

SECTION 26 09 26
LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Lighting control system requirements
- B. Power switching equipment requirements
- C. System operator's equipment requirements

1.02 RELATED SECTIONS

- A. Section 26 50 00 – Lighting
- B. Section 26 24 24 – Circuit Breaker and Panelboards

1.03 MEASUREMENT AND PAYMENT

- A. General: Lighting Control System, as specified herein, will not be measured separately for payment but will be paid for as part of the Contract lump-sum price for Electrical Work as indicated in the Bid Schedule of the Bid Form.

1.04 REFERENCES

- A. American National Standards Institute (“ANSI”):
 - 1. ANSI C62.41 IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- B. California Title 24:
 - 1. All control equipment shall be California Title 24 compliant.
- C. FCC Emissions Standards:
 - 1. FCC Rules and Regulation 47, Part 15, subpart J, Class A.
- D. Illuminating Engineering Society of North America (“IES”):
 - 1. IES Lighting Handbook, Reference and Application.
- E. National Electric Manufacturing Agency (“NEMA”)
 - 1. NEMA 250 Enclosure for Electrical Equipment (600 Volts).

2. NEMA PB.1 Panelboards.
3. NEMA PB 1.1 Instructions for installations and Maintenance of Panelboards.

F. National Fire Protection Association (“NFPA”):

1. NFPA 70 National Electrical Code (“NEC”).

G. Underwriters Laboratories Inc. (“UL”):

1. UL 916 Energy Management Equipment
2. UL 67 Panelboard Interiors
3. UL 50 Panelboard Box

1.05 REGULATORY REQUIREMENTS

- A. The lighting control system shall be UL labeled. Programmable panelboards shall be UL listed under UL 916 Energy Management Equipment, UL 67 Panelboard Interiors and UL 50 Panelboard Box.
- B. All control equipment shall be in compliance with FCC emissions' standards in Part 15 Subpart J for Class A application.
- C. Refer to Section 20 70 26 – Common Materials and Methods for Electrical Systems, for requirements.

1.06 SUBMITTALS

- A. General: Refer to Section 01 33 00 – Submittal Procedures, and Section 01 33 23 – Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. The following information shall be submitted:
 1. Breaker layout drawing with dimensions indicated and nameplate designation
 2. Component list
 3. Conduit entry/exit locations
 4. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 5. Cable terminal sizes
 6. Product data sheets. Submit original manufacturer’s data sheets on system submitted and components supplied, with complete descriptions of hardware and software components supplied

7. Shop drawings
 8. Detailed layout drawings sealed and stamped by a licensed engineer who is registered in the state of California
- C. Wiring Diagrams – Submit typical wiring diagrams for all components including, but not limited to, programmable panelboards, controllers, override switches, daylighting components, dimming ballasts, network wiring, and the operator’s station.
 - D. One line diagram – Submit a one line diagram of the system.
 - E. As-built drawings, seismic certification and equipment anchorage details.
 - F. Test Reports: Submit certified test reports of factory and field tests performed, in accordance with applicable referenced standards and Specification requirements.

1.07 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. The manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have a minimum of five (5) years manufacturing experience.
- D. Provide Seismic tested equipment as follows:
 1. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC).
 2. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 - a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer who is registered in the state of California. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
 - b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
 - c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment.

1.08 DELIVERY, HANDLING, AND STORAGE

- A. Equipment shall be delivered, handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

