SECTION 40 67 00

CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

A. SCOPE:

1. This section specifies requirements for the fabrication of a new PLC panel for the RTP I/O Replacement project. Major panel components are provided with part numbers and are shown on the Drawings.

    a. PLC programming software is not required, and programming of the PLC is not in the scope of this Contract and will be performed by others.

    b. Contractor shall reimburse the District all applicable travel expenses including airfare, lodging, car rental, and meals and incidentals for one district representative to travel to the manufacturing facility to witness and test the PLC panel for two-days if the manufacturing facility is located more than 150 miles from the Sacramento Regional Wastewater Treatment Plant in Elk Grove, CA.

        1) Per diem for lodging (equal to the federal standard CONUS per diem rate for Sacramento County at the time of contract negotiation) will be reimbursed for each work night, up to five nights per week.

        2) Per diem for meals and incidentals (equal to the federal standard CONUS per diem rate for Sacramento County at the time of contract negotiation) will be reimbursed for each work day, up to five days per week.

        3) Airfare and local and home transportation costs will be reimbursed at cost with no markup.

        4) Mileage will be reimbursed at the current IRS rate which can be accessed by clicking the following link:

            https://www.irs.gov/newsroom/irs-issues-standard-mileage-rates-for-2021

    c. Control panel shall be built, successfully tested, and delivered to the District by **August 1, 2022**.

2. Panels that do not comply with the specified products, specified logic method, hardwired or PLC logic, shall not be accepted. Cost to retrofit the panel as specified shall be borne by the panel supplier. Corrections or modifications to UL 508A Industrial Control Panels shall be transported to the panel supplier's facility for

corrections, testing, relabeling and inspection, or shall require a UL inspector site inspection for approval of panel modifications and to re-label the panel after the field modifications are completed.

B. UNIT RESPONSIBILITY:

1. Provide all conforming electrical and control components and devices, support hardware, fasteners, interconnecting wiring required to make the control panels and/or enclosures complete and operational.

2. Demonstrate panel conformance, performance, and functionality as specified herein.

C. PANEL DESIGN:

1. GENERAL: Panel hardware is specified herein and as shown on the Drawings.

2. CONTROL POWER DISTRIBUTION: Panel containing 120-volt powered equipment use the din-rail power distribution method with circuit breakers. Power is restricted to 120 Vac and 24 Vdc.

D. DELIVERY AND HANDLING:

1. Control panels shall be shipped directly to the site from the factory. Contractor shall coordinate with District for final delivery schedule and location.

1.02 REFERENCES

A. REFERENCE STANDARDS: The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of a conflict between the requirements of this section and those of the listed references, the requirements of this section shall prevail.

Reference	Title
ANSI/EIA 310	Racks, Panels and Associated Equipment
ASTM A36	Structural Steel
ISA S5.1	Instrumentation Symbols and Identification
NEMA ICS 1	Industrial Control and Systems: General Requirements
NEMA ICS 2	Industrial Control and Systems: Controllers, Contactors and Overload Relays Rated 600 Volts
NEMA ICS 6	Industrial Control and Systems: Enclosures
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NFPA 70	National Electrical Code (NEC)

Reference	Title
NFPA 79	Electrical Standard for Industrial Machinery
UL 20	General-Use Snap Switches
UL 50	Enclosures for Electrical Equipment
UL 83	Thermoplastic-Insulated Wires and Cables
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508	Industrial Control Equipment
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous (Classified) Locations
UL 1063	Machine-Tool Wires and Cables
UL 1598	Luminaires

1.03 SUBMITTALS

A. The following information shall be submitted for review:

1. Table of contents and list of explanations, clarifications or exceptions.

2. Control panel component catalog data and cut sheets for all control panel equipment provided.

3. Dimensioned panel fabrication and layout drawings:

   a. Interior and exterior panel elevation drawings to scale.

   b. Panel total weight including all components.

   c. Panel construction details.

   d. Conduit entry location and enclosure seismic bolting patterns

   e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a comprehensive bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify any component of the assembly by manufacturer and model number.

4. Panel control schematics and interconnection diagrams detailing the electrical connections of all equipment in and on the panel. Diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering.

