DIVISION 40 - PROCESS CONTROL
SECTION 40 63 00 – CONTROL SYSTEM EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Programming Software
2. Programmable Logic Controller
3. Ethernet Lan Equipment and Materials
4. Equipment Enclosures
5. Miscellaneous Equipment

B. Related Sections

1. Section 40 61 96 – Process Control Descriptions

1.02 SYSTEM DESCRIPTION

A. Design, Supply and Install all hardware and software products required to provide a complete and fully functional control system.

B. Design the control panels and field wiring interfaces required to implement the control equipment.

1. All control panels shall be designed and manufactured in accordance with UL 508A, Standard for Industrial Control Panels, and NFPA 79, Electrical Standard for Industrial Machinery.
2. All components shall be UL recognized.

C. Furnish, Install and Test:

1. Control panels, programmable controllers, enclosures and appurtenant equipment.
2. Software products, interface cables and related products.
3. Software required to interface the new control equipment to the existing SCADA network.
4. Relays, resistors, signal splitters or other devices required to condition input and output field signals for the control equipment.

D. Connect and test all input and output field wiring to and from the control equipment.

E. Provide all manufacturer's services required for installation, startup, calibration, inspection, and training.

F. Provide all coordination required for system integrator's services.

1.03 SUBMITTALS

A. Submit in accordance with the requirements of Section 01 33 00.

B. Submit catalog cuts, shop drawings, and O&M manuals for all equipment.

1. All control equipment hardware, software and control panel shop drawings shall be reviewed and approved by the System Integrator prior to submission to the Authority.

C. Submit the following information involving proposed hardware for the control system:

1. A detailed written description of the control system outlining the purpose and capabilities of each component.

2. Catalog information, shop drawings, and descriptive literature for each component of the control system.

3. Shop drawings and catalog cuts for all panels and enclosures.

D. Submit complete detailed shop drawings, working drawings and descriptive literature for control panel equipment, cabinets, and components. As a minimum the shop drawings and working drawings shall include the following:

1. Bill of Materials

2. Power load calculations verifying capacity of power supplies and UPS units to carry the panel load.

a. Provide a minimum of 20% spare capacity on DC power supplies.
b. Provide 10 minutes of no power operation on UPS units.

3. Heat rise calculation of each enclosure.

4. Front panel, back panel and panel schematic wiring diagrams.

a. Submit detailed drawings showing proposed arrangement of equipment within each enclosure, proposed locations of all equipment and enclosures, and proposed arrangement of all conduits and conductors that will enter each enclosure.
b. Provide a minimum of 20%, but no less than two (2), installed spare I/O for each type of I/O present in the panel. All I/O are to be factory wired out to field terminal strips in the panel. These spare I/O are to be in addition to the material to be supplied under the Spare Parts section of this specification.
c. Provide a minimum of 20%, but no less than two (2), spare (open) module slots on the controller I/O back plane.

5. Interconnection wiring diagrams showing all component and panel terminal board identification numbers and external wire numbers, including existing equipment and equipment furnished by others.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. The contractor shall retain the services of a qualified system integrator to assist in the selection of equipment, preparation of submittals, installation, configuration and startup of all control equipment.

1.05 AUTHORITY'S INSTRUCTIONS

A. Communication:

1. The Authority will identify the communication mode to be used based on highest expected reliability.

PART 2 - PRODUCTS

2.01 PROGRAMMING SOFTWARE

A. All Programming shall be performed using the latest version and edition of the programming software being used by the Authority. Consult with the Authority for information.

B. The Contractor's System Integrator shall be responsible for maintaining his own version of the programming software for his own purposes, and shall not be permitted to use or work with the Authority's software for the execution of the work required.

1. Refer to Section 40 68 00 – Control System Integration, for system programming requirements.

2. Refer to Section 40 61 96 – Process Control Descriptions for a general description of system functionality.

2.02 PROGRAMMABLE LOGIC CONTROLLER

A. In order to minimize training requirements, provide a uniform look and feel, and provide better support and administration, the Authority has standardized on a single Control System software package and PLC manufacturer. Therefore, no substitutes will be accepted for the specified products.

B. The Programmable Logic Controllers (PLC) shall be Allen-Bradley CompactLogix 1769 Controller.

1. Operator Interface Terminal (OIT) shall be Allen Bradley PanelView Plus 1000 Color with Ethernet port and a 10 inch display.