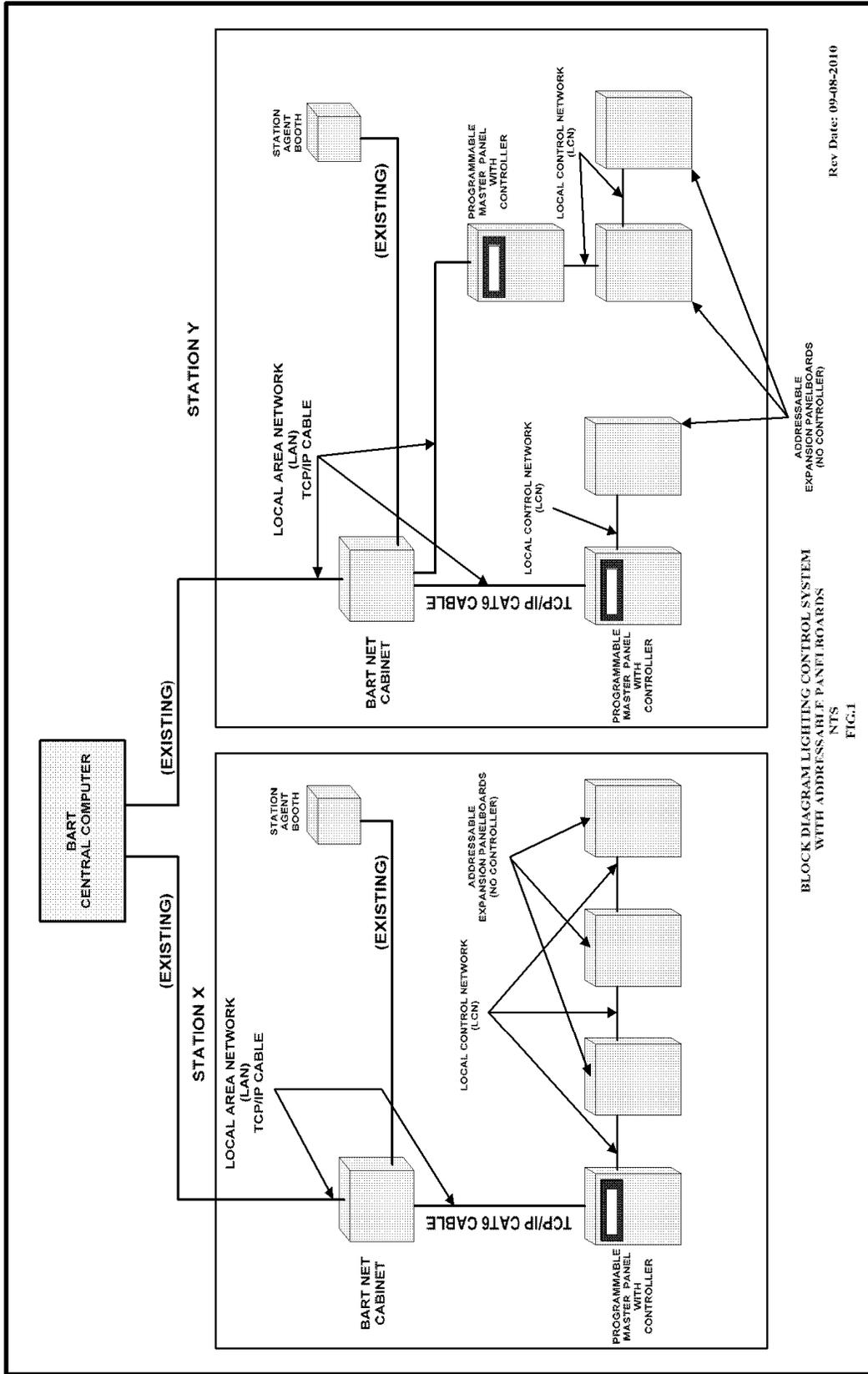
1.09 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL SYSTEM REQUIREMENTS

- A. The Lighting Control System shall meet or exceed the following capabilities:
 1. The Lighting Control System shall have web-based software management program that enables remote system control, status monitoring, and creating of lighting control profiles.
 2. Lighting Control Systems shall support external control using external industry standard protocol preferably BAC net.
 3. The system shall be capable of monitoring and controlling a single circuit breaker and group of circuit breakers locally and remotely.
 4. The system shall be capable of switching for a specific lighting zone.
 5. Ethernet connections shall use industry standards per BFS Section 27 13 01. See Fig 1.
 6. Individual lighting zones shall be capable of being segmented into several channels of occupancy, photocell, and switch functionality for sequences of operation.
 7. The system shall be capable of operating a lighting control zone based on:
 - a. Time-of-day scheduling.
 - b. Sunrise/sunset times using an astronomical clock.
 - c. Daylight savings time adjustments.
 - d. Light level sensors.
 - e. Synchronize to Network time protocol version 3 client capable of listening to broadcast messages.