5. Point-to-Point I/O Card Wiring Diagrams: Provide point to point wiring diagrams depicting wiring within the panel as well as descriptions for connections to external devices. **Wiring diagrams depicting external connections to/from the panel are not required.**

    a. Layout, format, and labeling used on the wiring diagrams shall match that shown on the Drawings.

    b. Process controller I/O and interface boards for networking, or other special systems wiring shall be numbered with rack number, slot number, and point number where applicable.

    c. Two-wire and four-wire equipment shall be clearly identified and power sources noted.

    d. All panel and field wiring shall be tagged and indicated on the wiring diagram. Complete all terminal board identification and terminal board numbers.

    e. Incorporate panel/module power wiring and power supplies. Include all fuse and protection devices including ratings.

6. Communication block diagram showing the interconnections between major communication hardware components, and media type between components.

7. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Contractor and included in the Project Bid Price.

8. Test results as specified herein.

1.04 LIQUIDATED DAMAGE

A. Control panel shall be built, successfully tested, and delivered to the District by August 1, 2022. Contractor shall pay $500/day in liquidated damage to the District for late delivery.

1.05 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Submit operation and maintenance (O&M) instructions. O&M instructions shall be submitted after all submittals specified above have been returned “NO EXCEPTIONS TAKEN” or “MAKE CORRECTIONS AS NOTED.” O&M instructions shall reflect the approved materials and equipment. O&M manual shall include the latest shop drawings. Submit shop drawings in PDF and AutoCAD format.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Control and power panels and cabinets shall be factory assembled and tested. Panels and cabinets shall include all components indicated in the applicable drawings, required by the particular equipment specifications, specified in this section, and all necessary accessories to make a complete and operable system. The catalog numbers listed herein require special modifications and accessories to meet all requirements specified herein and shown on the drawings.

B. Equipment and materials shall be new and free from defects.

1. All material and equipment of the same or similar type shall be of the same manufacturer throughout the work.

2. Standard production materials shall be used wherever possible.

C. Control panel and all its components shall be warranty for 2-year after delivery and acceptance by the District.

D. All control panels shall include marking to identify the short circuit current rating (SCCR) to which it is designed per the National Electric Code Article 409. Minimum SCCR shall be 10kAIC.

E. Panels shall be arranged to separate control and instrument devices from power wiring and for dedicated field wiring terminations rated for 600 Vac or less for power, control, and instrument signal wiring.

F. Panels shall be fabricated by a UL-508A recognized facility and shall bear the appropriate UL 508A Industrial Control Panel label. The UL 508A facility shall be in business manufacturing listed panels for a minimum of ten years.

2.02 PANEL TYPES

A. The following panel types are applicable to new panels and to the modification of existing panels. Panel type designations shall conform to the requirements of NEMA 250, NEMA ICS 6, UL 50, UL 508 or 508A, and as specified herein.

Type	Construction
D	NEMA 12 enclosed unit with hinged door(s) and front access only. All devices mounted on an interior subpanel.

2.03 FABRICATION REQUIREMENTS

A. GENERAL:

1. SEISMIC: Completed and installed panel work shall safely withstand Seismic Zone 3 loading requirements as defined in the Uniform Building Code. All enclosures and equipment shall be braced to prevent damage from specified forces. Equipment shall not be required to function properly during periods of seismic disturbance but shall be capable of manual restart following a disturbance.

2. UL LABEL: Enclosures shall be UL labeled. All other devices specified in this section shall be UL listed. This requirement shall be waived only if a UL listing is not available from any manufacturer of a similar product that meets all other specified requirements.

3. FACE-MOUNTED INSTRUMENT REINFORCEMENT: (NOT USED)

    a. Face-mounted instruments on panel Types B, C, D, E, and F, as defined herein, that are more than 6 inches deep, weigh more than 10 pounds, or exert more than a 4 ft-lb moment force on the face of the panel shall be rigidly supported at the rear of the instrument.

    b. Identify face-mounted devices with nameplates including tag number and equipment description. Mount instruments for access to components and ease of removal. Components for installation on panel exterior locate a minimum of 36 inches above the operating floor level and no greater than 60 inches above the operating floor level. Blank off cutouts for future equipment with suitable covers as required to retain the cabinet's NEMA rating. Identify device tag numbers on the panel rear as well as the panel front.

    c. Face-mounted devices shall be the same NEMA rating as the associated panel.

    d. FLOOR STANDS AND PEDESTALS: (NOT USED)

4. STEEL THICKNESS: For fabrication Types D, the enclosure and interior panel shall constructed using the sheet steel sizes in the table below. Heavier sheet metal shall be used if required to meet seismic requirements, required to meet design standards in this section, or needed due to Contractor's selection of equipment.

