by the Government.

1.7.2 Nameplates

Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Laminated plastic nameplates shall be provided for equipment devices and panels furnished. Each nameplate shall identify the device, such as pump "P-1" or

valve "VLV-402". Labels shall be coordinate with the schedules and the process and instrumentation drawings. Laminated plastic shall be 1/8 inch thick, white with black center core. Nameplates shall be a minimum of 1 by 3 inches with minimum 1/4 inch high engraved block lettering. Nameplates for devices smaller than 1 by 3 inches shall be attached by a nonferrous metal chain. All other nameplates shall be attached to the device.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

Equipment located outdoors, not provided with climate controlled enclosure, shall be capable of operating in the ambient temperature range indicated in paragraph ENVIRONMENTAL CONDITIONS, unless otherwise specified. Electrical equipment will conform to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Equipment and wiring must be in accordance with NFPA 70, with proper consideration given to environmental conditions such as moisture, dirt, corrosive agents, and hazardous area classification.

2.2 MONITORING AND CONTROL PARAMETERS

The control system shall be complete including sensors, field preamplifiers, signal conditioners, offset and span adjustments, amplifiers, transducers, transmitters, control devices, engineering units conversions and algorithms for the applications; and shall maintain the specified end-to-end process control loop accuracy from sensor to display and final control element. Enclosures shall be rated for NEMA 4X, corrosive environments; NEMA 4, Outdoor non-corrosive; and NEMA 12.

2.2.1 Transmitter

Unless indicated otherwise, each sensor shall be provided with a transmitter, selected to match the sensor. Except where specifically indicated otherwise on the drawings, the transmitter shall be provided with a four digit or analog visual display of the measured parameter and shall provide a 4 to 20 mAdc output signal proportional to the level of the measured parameter. Accuracy shall be plus or minus 0.5 percent of full scale reading with output error not exceeding plus or minus 0.25 percent of the calibrated measurement. Transmitter shall be located where indicated, mounted integrally with the sensor, pipe mounted, wall mounted or installed in the control panel. The distance between the sensor and transmitter shall not exceed the manufacturer's recommendation. Field preamplifiers and signal conditioners shall be included when necessary to maintain the accuracy from sensor to the programmable logic controller or recorder.

2.2.2 Process Instrumentation, Sensors and Meters

Provide process instrumentation as shown on drawings, and as required in Supplements to this section, Instrument List, and Component Specifications.

2.2.3 Mechanical Systems

a. Flow Element, Rotameter, Purge:

1. For air service unless otherwise noted.

2. Materials: Glass tube, fiberglass body, stainless steel float, nylon ball check valve.

3. Direct-Reading Scale Length: 2-1/2 inches, minimum.

4. Scale Ranges: 0 to 2.5 scfh for air service or 0 to 10 gph for water service.

5. Integral inlet needle valves.

6. Integral differential pressure regulators:

a. For water service.

b. For air service for level ranges greater than 10 feet of water.

7. Rotameters for water service.

8. Manufacturers and Products:

a. Abb 10a6100.

b. Brooks; Series DS-1350.

b. Test Tap:

1. Manufacturers and Products:

a. Imperial-Eastman; quick-disconnect couplings No. 292-P and caps No. 259-P.

b. Crawford Fitting Co.; Swagelok quick-connects Series QC4 and caps QC4-DC.

c. Parker; CPI Series precision quick couplings.

c. Tubing Raceways:

1. Cable tray systems complete with tees, elbows, reducers, and covers.

2. Size in accordance with manufacturer's recommendations for the intended service.

3. Materials: Galvanized steel.

4. Manufacturers:

a. Globetray.

b. Cope.

2.3 PROGRAMMABLE LOGIC CONTROLLER (PLC)

2.3.1 PLC General Requirements

PLCs shall be micro-processor based, capable of receiving discrete and analog inputs and, through programming, shall be able to control discrete and analog output functions, perform data handling operations and communicate with external devices. PLCs shall meet the requirements of Class A computing devices, and shall be labeled as set forth in 47 CFR 15

and shall be able to withstand conducted susceptibility test as outlined in NEMA ICS 1, NEMA ICS 2, NEMA ICS 3, or IEEE C37.90.1. PLCs shall function properly at temperatures between 32 and 122 degrees F at 5 to 95 percent relative humidity non-condensing and shall tolerate storage temperatures between minus 40 and plus 140 degrees F at 5 to 95 percent relative humidity non-condensing.

2.3.2 Modular PLC

PLCs shall be based on a modular, field expandable design allowing the system to be tailored to the process control application. The system shall be expandable through the use of additional hardware and/or user software. As a minimum, the PLC shall include a mounting backplane, power supply module, central processing unit (CPU) module, communications module, and input/output (I/O) module. The modules shall be grouped together in a mounting rack or cabinet. The mounting rack backplane shall provide the communications mechanism to fully integrate the individual modules located within the rack. Modules shall plug directly into the backplane. The use of wire connectors between modules will not be allowed. The rack size shall be as needed to hold the equipment necessary while performing the required control functions. The system configuration shall allow for the removal and/or installation of modules under power.