2.03 ETHERNET LAN EQUIPMENT AND MATERIALS

A. For premises wiring cable refer to Division 26.

B. Unmanaged Ethernet Switches

1. Heavy Duty, hardened, sealed steel enclosure, DIN rail mounted, copper switch.

2. Features:

   a. Support VLAN tagging and spanning tree pass through.

   b. Include Link-Loss-Learn (LLL) feature for fast network recovery.

   c. Auto MDI/MDI-X ports

   d. Nonblocking switching architecture with a 2K MAC address table

3. Ports:

   a. (5) RJ-45 10/100Mbps copper ports.

4. LED Indicators:

   a. Power

5. Standards: IEEE 802.3, IEEE 802.3u, IEEE 802.1p/q

6. CE Approved

7. Temperature Rating:

   a. Storage: -40 to +185° F

   b. Long-term operating: -13 to +140° F

8. Humidity: 5–95%, noncondensing

9. Size: 3.6"H x 3"W x 1.7"D

10. Weight:

    a. Switches: 0.8 lb.

    b. Power Supplies: 0.4 lb.

11. Black Box Heavy Duty Hardened Edge Switch with hardened power supply, or approved equal.

C. Cat-5 Patch Cables

1. Shielded twisted pair (ScTP) cables shall be high performance 4-pair cables with protective foil shielding specifically designed for Ethernet applications, verified to EIA/TIA Category 5e, with snagless boot and factory installed RJ-45 connectors.

a. Cat-5 Patch Cables shall be Black Box CAT5 Shielded Twisted-Pair (STP) Patch Cables, or approved equal.

2.04 EQUIPMENT ENCLOSURES

A. Enclosures

1. Enclosures shall be UL 508A listed, wall or floor mounted, NEMA 4X, 12 gauge stainless steel, hinged with quick-release latches.

2. Dimensions shall be adequate to enclose all required equipment.

3. Doors shall be lockable using a padlock.

4. External hardware shall be manufactured of Type 316 stainless steel.

5. Hoffman Bulletin A80-series or approved equal.

2.05 MISCELLANEOUS EQUIPMENT

A. Control Power Transformers:

1. The control panel shall be provided with a single voltage feed. Provide a control power transformer(s) as required for each voltage in the control panel

2. Primary voltage shall be the primary voltage of the system. Secondary voltage shall be as required for the equipment being powered.

3. Transformer VA rating shall be as required for the system being provided.

4. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

5. Transformer shall be UL listed, Square D or equal

B. Uninterruptible Power Supply (UPS)

1. DIN-Rail Mounted UPS, 500VA, Input 120V/Output 120V, SOLA Model SDU500, or approved equal.

C. DC Power Supply

1. Din Rail mounted power supply housed in rugged narrow metal case with large, rugged, accessible, multiple connection screw terminations.

a. Power supply shall be enclosed and completely finger safe. Open power supplies shall not be acceptable.

2. Auto Select 115/230 VAC, 50/60 Hz single phase Input

3. Powers high inrush loads without shutdown or foldback, meet SEMI F47 Sag Immunity

4. Power Factor Correction (per EN61000-3-2)

5. Adjustable Voltage

6. Industrial grade design

7. – 10 C to 60 C operation without derating.

8. Indefinite short circuit, overvoltage and overtemperature protection.

9. High MTBF and reliability

10. Highly efficient greater than 90% switching technology

11. Power supply shall be UL listed (UL 508) and have 5 year warranty.

12. SOLA Hevi-Duty, model: SDN, in size and voltage as required for application, or approved equal.

D. Signal Isolators

1. Signal conditioner with AC powered re-transmitter

2. Single or Dual channel DC input, as required for the application.

3. Signal Isolation: 2000VAC isolation between Input, Output and Power.

4. Action Instruments Q403 DC input multi-channel isolator or approved equal

E. Interposing Relays

1. Miniature plugin relay, 10A resistive rating, double throw C-Form contact output, UL Listed

2. Coil Voltage and contact count as required for the application.

3. SqD Class 8501 - Type R Miniature Plug-in Relays with DIN Rail mounting Socket, or approved equal

F. Power-On Relay

1. Miniature plugin relay, 10A resistive rating, double pole, double throw C-Form contact output, UL Listed

2. Coil Voltage equal to panel incoming power.

   a. Coil to be wired to panel incoming power.
   b. Contact output to be wired to receiving device as indicated in other section of these specifications or as shown on the drawings.