Enclosure Height (inches)	**Minimum Enclosure Steel Thickness**	**Minimum Panel Thickness**
4 - 8	16	14
9 - 56	14	12
57 or more	12	12

5. MISCELLANEOUS:

    a. Locate and install all devices and components so that connections can be easily made and ample room is provided for servicing each item.

b. Panels shall include a drawing pocket and ground studs on the enclosure and doors.

c. Panels with a total finished weight of over 50 pounds shall be furnished with lifting eyes.

d. Provide terminal blocks per the drawings. For power distribution, provide a minimum of 10 percent spares.

e. Terminate all wiring to panel connections from field instruments, devices, and other panels at master numbered terminal strips.

f. Provide a minimum of 2½ inches between wire ways and terminals.

g. Panels shall be arranged to separate control and instrument devices from power wiring. AC, DC, and digital circuits shall be arranged to be physically separated inside the panel. Digital circuits shall follow the network installation protocol requirements

h. Wiring channels shall comply with UL94, Type V. Wiring channel fill shall not exceed 40 percent.

i. Wiring duct, spiral wrap, and cable ties shall be used to manage cables within the panel.

j. All equipment mounted on subpanels shall be drilled and tapped, the use of drive screws or nuts and bolts are prohibited for equipment mounting.

B. PANEL FABRICATION REQUIREMENTS:

1. TYPE D: Cabinet shall be a NEMA 250 and NEMA ICS 6, Type 12 enclosure fabricated from sheet steel. Face-mounted instruments, if required, shall be mounted in the door. Cabinet shall be provided with an interior frame or otherwise formed so as to provide a rigid structure. Doors shall be hung on full-length piano-type hinges and equipped with vault-type latch capable of accepting a 3/8-inch shackle padlock. Three-point latch hardware shall be provided for doors exceeding 30 inches height. No single door shall exceed 36 inches in width. Enclosure shall be as shown on the Drawings.

2.04 HEATING AND VENTILATING

A. Forced air ventilation shall be provided as shown on the Drawings.

2.05 COATING

A. Metal surfaces of panels and cabinets shall be prepared by chemical cleaning and mechanical abrasion in accordance with the panel manufacturer's recommendations. Scratches or blemishes in panel faces shall be putty filled prior to finishing. One coat of

zinc phosphate shall be applied at the manufacturer's recommended dry film thickness and allowed to dry prior to applying the finish coat. Finish coat shall be alkyd melamine liquid enamel coating. Total dry film thickness shall be 3 mils. Cabinet interiors shall be panel manufacturer's standard white. Exterior color of cabinets mounted outdoors shall be panel manufacturer's standard white. Exterior color of cabinets mounted indoors shall be panel manufacturer's standard light gray.

2.06 CORROSION-INHIBITORS (NOT USED)

2.07 NAMEPLATES (NOT USED)

2.08 RECEPTACLES AND PLUG STRIPS

A. DUPLEX RECEPTACLES: Duplex receptacles shall be rated 15 amps, 125V AC, NEMA 5-15R two pole, three-wire grounding type. Bodies shall be of ivory colored phenolic compound. Contact arrangement shall be on two sides of the inserted blade. Receptacles shall be side wired with two screws per terminal. Duplex receptacles shall be heavy duty specification grade type Hubbell HBL5262I, or equal.

B. GROUND FAULT RECEPTACLES: GFI receptacles shall be duplex 15 amp, NEMA 5-15R two pole, three-wire type. Receptacles shall be ground-fault circuit interrupter, heavy duty hospital grade. Bodies shall be gray colored nylon compound. GFI receptacles shall be Hubbell GF8200GYA or equal.

2.09 WIRING

A. PANEL CONNECTION WIRE: The term "connection wiring" shall refer to all wires that have both ends terminated within the same panel or group of attached enclosures.