2.3.2.1 Central Processing Unit (CPU) Module

The CPU module shall be a self contained, microprocessor based unit that provides time of day, scanning, application program execution, storage of application programs, storage of numerical values related to the application process and logic, I/O bus traffic control, peripheral and external device communications and self diagnostics.

2.3.2.2 Communications Module

The communications module shall allow peer-to-peer communication with other PLCs and shall allow the PLC to communicate with the central station, or workstation. The communication module shall utilize Ethernet architecture and protocol. The communication module shall allow programming of the PLC to be done locally through the use of a laptop computer or from the central station or remote workstation.

2.3.2.3 Remote I/O (RIO) Interface Module

The RIO modules shall provide communication between PLC processors and RIO panels and racks, using Control Net protocol.

2.3.2.4 System Redundancy Module

System redundancy modules shall provide for dual processor redundant operation, with automatic switch over in the event of a failed PLC processor.

2.3.2.5 Serial Modbus Converter Module

The Modbus modules shall provide interface from the PLC backplane to external serial equipment such as power meters via Modbus protocol. Similar to Prosoft MVI module.

2.3.2.6 Power Supply Module

One or more power supply modules shall be provided as necessary to power other modules installed in the same cabinet. Power supply modules shall plug directly into the backplane. Auxiliary power supplies may be used to supply power to remote cabinets or modules.

a. Power supply modules shall use AC power with a nominal voltage of 120 vAc plus or minus 5 percent. The power supply module shall monitor the incoming line voltage level and shall provide over current and over voltage protection. If the voltage level is detected as being out of range the power supply module shall continue to provide power for an adequate amount of time to allow for a safe and orderly shutdown. Power supply modules shall be capable of withstanding a power loss for a minimum of 20 milliseconds while still remaining in operation and providing adequate power to all connected modules.

b. Each power supply module shall be provided with an on-off switch integral to the module. If the manufacturer's standard power supply module is not provided with an on-off switch, a miniature toggle type switch shall be installed near the PLC and shall be clearly labeled as to its function.

c. Power supply modules shall be provided with an indicating light which shall be lit when the module is operating properly.

2.3.2.7 Input/Output (I/O) Modules

Modules shall be self contained, microprocessor based units that provide an interface to field devices. The module shall be located in the CPU mounting rack or a rack containing a remote I/O communication module connected to the CPU rack. The unit shall plug directly into the backplane of the mounting rack. Each module shall contain visual indication to display the on-off status of individual inputs or outputs.

2.3.3 PLC System Requirements

A complete system of networked PLCs with Remote I/O (RIO) shall be provided. PLC-200 shall be fully redundant with two processors as shown. PLC racks and modules shall be located in control panels as shown on the drawings. PLCs shall also be provided as integral part of process equipment packages. All PLCs provided under this contract shall be the product of a single manufacturer to ensure compatibility, and shall be programmed with the same software package. The PLC system provided shall also interface with the existing Perris I and Menifee PLCs and FIX32 Intellution HMI servers. Refer to SCADA Block Diagram in drawings and Supplement PLC I/O List for detailed requirements.

a. PLC System Manufacturer and Product Series: similar to Allen-Bradley; 1756 ControlLogix, to allow interface to existing Perris I SCADA system.

b. CPU Rack:

1. All CPU processors shall be identical for compatibility and ease of maintenance.

2. Provide dual redundant CPUs and redundancy modules where shown.

3. Minimum 7.5 MB memory.

4. ControlNet remote I/O network capability.

5. Ethernet TCP/IP compatible communications capability.

6. Modbus interface capability (for interface with other systems).

7. Similar to Allen-Bradley Model 1756-L61 Control Logix, latest version.

c. I/O Modules: Provide all input/output modules required as per Input/Output Summary. Modules shall meet the following minimum specifications:

1. Discrete Input Modules: Voltage: 120 volts, 60-Hz or 24 Vdc. Points per Module: 16 maximum. LED status indicator for each point. Isolation: Between input point and PLC, 1,500 volts rms. Similar to Allen-Bradley 1756-IA16I.

2. Isolated Discrete Output Modules: Type: Relay contact, SPST. Voltage: 120 volts ac, and 30 volts dc, minimum. Outputs per Module: 16 maximum. Load Rating: 2 amps continuous. LED status indicator for each point. Isolation: Between PLC and output point, 1,500 volts rms. Similar to Allen-Bradley 1756-OW16I.

3. Analog Input/Output Modules: Voltage: 24V dc, 4 to 20 mA dc into 750 ohms. Differential Analog Input Points per Module: 8 maximum. Isolated Analog Output Points per Module: 6 maximum. Isolation: Between PLC and I/O point and between I/O points, 1,500 volts rms. Similar to Allen-Bradley 1756-IF6I analog inputs, and 1756-OF6CI analog outputs.