3. SqD Class 8501 - Type R Miniature Plug-in Relays with DIN Rail mounting Socket, or approved equal

G. Motor Controllers

1. Variable Frequency Drives (VFD's)

    a. All VFD's required for a system shall be in accordance with the applicable requirements of Section 26 29 23 - Variable Frequency Motor Controllers.

H. Wiring

1. All wiring shall be in accordance with the applicable requirements of Division 26 05 19 – Electrical Power Conductors and Cables.

I. Terminal Blocks

1. Terminal blocks shall be one-piece molded plastic blocks with screw type terminals and barriers rated for 300 volts.

2. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits.

3. Terminals shall have permanent, legible identification, clearly visible with the protective cover removed.

4. Terminal blocks shall be fused type where indicated on the drawings.

5. Analog signals shall be terminated on modular narrow form factor terminal blocks intended for the protection of a floating double conductor (4-20 mA analog) signal.

    a. Two-stage surge protection for one operated floating double conductor.
    b. Disconnect knife on both signal paths.
    c. Separate ground connection.
    d. Screw terminal connections.
    e. Nominal voltage: 24 V DC
    f. Phoenix Contact TERMITRAB TT-2-PE-M-24DC or approved equal.

J. Power Disconnects

1. Panel disconnects

    a. Provide NEC compliant panel disconnects. Disconnect and shall be interlocked to the control panel door handle.

2. Motor disconnects

    a. Provide NEC compliant lockable motor disconnecting means for each controlled motor.

K. Nameplates And Name Tags

1. Panel mounted tags shall be plastic; field mounted tags shall be stamped stainless steel.

2. Nameplate shall be engraved, rigid, laminated plastic type with adhesive back. Unless otherwise noted, color shall be black with white letters and letter height shall be 3/16 inch.

2.06 SPARE PARTS

A. Terminal Blocks: Provide 20% spare blocks of each type used, installed

B. Fuses: Provide 10% spares for all types used (no less than one each).

C. Patch Cables: Provide 10% spares for all types used (no less than one each).

D. 1 (One) spare 5 Port Copper Ethernet switch

E. PLC Equipment:

1. 1 (one) spare Power Supplies

2. 1 (one) spare CPU

PART 3 - EXECUTION

3.01 SCHEDULING OF WORK

A. The Plant will be kept in full scale operation during the performance of the work specified in this section. All modifications to existing panels, all equipment/device/panel replacement work and all rehabilitation work shall be scheduled by the contractor and submitted to the Engineer for approval.

B. The Contractor, in addition to the requirements of Section 01 33 00, shall submit an expended initial schedule to the Authority for approval showing all the work specified in this section. The contractor shall adjust the schedule as per the comments of the Authority and resubmit the schedule for final approval.

C. Written consent from the Authority must be obtained not less than one week prior to carrying out any portion of the work which requires interruption of service and control/instrumentation systems.

D. Unavoidable interruptions must be confined to the daytime. The Authority will not responsible for overtime, should this become necessary to insure continued service.

E. In connection with all of the foregoing, Contractor must have on the construction site, all materials, equipment, construction facilities, adequate supervision and a sufficient number of qualified workmen to insure carrying out of the above work in the shortest possible time.

3.02 CONTROL SYSTEM COMMUNICATION COORDINATION

A. Establish communications between the existing Human Machine Interface (HMI) server and each programmable logic controller (PLC), and verify monitoring of I/O data points.

B. Cutover PLC data points to the SCADA monitoring system.

3.03 DISCONNECTION AND REMOVALS

A. All power, control and instrumentation wiring associated with equipment, panels, devices, etc. to be removed and replaced shall be identified, marked and then disconnected to facilitate their replacement and any related work.

B. All materials no longer used shall be removed unless otherwise directed by the Engineer. Affected surfaces shall be repaired to confirm to the type, quality, and finish of the surrounding surface in a neat and workmanlike manner.