1. Power and control wiring shall be single conductor stranded copper with 600V rated insulation conforming to UL 83 type THHN, 14 AWG minimum, except PLC discrete input/output wiring shall be UL 1063 type MTW, 16 AWG minimum.

2. Analog 4-20mA signal wiring shall be multiple conductor shielded cable 16 X 30, 18 AWG stranded tinned copper twisted pair with 300V rated PVC jacket and polyethylene conductor insulation conforming to UL 83. Conductor color code shall be black and clear. Shield shall provide 100 percent coverage with aluminum polyester foil and #20 AWG stranded tinned copper drain wire. Cable shall be Belden Type 8760, or equal.

B. CABLE AND WIRE MARKERS: Cable and wire markers for all power, control, and signal wires shall be resistant to smudging, fading, chemical and harsh environment deterioration. Sleeves shall be sized to fit the conductor insulation and shrunk to fit the conductor with hot air after installation. Cable and wire markers shall be heat shrinkable irradiated polyolefin, conforming to UL 224. The letters and numbers that identify each cable or wire shall be machine printed with 1/8-inch high characters on 2-inch sleeves

with permanent black ink. The wire marking system shall be Brady Perma-sleeve PS-XXX-2W series and Brady PS Printer, or equal.

C. Conductor insulation Colors

1. POWER & CONTROL INSULATION COLORS: Power and control conductors in panels shall have the following insulation colors per NFPA 70 & NFPA 79:

Conductor	Insulation Color
AC Power & Control	Black and/or Red
DC Power & Control	Dark Blue
DC Power & Control common	White w/blue stripe
Intrinsically Safe	Light Blue
Neutral	White
Ground	Green
AC Control External Source	Yellow
External Neutral	White w/yellow stripe
DC Control External Source	Yellow w/blue stripe

2. SIGNAL INSULATION COLORS: Signal conductors in panels shall have the following insulation colors per NFPA 70 & NFPA 79:

Conductor	Insulation Color
DC Power & Control	Dark Blue
DC Power & Control common	White w/blue stripe
Intrinsically Safe	Light Blue
Signal, pair	Black, White or Clear
Signal, triad	Black, Red, White
Signal Common	White
Equipment Ground	Green

2.10 DIN-RAIL TERMINAL BLOCKS

A. TERMINALS BLOCK TYPES: Terminal blocks shall be panhead captive screw strap type rated 600 volts. All metal parts shall be made of 85 percent copper alloy nickel-plated. Insulated housing shall be made of 6.6 polyamide suitable for DIN EN 50034 rail mounting. Terminal block types shall be as specified in the following table, or equal:

Description	Type	Application
120V AC Power and Control		
Fuse terminal block w/blown fuse LED indicator	Phoenix UK6.3- HESILED, or equal	Power supply for field panels
Terminal block	Phoenix UK5N, or equal	Neutral and control wiring
Grounding terminal block	Phoenix USLKG5, or equal	Equipment grounding Conductor
Disconnect terminal block, w/ female test socket	Phoenix UK5-MTK-P/P, or equal	Foreign circuit disconnect
Above 120V AC Power		
Terminal block	Phoenix UK16N, UKH series, or equal	Power wiring
24V DC (and other voltage) Signals		
Disconnect terminal block w/ female test socket	Phoenix UK5-MTK-P/P, or equal	4-20 mA current loop (supply side)
Terminal block	Phoenix UK5N, or equal	4-20 mA current loop (return side)
Terminal block w/test sockets	Phoenix UK5N w/PSB 3/10/4 Test Plug Socket, or equal	1-5V DC analog signals, RTD wiring
Terminal block	Phoenix UK5N, or equal	shield drains 24V DC signal & discrete control
Terminal block	Phoenix UK5N, or equal	Pulse train
Computer Pulse Train Signals		
Terminal block w/suppressor diode	Phoenix UK5, Termitrab (24VDC, 117VAC), or equal	Pulse train increase, decrease, and common
Terminal Markers		
Terminal marking card	Phoenix ZB series, or equal	All terminal blocks

2.11 FUSES AND BREAKERS

A. CONTROL POWER TRANSFORMER FUSING: Control power transformers shall be protected by 13/32-inch x 1½-inch rejection type primary fuses rated 200,000AIC and

¼-inch x 1¼-inch secondary fuses rated 10,000AIC. Secondary fuses shall be sized at 125 percent of full load. Fuses shall have time delay characteristics to prevent false tripping due to coil in-rush currents. Fuses shall be Bussman FNQ-R, MDQ, and MDA series, or equal. Primary fuse holders shall be rated 600V, 30A, 200,00AIC with DIN-rail adaptors. Secondary fuse holders shall be blown fuse indicating type with clear transparent knob mounted on the panel face. Fuse holders shall be Bussman BC series and HK series, or approved equal.