4. Module Layout and Configuration: Where possible, partition the I/O signals so that the failure of a single module does not cause failure of multiple process units. Position modules of the same type together. For example, all DI modules in one group, all DO modules in another group, etc. Provide interface module field terminal wiring units for each I/O module. Individually fuse power supply to each module.

5. I/O Expandability: Provide spares of each type of I/O signal at each PLC I/O cabinet. For each type of I/O, the minimum number of spares shall be 20 percent of used points, or 4 points, whichever is greater. All spare I/O shall be wired to field terminal blocks for easy system expansion. Provide a minimum of two spare I/O slots in each mounting rack. Provide a minimum of two of each type of I/O module as shelf spare.

2.4 PLC SOFTWARE

PLC programming software described in this specification shall be furnished as part of the complete control system.

2.4.1 PLC Programming Software

Provide two fully licensed sets of software including ControlLogix 5000

Professional, RS Linx Gateway, and RS NetWorx for ControlNet, latest versions.

2.5 CONTROL PANELS

2.5.1 Components

Control Panels and components shall meet applicable requirements of Section 40 99 90, PACKAGE CONTROL SYSTEMS, and shall have features noted in Supplement CONTROL PANEL SCHEDULE.

2.5.1.1 Enclosures

The enclosure for each control panel shall conform to the requirements of NEMA 250 for the types specified. Finish color shall be the manufacturer's standard, unless otherwise indicated. Damaged surfaces shall be repaired and refinished using original type finish. Enclosures for installation in electrical and mechanical equipment rooms shall be Type 12; other locations shall be as otherwise specified or shown. Enclosures for equipment installed outdoors shall be Type 4 or as shown. Enclosures for installation in a corrosive environment shall be Type 4X and shall be constructed of stainless steel. Painted steel shall not be allowed for use in a corrosive environment. Enclosure shall be provided with a single, continuously hinged exterior door with print pocket, 3-point latching mechanism and key lock and a single, continuously hinged interior door.

2.5.1.2 Controllers

Controllers shall be in accordance with paragraph Programmable Logic Controller (PLC).

2.5.1.3 Standard Indicator Light

Indicator lights shall comply with NEMA ICS 1, NEMA ICS 2 and UL 508. Lights shall be heavy duty, round and shall mount in a 0.875 inch mounting hole. Indicator lights shall be LED type and shall operate at 120 vAc or 24 vDc. Long life bulbs shall be used. Indicator light shall be provided with a legend plate labeled as shown on the drawings. Lens color shall be as indicated on the drawings. Lights shall be push to test (lamp) type.

2.5.1.4 Selector Switches

Selector switches shall comply with NEMA ICS 1, NEMA ICS 2 and UL 508. Selector switches shall be heavy duty, round and shall mount in a 0.875 inch mounting hole. The number of positions shall be as indicated on the drawings. Switches shall be non-illuminated. Switches shall be rated for 600 volts, 10 amperes continuous. Selector switches shall be provided with a legend plate labeled as shown on the drawings. Where indicated or required, dual auxiliary contacts shall be provided for the automatic position to provide position sensing at the central station or workstation. Auxiliary contacts shall be rated for 120 vAc, 2A as a minimum. Where indicated on the drawings, switches shall be key operated. All keys shall be identical.

2.5.1.5 Push Buttons

Push buttons shall comply with NEMA ICS 1, NEMA ICS 2 and UL 508. Push buttons shall be heavy duty, round and shall mount in a 0.875 inch mounting hole. The number and type of contacts shall be as indicated on the

drawings or required by the Sequence of Control. Push buttons shall be rated for 600 volts, 10 amperes continuous. Push buttons shall be provided with a legend plate labeled as shown on the drawings.

2.5.1.6 Relays

Relays shall comply with IEEE C37.90 and derated for altitude above 1,500 m. Relays shall be as required by the Sequence of Control. Relay coil shall be 120 vAc or 24 vDc, as required, and shall be provided with matching mounting socket. Provide indicator lights on all relays, on when relay is energized. Power consumption shall not be greater than 3 watts.

2.5.1.7 Digital Panel Indicators

As specified in Supplement COMPONENT SPECIFICATIONS, Code S27.

2.5.1.8 Signal Isolators

As specified in Supplement COMPONENT SPECIFICATIONS, Code S24.

2.5.1.9 Terminal Blocks

Terminal blocks shall comply with NEMA ICS 4 and UL 1059. Terminal blocks for conductors exiting control panels shall be two-way type with double terminals, one for internal wiring connections and the other for external wiring connections. Terminal blocks shall be made of bakelite or other suitable insulating material with full deep barriers between each pair of terminals. A terminal identification strip shall form part of the terminal block and each terminal shall be identified by a number in accordance with the numbering scheme on the approved wiring diagrams.

