

SECTION 26 09 26
LIGHTING CONTROL SYSTEM

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Lighting control system 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. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE C62.41 IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
- B. California Code of Regulations (CCR):
 - 1. Title 24, Part 2 California Building Code
- C. Illuminating Engineering Society of North America (IES):
 - 1. IES Lighting Handbook, Reference and Application
- D. National Electric Manufacturing Agency (NEMA)
 - 1. NEMA 250 Enclosure for Electrical Equipment (1000 Volts Maximum)
 - 2. NEMA PB 1 Panelboards
 - 3. NEMA PB 1.1 General Instructions for Proper Handling, Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or less

- E. National Fire Protection Association (NFPA):
 - 1. NFPA 70 National Electrical Code
- F. Underwriters Laboratories Inc. (UL):
 - 1. UL 916 Standards for Safety Energy Management Equipment
 - 2. UL 67 Standard for Safety Panelboard
 - 3. UL 50 Standard for Safety Enclosures for Electrical Equipment, Non-environmental Considerations
- G. International Organization for Standardization (ISO):
 - 1. ISO 9001 Quality Management Systems
 - 2. ISO/IEC 14908-1 Information Technology- Control Network Protocol- Part 1: Protocol Stack
 - 3. ISO/IEC 14908-2 Information Technology- Control Network Protocol- Part 2: Twisted Pair Communication
 - 4. ISO/IEC 14908-3 Information Technology- Control Network Protocol- Part 3: Power Line Channel Specification
 - 5. ISO/IEC 14908-4 Information Technology- Control Network Protocol-Part 4: IP Communication

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 Electrical Equipment, Non-environmental Considerations.
- B. 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:
 5. Short-circuit rating
 6. Voltage
 7. Continuous current
 8. Cable terminal sizes
 9. Product data sheets. Submit original manufacturer's data sheets on system submitted and components supplied, with complete descriptions of hardware and software components supplied
 10. Shop drawings
 11. 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 controllers, override switches, daylighting components, dimming controller, 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 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.

1.10 DISCREPANCIES

- A. Any items not included in the specification but referred to in the Drawings in reference to this project and any other incidentals not referred to but required as a basic element to the overall performance and/or successful completion of the work shall be installed as part of this contract.

1.11 COORDINATION WITH OTHER TRADES

- A. This section specifies cooperation of the Lighting Control Contractor with other trades to assure proper arrangement of control items.
- B. The interface between the Lighting Control System (LCS) and other equipment is the responsibility of the Lighting Control Contractor.
- C. Electrical wiring
 - 1. All control wiring required for work under this section of the specification shall be provided under this section of the specification unless otherwise specified.
- D. Electrical wiring - power for lighting control panels, control devices, and sensors

1. Power for control units, control devices, and sensors shall be coordinated with the Electrical Contractor for the project and/or the Owner.
2. The Division 26 electrical contractor shall be responsible for bringing all power required by the control systems from the source (junction box, lighting panel, distribution panel, etc.) to the point of use. This includes furnishing and installing any branch circuit protection equipment and disconnecting equipment required to comply with code requirements.
3. The Division 26 electrical contractor shall include a green grounding conductor in all power conduits.

PART 2 – PRODUCTS

Lighting Control System shall include control unit hardware and software, control devices, sensors, operator input/output devices, all miscellaneous devices required for complete operation, and that will provide maximum benefit to the end-user.

2.01 LIGHTING CONTROL SYSTEM REQUIREMENTS

This specification covers the requirements to provide a Lighting Control System. The use of any other Lighting Control System is subject to the Engineers approval.

A. Lighting Control System:

1. Lighting Control System requirements are as described below:
 - a. Definition: The Lighting Control System shall include unit hardware, software, control devices, sensors, operator input/output devices, and all miscellaneous devices required for complete operation.
 - b. Control equipment shall be in compliance with Title 24, Part 2, California Building Code.
 - c. The Lighting Control System shall have web-based software management program that enables remote system control, status monitoring, and creating of lighting control profiles.
 - d. Lighting Control Systems shall support external control using external industry standard protocol preferably BAC net.
 - e. The system shall be capable of monitoring and controlling a string of lights connected to a single circuit breaker or multiple strings of lights connected to a group of circuit breakers locally and remotely.
 - f. The system shall be capable of monitoring and controlling a specific lighting zone.
 - g. Ethernet connections shall use industry standards per Contract Specifications Section 27 13 01, Communication Cables and Related Equipment. See Fig 1.