B. TERMINAL BLOCK FUSES: Fuses shall be 1/4 x 1-1/4 inches. Fuses on 120VAC circuits shall be ceramic tube type with 25,000 amperes interrupting capacity at 125 volts and neon blown fuse indicator lamps. Fuses for 24V DC circuits shall be fast acting glass tube type rated 1/8 or 1/10 amp for 4-20 mA loops and 3 amps for the power supply to individual instruments. Fuse holders for 120VAC shall be din rail mounted terminal block style or the panel mounted style as specified herein.

C. DC BREAKERS: Din rail mounted dc circuit breakers shall be the high density, 2-pole, energy limiting type rated 120VDC, with current ratings as shown on the drawings. DC breaker shall be Allen Bradley 1492-CB Series B, or approved equal.

D. AC BREAKERS: Din rail mounted circuit breakers shall be thermal magnetic type rated 240V, 10,000 AIC. AC Breakers shall be Square D QOU Series 3 or approved equal.

2.12 CONTROL DEVICES

A. PUSHBUTTONS: (NOT USED)

B. SELECTOR SWITCHES: (REFER TO DRAWING FOR PART NUMBER)

C. PUSHBUTTON AND SWITCH COLORS: (NOT USED)

D. INDICATING LIGHTS: (NOT USED)

E. INDICATING LIGHTS TYPE AND COLOR: (NOT USED)

F. CONTROL DEVICE NEMA RATING: Control devices shall have an environmental rating to match the NEMA 250 and NEMA ICS-6 enclosure type as follows:

NEMA Enclosure	NEMA Control Device Rating
NEMA 12	NEMA 4/13

G. LEGEND PLATES: (NOT USED)

2.13 RELAYS (NOT USED)

2.14 PROGRAMMABLE LOGIC CONTROLLERS AND PLC COMPONENTS (REFER TO DRAWINGS FOR PART NUMBERS)

2.15 POWER DEVICES

A. CONTROL POWER TRANSFORMERS: Control power of 120V AC shall be derived from primary and secondary fused control circuit transformers. The control transformers shall meet the requirements of NEMA ST-1. The control transformer shall be protected by two 600V AC fuses on the primary side and one 250V AC fuse on the secondary side.

2.16 DC POWER SUPPLIES (REFER TO DRAWINGS FOR PART NUMBERS)

2.17 PANEL GROUNDING

A. Each panel shall be provided with two copper ground bars. One bar shall be bonded to the panel frame or sheet metal and to the facility grounding system. The second (isolated signal) ground bar shall be mounted on insulated stand-offs and shall be bonded to the frame ground bar at one point only. Provide minimum dimensions per grounding bar of 1/4 inch x 1 inch x entire length of panel interior at bottom of panel.

B. Signal circuits, signal cable shields, and low-voltage DC power supply commons shall be bonded to the signal ground bar. The individual cabinet signal ground bar shall be connected to the plantwide grounding grid at one point only.

C. Surge protectors and separately derived AC power supplies shall be bonded to the frame ground bar.

2.18 UNINTERRUPTIBLE POWER SUPPLY (UPS) – (REFER TO DRAWING FOR PART NUMBER)

2.19 MISCELLANEOUS

A. FIXTURES AND SWITCHES: Provide LED enclosure fixtures for each section of the enclosure. LED Fixture shall be rated for 120VAC and have 4000k color temperature. LED fixture shall be by Hoffman or approved equal. Door Light switches shall be rated for 10A, 120/250VAC, mounted on enclosure frame and activated the light when the enclosure door is opened

PART 3 -- EXECUTION

3.01 GENERAL

A. Examine all specified panel requirements, design the panel layouts and fabrication details for all new panels within the guidelines specified herein, and submit these layouts to obtain approval prior to fabrication.