2.5.1.10 Alarm Horns

Alarm horns shall be provided where indicated on the drawings. Horns shall be vibrating type and shall comply with UL 508. Horns shall provide 100 dB at 10 feet. Exterior mounted horns shall be weather proof by design or shall be mounted in a weather proof enclosure that does not reduce the effectiveness of the horn.

2.5.2 Panel Assembly

Control panels shall be factory assembled and shipped to the jobsite as a single unit. Panels shall be fabricated as indicated and devices shall be mounted as shown or required. Each panel shall be fabricated as a bottom-entry connection point for control system electrical power, control system wiring and communications system wiring to other control panels.

2.5.3 Electrical Requirements

Each panel shall be powered by a dedicated 120 volts ac circuit, with a circuit breaker, sized as recommended by the equipment manufacturer, and a disconnect switch located inside the panel. Wiring shall terminate inside the panel on terminal blocks. Electrical work shall be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and as shown on the drawings.

2.5.4 Grounding

Control panel enclosures shall be equipped with a solid copper ground bus or a solid metal grounded backpanel, or equivalent. The ground bus shall

be securely anchored to the enclosure so as to effectively ground the entire structure. Clamp-type terminals sized large enough to carry the maximum expected current shall be provided for grounding cables. Where a definite circuit ground is required, a single wire not less than #10 AWG shall run independently to the panel ground bus and shall be fastened to the ground bus with a bolted terminal lug. Cases of instruments, relays and other devices shall be effectively grounded through the enclosure steel structure unless otherwise indicated. Insulated wiring having a continuous rated current of not less than the circuit fuse rating shall be used for grounding. Grounding terminals of power receptacles shall be solidly grounded to the panel enclosure.

2.5.5 Convenience Outlet

A 120 volt ac, 20 amp, ground fault interruption (GFI) type duplex convenience outlet shall be provided inside the panel.

2.5.6 Panel Interior Light

Each free-standing control panel shall be provided with a 40 watt fluorescent light. The light shall be operated by a manual on-off switch mounted on the interior door of the enclosure. The light shall be powered by the same circuit as the convenience outlet.

2.5.7 Ventilation System

Each free-standing control panel shall be provided with two single phase, 120 volt ac ventilation fans. Each fan shall supply a minimum of 100 cfm of ventilation air through the enclosure. Each fan shall be provided with a line voltage thermostat. Thermostat setpoints shall be adjustable in a range of 70 to 140 degrees F as a minimum. Each supply and exhaust grille shall contain a filter that is easily removed for cleaning or replacement.

2.5.8 Heating System

Where indicated, control panel(s) shall be provided with a thermostatically controlled electric heater capable of maintaining an enclosure temperature of 40 degrees F when continuously exposed to an ambient temperature of 15 degrees F.

2.5.9 Air Conditioning System

Where indicated, control panels shall be provided with a mechanical refrigeration air conditioning system. The system shall be capable of maintaining a temperature of 90 degrees F inside the enclosure with all equipment in the panel operating and while continuously exposed to full sunlight and an ambient air temperature of 120 degrees F. The compressor and condenser shall be located outside the control panel enclosure. Provisions shall be made to remove condensate from the control panel and to protect all devices within the enclosure from condensate.

2.6 CENTRAL STATION AND OPERATORS WORKSTATION EQUIPMENT

2.6.1 Central Station and Operators Workstation Computer

Provide latest available technology computer equipment available at time of system software development. Computer shall be a standard rack mount or tower configuration, as shown, unmodified digital computer of modular design. Computing devices, as defined in 47 CFR 15, supplied as part of

the control system shall be certified to comply with the requirements of Class B computing devices and shall be labeled as set forth in 47 CFR 15.

2.6.1.1 Components

Provide computer component quantities and arrangement as shown and specified. Computer components shall be as specified in Supplement COMPONENT SPECIFICATIONS for the following: Y71 SCADA Server; Y72 Historical Server; Y73 HMI Client Workstation; and Y74 Laptop Workstation.

2.6.2 Printer

A laser printer shall installed at the Main Control Room. The printer shall meet the following requirements: The input interface shall be dual Ethernet connections. Resolution shall be a minimum of 1200 dots/inch. Printing speed shall be a minimum of 17 pages per minute. The data buffer size shall be a minimum of 10 megabytes. The size for paper and other media shall be 8.5 X 11 inches. The paper cassette shall have a 250 sheet minimum capacity.