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BLOCK DIAGRAM LIGHTING CONTROL SYSTEM WITH ADDRESSABLE PANELBOARDS NTS FIG.1

2.02 POWER SWITCHING EQUIPMENT REQUIREMENTS

- A. The power switching equipment shall be programmable panelboards. The programmable panelboards shall contain low voltage controlled circuit breaker switching and thermal magnetic overcurrent protection in a standard panelboard enclosure. The programmable panelboards must be integrated and modular.
- B. Programmable Panelboard General Requirements:
1. The panelboard shall contain an integral programmable plug and play control module that provides ON/OFF control for low voltage switchable circuit breakers, network communications capability and web services for data exchange between a standard web browser and the controller.
 2. The panelboard shall be pre-wired and assembled at the factory and consist of the following modular construction:
 - a. Enclosure to be NEMA Type 1.
 - b. Circuit breakers shall be remotely controlled ON or OFF with low voltage.
 - c. Interior to be sized to Distribution System Characteristics, Voltage and Current requirements.
 - d. Internal Remote Controllable Circuit Breaker Electronic Bus.
 - e. Internal programmable Control Module.
 - f. Internal 120/277 Vac Power Supply with primary fuse and secondary thermal magnetic On/Off protection.
 - g. Programmable control module to be listed as UL 916 Energy Management Equipment.
 3. Each programmable panelboard shall be capable of controlling at least 3 additional expansion panelboards. Expansion panelboards shall be powered and controlled from the programmable panelboard.
- C. Programmable Panelboard Construction Requirements:
1. The panelboard shall be rated for 480Y/277 Vac. Continuous main current ratings shall be as indicated on the drawings. Panelboard shall be fully rated to meet the panelboard short circuit current rating shown on the drawings.
 2. Panelboard bus current rating shall be determined by heat-rise tests conducted in accordance with UL 67.
 3. Neutral shall be 200% rated solid copper for non-linear load applications and marked for non-linear load applications.
 4. Nametags shall be provided for main and sub-feed circuit breakers.
 5. Interiors of panelboard shall be sized to allow easy access and replacement of the programmable control module.
 6. Interiors shall come complete and factory assembled with rigid chassis assembly that assures accurate alignment of interior and programmable control module with panel front and prevent flexing and possibility of loosening or damage to parts during and after installation.
 7. Main Circuit Breaker

- a. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole.
- b. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breaker frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the breaker. Breaker handle and faceplate shall indicate rated ampacity.
- c. Lugs shall be UL listed to accept solid or stranded copper conductors only. Lugs shall be suitable for (75 degrees C rated wire), (90 degrees C rated wire, sized according to the 75 degrees C temperature rating per NEC Table 310-16). Lug body shall be bolted in place, snap-in designs are not acceptable.

8. Branch Circuit Breakers

- a. Branch circuit breakers shall have bolt-on type bus connectors.
- b. Circuit breakers shall have an overcenter toggle mechanism, which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
- c. Circuit breaker contacts shall respond to a remote low voltage signal for Open or Closed contact positioning. Circuit breaker power contacts shall remain Open when the breaker handle is in the OFF or tripped position, regardless of the remote low voltage signal. Remote control shall only be possible when the breaker handle is in the ON position. Operating the breaker handle in the event of a panelboard control module hardware failure may manually control circuit breakers. Control power to the remotely controlled circuit breakers shall come from the programmable panelboard control module.

9. Enclosures:

- a. Type 1 Boxes shall be standard size deep galvanized steel constructed in accordance with UL 50 requirements. Boxes shall have removable box ends without knockouts on both ends.
- b. Fronts shall meet strength and rigidity requirements per UL 50 standards with ANSI-61 Gray finish over cleaned steel. Fronts shall be one-piece with hinged flush-type lock/latch handle assembly on door and mounting screws. Mounting shall be flush or surface as indicated on the drawings.

D. Programmable Panelboard Control Requirements:

1. The stand-alone feature shall permit the panelboard to operate without a central computer. All time-of-day functions such as load schedules, ON/OFF times, real-time clock, day/date, month, etc. shall be included.
2. A panelboard non network port shall be provided for local laptop programming and diagnostic maintenance. An Ethernet shall be provided for direct connection to a TCP/IP network.
3. The panelboard shall be capable of coordinating all Logic, Control, Runtime Data, Status Information and Communications functions.