B. Vacuum clean control panels and cabinets.

C. Provide panels with the as-built schematics, point to point wiring diagram, communication block diagram, I/O list, dimensions and layout drawings.

3.02 INSTALLATION

A. FREESTANDING PANELS: Freestanding panels shall have the provisions be anchored to the floor.

B. PANEL POWER SUPPLY:

1. Mount and connect power supply and conditioning equipment in compliance with the manufacturer's instructions.

2. Provide line side disconnect for power supply and conditioning equipment. Provide line and load side over current protection for power supply and conditioning equipment in compliance with NFPA 70.

C. WIRING:

1. GENERAL: Power conductor sizing shall comply with the minimum requirements specified herein and of NEMA ICS 1, NFPA 70 and NFPA 79. Wiring shall be supported independently of terminations. Conductors shall be trained onto terminals and laced into fixed bundles at nominal 6-inch centers and routed into wire duct. Conductors crossing hinged doors shall be slack looped to accommodate the door fully opened. Slack conductors shall be contained in spiral wrap secured on both sides. Wire duct fill shall not exceed 40 percent of cross section area.

2. CIRCUIT SEPARATION: In any panel containing signal conductors and power or control conductors, proper circuit isolation shall be maintained. Locate terminals and devices to separate power and control circuits from signal circuits.

3. FIELD WIRING PROVISIONS:

a. For field wiring terminal blocks located in interior spaces, provide dedicated wire duct with sufficient capacity for all field wiring and space for the wire tags between the wire duct and the terminal blocks.

b. Provide terminal blocks for field wiring such that connecting wires terminate on one side and all field wiring is terminated on the opposite side of the terminal block.

c. Field wiring terminal blocks located along the outside edges shall be located so that sufficient space is provided for wire bending radius and wire tags.

D. CABLE AND WIRE MARKERS:

1. GENERAL: All conductors and cables shall be identified with markers. Each wire shall be numbered in accordance with approved drawings. Signal cable markers shall not be heat shrunk until the outer jacket and foil shield is cut back so that the marker shall also serve to insulate the end of the foil shield from ground. Installed markers shall be positioned to be read without twisting the conductor. Installed conductor markers that can be smudged or erased after installation shall be sprayed with a clear acrylic fixative. No two markers shall have the same number unless they are electrically identical. Conductors shall have the same marker number on both ends.

E. TERMINAL BLOCKS:

1. TERMINALS: Each field connection shall be made to an individual terminal block, except for low level (less than 80 volts AC or DC) signals where no more than two conductors shall be inserted into a terminal. Terminal blocks for field terminations shall be separated from terminal blocks for other purposes and shall be located close to where the field cables enter the panel. Panelwork shall contain no exposed power or control (80 volts or greater) connections, and adjustments to equipment shall be made without exposing these terminals. Terminal blocks shall be numbered with permanent type- written characters with minimum 1/8 inch text height.

2. TERMINAL TAGS, COVERS AND MARKERS: Each terminal strip shall have a unique identifying alphanumeric code at one end and a plastic marking strip running the entire length with a unique number for each terminal. Numbers shall be machine printed and l/8 inch high. All terminal blocks carrying power circuits over 120V AC shall be guarded with a transparent removable cover for personnel protection.

3.03 TESTING

A. General

1. Control panel shall be factory tested prior to shipment of the equipment.

2. Provide all special testing materials and equipment.

3. District reserves the right to test or retest all specified functions as required to determine compliance with approved submittals, and drawings.

B. Witnessed Factory Test (WFT).

1. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation.

2. Control panel assemblies shall be inspected and tested to verify that they are in conformance with approved submittals, specifications and drawings.

3. Test and verify control panel wiring of all components and PLC I/Os.

4. Demonstrate the data communication network communicate between devices.

5. Other tests as necessary to verify complete functionality of the control panel wiring.

6. The factory test shall be witnessed by the District. The factory test shall be at the panel manufacturing facility and not at any manufacturer's remote offices or third-party locations. Provide one week schedule notification to District prior to performing the WFT. The WFT shall not be held until after favorable review of all the submittals as specified herein.

7. Submit WFT results.

3.04 TRAINING (NOT USED)

****END OF SECTION****