2.6.3 LAN System

The local area network (LAN) shall be used to allow communication between PLCs located in the control panels, the central station computers the operator's workstation computers and the printer. The LAN system configuration and requirements shall comply with the control system schematics and block diagram shown on the drawings. All LAN equipment shall fully comply with IEEE Std 802.3 Ethernet networks. Cables and connecting hardware shall conform to the requirements of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.6.4 LAN Components

Provide LAN component quantities and arrangement as shown and specified. LAN components shall be as specified in Supplement COMPONENT SPECIFICATIONS for the following: Y81 SCADA Ethernet Switch; Y82 Industrial Ethernet Switch, Large size for mounting in LCP-200 and Small size for mounting in other control panels; and Y83 Network Router and Security Firewall. Provide equipment mounting racks as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.6.5 Uninterruptible Power Supply (UPS)

All computers and networking components shall be powered from plant UPS.

2.7 RADIO EQUIPMENT

2.7.1 Antenna Mast

The antenna mast shall be a 50 foot high freestanding aluminum tower supporting antenna, cable, surge suppressor, and mounting hardware. Tower shall be lightweight sectional design with tapered sections. Tower shall be anchored to and supported by a concrete base without need for guy wires or other structural support. Tower, anchorage, and base shall be designed by Registered Structural or Civil Engineer, licensed in the State of California, for seismic and wind loads meeting requirements noted on structural drawings and in Section 13 48 00, Seismic Protection for Miscellaneous Equipment. Submit base footing and anchorage requirements. Tower shall be similar to Universal Towers Model HD-21-50, or approved

equal.

2.7.2 Antenna

The antenna shall be Yagi for interface to existing District radio telemetry (King Fisher) system. Provide antenna compatible with existing District radio system. Constructed of anodized aluminum with stainless steel hardware. 12 dBi gain, 50 ohm impedance, N female connector. Similar to Kathrein Scala or equal.

2.7.3 Cable and Surge Protector

Coaxial cable for connection between King Fisher RTU and antenna, 50 ohm, outdoor watertight, 1.25-inch installed bend radius, similar to Times Cable LMR 500, or equal. Surge suppressor mounted on antenna mast with direct connection to ground rod, similar to PolyPhaser B50 series, or equal.

2.8 DATA COMMUNICATION REQUIREMENTS

Control system data communications shall support the specified functions and control system configuration shown on the drawings.

2.8.1 Central Station/Workstation

Each workstation shall be able to communicate with the central station servers. The workstation shall be able to initiate uploads or downloads of programs and resident data, including parameters of connected systems PLCs and devices, constraints and programs in the central station.

2.8.2 Computer/PLC

The central station servers shall be able to initiate an upload or download of PLC data. The programming workstations shall be able to connect to PLC for online programming, and for program upload and download.

2.9 CONSUMABLE SUPPLIES

The Contractor shall provide the following consumable supplies, after the endurance test. These extraordinary supplies shall not be used during system installation or testing.

CONSUMABLE SUPPLIES	
Writeable DVD-RW disks	100 each
laser printer toner cartridges	4 each

2.10 FACTORY TEST

The control system shall be tested at the factory prior to shipment. Written notification of planned testing shall be given at least 21 days prior to testing, and in no case shall notice be given until after the Contractor has received written approval of the test procedures.

2.10.1 Factory Test Setup

The Contractor shall assemble and integrate the factory test setup as specified to prove that performance of the system satisfies all requirements of this project, including system communications requirements

in accordance with the approved test procedures. The factory test shall take place during regular daytime working hours on weekdays. Equipment used shall be the same equipment that is to be delivered to the site. The factory test setup shall include the following:

	Factory Test
central station equipment	one each of the components
workstation	one of each type
control panel	not less than two control panels: at least one of each type used in the system
test set	one of each type
laptop workstation	one of each type
communications circuits	one of each type and speed to be utilized in the proposed system including bridges, modems, encoder/decoders, transceivers and repeaters.
surge protection equipment	for power, communications, I/O functions and networks
I/O functions	sufficient to demonstrate the I/O capability and system normal operation
software	test software provided by SCADA SOFTWARE SUPPLIER

2.10.2 Factory Test Procedure

Test procedures shall define the tests required to ensure that the system meets technical, operational, and performance requirements. The test procedures shall define location of tests, milestones for the tests, and identify simulation programs, equipment, personnel, facilities, and supplies required. The test procedures shall provide for testing all control system capabilities and functions specified and shown. The procedures shall cover actual equipment and sequences to be used by the Contractor for the specified project and shall consist of detailed instructions for test setup, execution, and evaluation of test results. The test reports shall document results of the tests. Reports shall be delivered within 7 days after completion of each test. Surge testing need not be conducted if the Contractor can provide acceptable documented proof that such testing has been satisfactorily demonstrated with identical surge protection applied. The procedures shall include the following:

	Test Procedure
equipment	block diagram
hardware and software	descriptions
commands	operator commands
I/O functions	test database points

Test Procedure	
each type of digital and analog point in the test database	description
test equipment	list
surge protection	circuit diagrams
inputs required (I/O point values and status) and corresponding expected results of each set of input values	for each application program
default values	for the application program inputs not implemented or provided for in the contract documents for the application programs to be tested.