3.04 CONTROL PANELS

A. Control panels shall be completely fabricated, instruments installed and wired in the manufacturer's factory and tested prior to delivery to the site. The control panels shall be factory assembled with all input and output devices.

1. All wiring and equipment shall be completed and tested prior to shipment.

2. All external connections shall be by way of numbered terminal blocks.

3. Install spare terminal blocks on back panel.

B. Panel instrumentation arrangement shall be as shown, with minor modifications as required by the particular equipment furnished. Modifications shall be subject to the approval of the Authority.

C. All back panels shall be secured with all the appropriate zinc plated mounting hardware.

D. All devices and wiring shall be properly labeled.

1. Front panel devices shall be identified by laminated nameplates

2. Panel mounted devices and wiring shall be identified by a permanent marking system.

E. All circuit breakers, terminal strips, and related devices required to provide a complete, safe, and neat installation shall be provided.

F. Wiring

1. Wires shall be 600-volt class, PVC insulated stranded copper and shall be of the sizes required for the current to be carried, but not below 14 AWG enclosed in either sheet metal raceway or plastic wiring duct.

2. Wiring for signal circuits shall be twisted shielded pairs not smaller than No. 18 AWG, and be separated at least 6-inches from any power wiring.

3. All wires shall be identified as per the requirements of Division 26 05 19.

4. Provide wiring channels as required.

5. All interconnecting wires between panel mounted equipment and external equipment shall be brought out to numbered external wiring terminals and terminated.

6. All wires shall be numbered and identified.

G. Terminal Blocks

1. Wires shall be terminated at the terminal blocks with crimp type, pre-insulated, ring-tongue lugs.

2. Lugs shall be of the appropriate size for the terminal blocks screws and for the number and size of the wires terminated.

3. Fused terminal Block shall be used for power distribution.

H. Nameplates And Name Tags

1. All components provided under this Section, both field and panel mounted, shall be provided with permanently mounted name tags bearing the entire tag number and description of the component.

3.05 INSTALLATION

A. All items shall be installed in accordance with the manufacturer's recommendations.

B. The Contractor shall furnish and install all material and hardware required to supply a complete and functional installation.

C. Notify Plant personnel prior to disconnect any existing signals.

D. Deliver all salvaged equipment to the Authority.

E. Prior to connecting any signals, each existing signal shall be tested to verify that the signal is within the expected range and suitable for connection to the new PLC.

F. Completely configure and program each PLC as required to meet these Specifications (Refer to Section 40 61 96 and Section 40 68 00).

3.06 CONFIGURATION AND PROGRAMMING

A. Configure each new programmable logic controller (PLC) for all inputs and outputs.

B. Configure and program the new programmable logic controllers to allow monitoring and control from the control system.

C. Configure the new PLC to communicate with the control system I/O servers via Ethernet connections.

D. Coordinate and document PLC LAN Node numbering and IP addresses with Plant personnel before installation.

E. Qualified representatives of the PLC manufacturer or a qualified systems integrator shall perform all configuration and programming.

F. Completely configure and program each PLC as required to meet these Specifications (see Section 40 61 96 and Section 40 68 00).

3.07 TESTING

A. Test the hardware and software using simulated inputs and outputs prior to installation.

1. The Contractor shall retain the services of a system integrator to provide detailed test plans and procedures to demonstrate and document that all equipment has been properly installed and configured for a full functional system which meets all contract requirements.

2. See Section 40 68 00 for additional details.

B. Test the complete installed system by demonstrating that all signals are properly received and sent and that the control system operates as intended.

3.08 CLEANING AND TOUCH-UP PAINTING

A. The premises shall be kept free from accumulation of waste material and rubbish. Upon completion of work, the Contractor shall remove materials, scraps, and debris from the site. Scratches, scrapes, or ships in interior or exterior surfaces of devices shall be touched up with finishes matching as nearly as possible the type and color of the original finish.

B. All material, equipment, and workmanship shall be subject to inspection by the Engineer or his representatives. In the event the Engineer finds the materials or workmanship not in accordance with these Contract Documents, the work or materials shall be removed and replaced, or corrected, by and at the expense of the Contractor.

3.09 TRAINING

A. Provide all on-site and off-site training, minimum of eight (8) hours. Cover all aspects of the control panel, including instrumentation and motor controllers.

END OF SECTION