E. Programmable Panelboard Performance Requirements:

1. Hardware Requirements:
 - a. Power source shall be adjustable to operate on either 120 Vac or 277 Vac. Power source shall be directly connected to the bus with overcurrent protection and able to be switched on and off.
 - b. Time schedules, time clock, day/date and panelboard configuration parameters shall be protected from memory loss if there is a power failure. The memory loss protection will be rated for a minimum of 10 years.
 - c. The panelboard controller shall have non-volatile memory. Subsequent to any loss of control power, the panelboard controller shall automatically reset and return to normally scheduled load position without any operator action required.
 - d. The Local Control Network (LCN) shall be self-powered from the panelboard, no external power supply shall be required.
 - e. The panelboard shall remove itself from the Local Area Network (LAN) should it fail. Network "Lock-Ups" due to failed panelboard shall not be acceptable.
 - f. Each panelboard controller shall at a minimum provide diagnostic LEDs for power, normal operation / fault, and LAN and LCN communication activity.
 - g. Each panelboard controller shall have local switches for maintenance functions such as bypass all loads ON / OFF.
 - h. Each panelboard shall have general-purpose low voltage I/O for local connection of override switches, occupancy sensors, ballasts, photo sensors, and pilot control relays.
 - i. Each programmable panelboard controller shall support an optional programming LCD panel. At a minimum the programming panel shall have an 8 line LCD to display parameters and status. Using buttons on the panel, a user may look at status, control local loads, modify load groups and schedules and allow configuration of network parameters such as IP address. User access shall be restricted based upon two levels of passwords. The programming panel shall also be capable of storing and loading panel control parameters from flash memory.
2. Hardware Resident Control Software Requirements:
 - a. Each panelboard shall provide the control software as an integral part of the panelboard. The hardware resident software shall provide the ability to construct user-defined lighting control scenarios. It shall be possible to program the panelboard remotely.

PART 3 EXECUTION

3.01 FACTORY TESTING

- A. The factory service shall provide adequate testing of the supplied equipment and software to ensure that the system performs as intended by the specification. BART engineering and maintenance personnel shall be trained on all aspects of operating and maintaining the system. Care shall be taken to ensure that the system load connections are to the electrical drawing and that the control scenarios are operating properly.

3.02 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in starting-up and programming the system for a period of two (2) working days.

The manufacturer's representative shall be factory-trained and shall have a thorough knowledge of the software, hardware and system programming.

- B. The Contractor shall provide three (3) copies of the manufacturer's field startup.
- C. The following system programming shall be provided by the factory trained manufacturer's representative:
 - 1. Assist the owner in developing a practical control scenario for each application
 - 2. Program the owner supplied control scenario
 - 3. Explain the operation of the control programs to the owner and walk through their operation

3.03 MANUFACTURER'S CERTIFICATION

- A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.04 TRAINING

- A. In addition to the requirements of Section 01 79 00 – Demonstration and Training, shall comply with the specific training requirements specified herein.
- B. The Contractor shall provide a training session for up to five (5) BART District representatives for normal three (3) workdays at a jobsite location determined by the BART District.
- C. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the control system, programming, and other major components.
- D. The training program shall include:
 - 1. System review of all system components and their function
 - 2. System review of all management software and its function
 - 3. Operator training to develop experience with control applications.

3.05 DOCUMENTATION

- A. Documentation shall be provided in electronic and hard copy form as indicated below:
 - 1. System 1 - Line Diagram: Show system components and quantities including programmable panelboards, expansion cabinets, switches, light sensors, data line, and central operator's station network connection
 - 2. Panelboard Load Schedule: Show load placement and sizing
 - 3. Panelboard Wiring Schedule: Show load terminations
 - 4. Wiring Diagrams: Show typical interconnect wiring diagram for each system component supplied
 - 5. Installation Guide: Provide instructions on how to install system components
 - 6. Manual: Provide System User's Guide and Programmer's Guide in loose leaf three-ring binders

7. Training Video: The contractor shall provide a complete training video for installation of software, basic operation of software, and common components of system
8. Riser Diagram: Provide single line drawing showing control connections for each system component

3.06 INSTALLATION

- A. The Contractor shall furnish, install and terminate all communication conductors and associated conduits external to any factory supplied equipment.
- B. All communication conductors wiring and routing shall be per the manufacturer's recommendations and as shown on the contract drawings.

3.07 FIELD TESTING

- A. Verify complete system operation including all hardware, software and communication devices.
- B. Verify networking performance with all interfacing systems by other manufacturers.