2.10.3 Factory Test Report

Original copies of data produced during the factory test, including results of each demonstration procedure, shall be delivered to the Government at the conclusion of the test, prior to Government approval of the factory test. The report shall be arranged so that commands, responses, and data acquired are correlated to allow logical interpretation of the data.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION REQUIREMENTS

3.1.1 Installation

The Contractor shall install system components and appurtenances in accordance with the manufacturer's instructions and shall provide necessary interconnections, services, and adjustments required for a complete and operable system. Instrumentation and communication equipment and cable grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation. The Contractor shall adjust or replace devices not conforming to the required accuracies. Factory sealed devices shall be replaced (rather than adjusted). Wiring in exposed areas, including low voltage wiring, shall be installed in metallic raceways as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.1.1 Isolation, Penetrations of Buildings and Clearance from Equipment

Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exteriors shall be made watertight. Holes in concrete, brick, steel and wood walls shall be drilled or core drilled with proper equipment; conduits installed through openings shall be sealed with materials which are compatible with existing materials. Openings shall be sealed with materials which meet the requirements of NFPA 70 and Section 07 84 00 FIRESTOPPING. Installation shall provide clearance for control-system maintenance. Control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.1.2 Device Mounting

Devices shall be installed in accordance with manufacturers' recommendations and as shown. Control devices to be installed in piping shall be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Any deviations shall be documented by the Contractor and submitted for approval prior to mounting. Damaged insulation shall be replaced or repaired after devices are installed to match existing work. Damaged galvanized surfaces shall be repaired by touching up with zinc paint.

3.1.1.3 Pneumatic Tubing

Tubing shall be concealed in finished areas. Tubing may be run exposed in unfinished areas, such as mechanical equipment rooms. For tubing to be enclosed in concrete, rigid metal or intermediate metal conduit shall be provided. Tubing shall be installed parallel or perpendicular to building walls throughout. Maximum spacing between tubing supports shall be 5 feet. Tubing and electrical conductors shall not be run in the same conduit.

3.1.1.4 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be the products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded.

3.1.2 Control Strategies

The Contractor shall study the operation and sequence of local equipment controls, as a part of the conditions report, and note any deviations from the described control stategies. The Contractor shall make necessary adjustments to make the equipment operate in an optimum manner and shall fully document changes made.

3.2 INSTALLATION OF EQUIPMENT

The Contractor shall install equipment as specified, as shown and as required in the manufacturer's instructions for a complete and fully operational control system.

3.2.1 Control Panels

Control panels shall be located as indicated on the drawings. Devices located in the control panels shall be as shown on the drawings or as needed to provide the indicated control sequences.

3.2.2 Flow Measuring Device

Fluid flow instruments shall be installed in accordance with manufacturer's recommendations, unless otherwise indicated in the specification. The minimum straight unobstructed piping for the flowmeter installation shall be 10.0 pipe diameters upstream and 5.0 pipe diameters downstream (except

where shorter distances are allowed for magnetic flowmeters). Meters for gases and vapors shall be installed in vertical piping, and meters for liquids shall be installed in horizontal piping, unless otherwise recommended by the manufacturer or indicated in the specifications.

3.2.2.1 Magnetic Flowmeter

Meter shall be installed so that the flow tube remains full of the process fluid under all operating conditions. A minimum of five pipe diameters straight run upstream of the flowmeter and two pipe diameters straight run downstream of the flowmeter shall be provided.

3.2.3 Level Instruments

3.2.3.1 Float Switches

Switches shall be mounted in accordance with manufacturer's published instructions.

3.2.3.2 Ultrasonic Sensor

Sensor shall be installed vertically in the top of the tank and in accordance with the manufacturer's instructions. Sensor shall be positioned to maximize the return echo signal and minimize vessel obstructions in the sensors line of sight. The minimum recommended distance from the tank fill opening and from the side of the tank shall be maintained .

3.2.4 Pressure Instruments

Pressure sensors and pressure transducers shall be verified by calibration. All pressure taps shall incorporate appropriate snubbers. Pressure sensors and pressure switches shall have valves for isolation, venting, and taps for calibration. Pressure switches and pressure transducers installed on liquid or steam lines shall have drains. Pressure transducers, differential pressure sensors and differential pressure switches shall have nulling valves. Pressure switches shall be adjusted to the proper setpoint and shall be verified by calibration. Switch contact ratings and duty shall be selected for the application.

3.2.5 Instrument Shelters

Instrument shelters shall be installed in the location shown with the bottom 4.0 feet above the supporting surface using legs and secured rigidly to minimize vibrations from winds. Instrument shelters shall be oriented with opening facing North. Instruments located in shelters shall be mounted in the 3-dimensional center of the open space of the shelter.

3.2.6 Enclosures

All enclosure penetrations shall be from the bottom of the enclosure, and shall be sealed to preclude entry of water using a silicone rubber sealant.

3.2.7 Transformers

Transformers for control voltages below 120 vAc shall be fed using circuits provided for the purpose. The Contractor shall provide a disconnect switch on the primary side and a fuse on the secondary side. Transformers shall be enclosed in a steel cabinet with conduit connections.

3.3 WIRE, CABLE AND CONNECTING HARDWARE

3.3.1 LAN Cables and Connecting Hardware

LAN cables and connecting hardware shall be installed in accordance with Section 40 95 33.23 20 FIBER OPTIC (FO) OUTSIDE PLANT (OSP) MEDIA and Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM .

3.3.2 Metering and Sensor Wiring

Metering and sensor wiring shall be installed in accordance with the requirements of NEMA C12.1, NFPA 70, Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION, UNDERGROUND and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.3.2.1 Power Line Surge Protection

Control panels shall be protected from power line surges. Protection shall meet the requirements of IEEE C62.41.1 and IEEE C62.41.2. Fuses shall not be used for surge protection.

3.3.2.2 Sensor and Control Wiring Surge Protection

Digital and analog inputs shall be protected against surges induced on control and sensor wiring. Digital and analog outputs shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both the normal and common mode using the following two waveforms: The first waveform shall be 10 microseconds by 1000 microseconds with a peak voltage of 1500 volts and a peak current of 60 amperes. The second waveform shall be 8 microseconds by 20 microseconds with a peak voltage of 1000 volts and a peak current of 500 amperes.

3.4 SOFTWARE COORDINATION

The Contractor shall communicate with SCADA SOFTWARE SUPPLIER all construction schedule activities, critical path items, and target dates for Factory Testing, Field Testing, and Startup. Contractor shall provide at least 2 months notice prior to each of these activities to allow SCADA SOFTWARE SUPPLIER to schedule necessary software installation, and participate in the testing and startup..

3.5 FIELD TESTING AND ADJUSTING EQUIPMENT

The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform site testing. The Government will witness the PVT, and written permission shall be obtained from the Government before proceeding with the testing. Original copies of data produced, including results of each test procedure, during PVT shall be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test. The test procedures shall cover actual equipment and functions specified for the project.

3.5.1 Testing, Adjusting and Commissioning

After successful completion of the factory test as specified, the Contractor will be authorized to proceed with the installation of the system equipment, hardware, and software. Once the installation has been completed, the Contractor shall test, adjust, and commission each control

loop and system in conjunction with SCADA SOFTWARE SUPPLIER, and shall verify proper operation of each item, including hardware and software. The Contractor shall calibrate field equipment, including control devices, adjust control parameters and logic (virtual) points including control loop setpoints, gain constants, constraints, and verify data communications before the system is placed online. The Contractor shall calibrate each instrumentation device connected to the control system control network by making a comparison between the reading at the device and the display at the workstation, using a standard at least twice as accurate as the device to be calibrated. The Contractor shall check each control point within the control system control network by making a comparison between the control command at the central station and field-controlled device. The Contractor shall deliver trend logs/graphs of all points showing to the Government that stable control has been achieved. Points on common systems shall be trended simultaneously. One log shall be provided showing concurrent samples taken once a minute for a total of 24 hours. The Contractor shall verify operation of systems in the specified failure modes upon Control system network failure or loss of power, and verify that systems return to control system control automatically upon a resumption of control system network operation or return of power. The Contractor shall deliver a report describing results of functional tests, diagnostics, calibrations and commissioning procedures including written certification to the Government that the installed complete system has been calibrated, tested, adjusted and commissioned and is ready to begin the PVT. The report shall also include a copy of the approved PVT procedure.

3.5.2 Performance Verification Test (PVT)

The Contractor shall prepare test procedures for the PVT. The test procedure shall describe all tests to be performed and other pertinent information such as specialized test equipment required and the length of the PVT. The test procedures shall explain, in detail, step-by-step actions and the expected results, to demonstrate compliance with all the requirements of the drawings and this specification. The test procedure shall be site specific and based on the inputs and outputs, required calculated points and the sequence of control. The Contractor shall demonstrate that the completed Control system complies with the contract requirements. All physical and functional requirements of the project including communication requirements shall be demonstrated and shown. The Contractor shall demonstrate that each system operates as required in the sequence of operation. The PVT as specified shall not be started until after receipt by the Contractor of written permission by the Government, based on the Contractor's written report including certification of successful completion of testing, adjusting and commissioning as specified, and upon successful completion of training as specified. Upon successful completion of the PVT, the Contractor shall deliver test reports and other documentation as specified to the Government.

3.5.3 Endurance Test

The Contractor shall use the endurance test to demonstrate the overall system reliability of the completed system. The endurance test shall be conducted in phases. The endurance test shall not be started until the Government notifies the Contractor in writing that the PVT is satisfactorily completed, training as specified has been completed, outstanding deficiencies have been satisfactorily corrected, and that the Contractor has permission to start the endurance test. The Contractor shall provide an operator to man the system 8 hours per day during daytime operations, including weekends and holidays, during Phase I endurance

testing, in addition to any Government personnel that may be made available. The Government may terminate testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation, as specified, to the Government prior to acceptance of the system.

3.5.3.1 Phase I (Testing)

The test shall be conducted 24 hours per day, 7 days per week, for 7 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing.

3.5.3.2 Phase II (Assessment)

After the conclusion of Phase I, the Contractor shall identify failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, the Contractor shall demonstrate that failures have been corrected by performing appropriate portions of the performance verification test. The Government reserves the right to cancel the test review meeting if no failures or deficiencies occur during the Phase I testing. If the Government chooses to do so, the Contractor will be notified in writing. Based on the Contractor's report and the test review meeting, the Government will determine if retesting is necessary and the restart point. The Government reserves the right to require that the Phase I test be totally or partially rerun. The Contractor shall not commence any required retesting until after receipt of written notification by the Government. After the conclusion of any retesting which the Government may require, the Phase II assessment shall be repeated as if Phase I had just been completed.

3.5.3.3 Exclusions

The Contractor will not be held responsible for failures resulting from the following: Outage of the main power supply in excess of the capability of any backup power source, provided that the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the control system performed as specified. Failure of a Government furnished communications link, provided that the PLC automatically and correctly operates in the stand-alone mode as specified, and that the failure was not due to Contractor furnished equipment, installation, or software. Failure of existing Government owned equipment, provided that the failure was not due to Contractor furnished equipment, installation, or software.

3.6 MANUFACTURER'S FIELD SERVICES

The Contractor shall obtain the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installing, adjusting,

and testing of the equipment.

3.7 INSTRUMENTATION AND CONTROL SYSTEM

Control drawings, reproducible, with corresponding CADD files, shall be provided for equipment furnished and for interfaces to equipment at each respective equipment location. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system manually shall be prepared in typed form, reproducible, with corresponding word processor files and posted beside the diagrams. Diagrams and instructions shall be submitted prior to posting.

3.8 FIELD TRAINING

Field training oriented to the specific system shall be provided for designated personnel. A copy of the training manual for each trainee plus two additional copies shall be delivered to the Contracting Officer. Manuals shall include an agenda, the defined objectives for each lesson, and a detailed description of the subject matter for each lesson. The Contractor shall furnish audiovisual equipment and other training supplies and materials. Copies of the audiovisuals shall be delivered with the printed training manuals. The Government reserves the right to videotape training sessions for later use. A training day is defined as 8 hours of classroom instruction, excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. Approval of the Contractor's training schedule shall be obtained from the Government at least 30 days before the training.

3.8.1 Preliminary Operator Training

Prior to the start of field testing, preliminary operator training shall be taught at the project site for 4 consecutive training days. Upon completion of this course, each student, using appropriate documentation, should be able to perform elementary operations with guidance and describe the general hardware architecture and functionality of the system. This course shall include: general system architecture; functional operation of the system, including workstations; operator commands; application programs, control sequences, and control loops; database entry and modification; reports generation; alarm reporting; diagnostics; and historical files.

3.8.2 Additional Operator Training

Following the field testing, additional classroom training for operators shall be taught for 2 consecutive training days; individual instruction sessions of 4-hour periods in the morning (or afternoon) of the same weekday for 2 consecutive weeks and an additional 1 day classroom session for answering operator questions. Individual instruction shall consist of "hands-on" training under the constant monitoring of the instructor. Classroom training shall include instruction on the specific hardware configuration of the installed control system and specific instructions for operating the installed system. The Contractor shall schedule activities during this period so that the specified amount of time on the equipment will be available for each student. The final session will address specific topics that the students need to discuss and to answer questions concerning the operation of the system. Upon completion of the course, the students should be fully proficient in system operation and have no unanswered questions regarding operation of the installed control system.

Each student should be able to start the system, operate the system, recover the system after a failure and describe the specific hardware architecture and operation of the system and be fully proficient in all system operations. The Contractor shall report the skill level of each student at the end of this course.

3.8.3 Maintenance Training

Following the endurance test, a minimum period of 10 training days shall be provided by a factory representative or a qualified Contractor trainer for ten designated personnel on maintenance of the equipment. The training shall include: physical layout of each piece of hardware, calibration procedures, preventive maintenance procedures, schedules, troubleshooting, diagnostic procedures and repair instructions.

3.8.4 Offsite Training

Provide 4 days of training at PLC manufacturer's training facility for a minimum of 2 District staff, including travel expenses. Offsite training to include PLC hardware and programming. Offsite training may be waived if designated staff have already received training for the PLC hardware provided.

3.8.5 Supplements

1. Instrument List
2. Component Specifications
3. Input/Output Summary
4. Control Stategies
5. Control Panel Schedule

-- End of Section --