- h. Individual lighting zones shall be capable of being segmented into several channels of occupancy, photocell, and switch functionality for sequences of operation.
- i. The system shall be capable of operating a lighting control zone based on:
 - 1) Time of day scheduling
 - 2) Sunrise/sunset times using an astronomical clock
 - 3) Daylight savings time adjustments
 - 4) Light level sensors
 - 5) Occupancy sensors
 - 6) Synchronize to Network time protocol, version 3 client, capable of listening to broadcast messages
- j. All lamps, LEDs, ballasts, drivers, sensors, and controls must be fully compatible, providing full operability of all components.

B. Lighting Control System - Hardware

- 1. Lighting Control System Hardware requirements are as described below:
 - a. Definition: Lighting Controller (LC) is an electronic device that is to be installed at the light point. The LC shall be capable of receiving ON/OFF and dimming commands that is executed through the driver and or ballast.
 - b. Consume less than 2 watts.
 - c. Operate on 120VAC to 277VAC, 60HZ.
 - d. Capable of stepless dimming from 20% to 100% light level with the possibility to set the dimming level at any percent between these two values.
 - e. The lighting controller shall communicate over power-line carrier (PLC) technology and or wireless, compliant with ISO 14908 protocol.
 - f. IP 65 rating or higher.
 - g. Compliant with open LonMark International Luminaire Controller profile.
 - h. The lighting controller shall measure voltage, current, power, and power factor.
 - i. The lighting controller shall measure the cumulated energy consumption.
 - j. The lighting controller shall measure and store the number of lamp burning hours.

C. Master Lighting Control Panel

- 1. Master Lighting Control Panel requirements are as described below:
 - a. Definition: Master Lighting Control Panel (MLCP) is an electronic programmable device that is to be installed in a cabinet or an enclosure. It shall provide an astronomical clock to control the main segment and each

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light point, individually or by group. The MLCP shall be capable of sending ON/OFF and dimming commands at times previously remotely configured by the Central Management Software (CMS).

- b. The MLCP shall be installed on a DIN Rail capable of fitting in new or existing cabinets and is to be located for convenient servicing. An enclosure shall be required to house the MLCP and other components.
- c. The lighting controller shall communicate over power-line carrier (PLC) technology and or wireless, compliant with ISO 14908 protocol.
- d. Operate on 120VAC to 277VAC, 60HZ.
- e. Communicate using TCP/IP over Ethernet or wireless and have no proprietary protocol accepted. The MLCP shall have RJ45 Ethernet port for: ADSL, fiber optic, Wi-Fi, 3G and RS232 for wireless modem.
- f. The MLCP shall be remotely configurable through the CMS.
- g. Consume less than 20 watts.
- h. Operating temperature: -40 degrees Celsius to +50 degrees Celsius
- i. Provide a minimum of one digital ON/OFF output to control the mains and provide 2 digital inputs for applications such as door-open detection.
- j. Provide digital and/or analog inputs to identify other signals, events, or failures.
- k. Provide a fail-safe lighting operation in case of power outage and failure of the MLCP.
- l. Provide an integrated astronomical clock that can be configured remotely. ON/OFF and dimming commands shall be programmed based on the signals provided by the astronomical clock.
- m. Communicate, manage, and control lights on wireless or PLC technology for tunnel lighting platform lighting, and wayside lighting.
- n. Support at least 250 lighting controllers.
- o. Provide an automatic mechanism to manage the repeating of the power line signal. This automatic mechanism shall continue to work 100% correctly should a lighting controller be out of service.
- p. The MLCP shall control the lighting controller autonomously and without any connection to a central server or central service.
- q. The MLCP shall be capable of dimming and switching light points ON/OFF.
- r. Provide RS485 or RS232 serial interface to control/monitor MODBUS devices.
- s. Provide means to program specific applications that shall run locally.
- t. The MLCP shall automatically update its real-time clock during summer/winter time shifts.

- u. The MLCP shall automatically synchronize its internal real-time clock with an SNTP server. This action shall not require any manual operation and shall be performed automatically by the MLCP at periodic intervals.
- v. Each MLCP shall have a local switch for maintenance functions such as: bypass all loads ON and OFF.

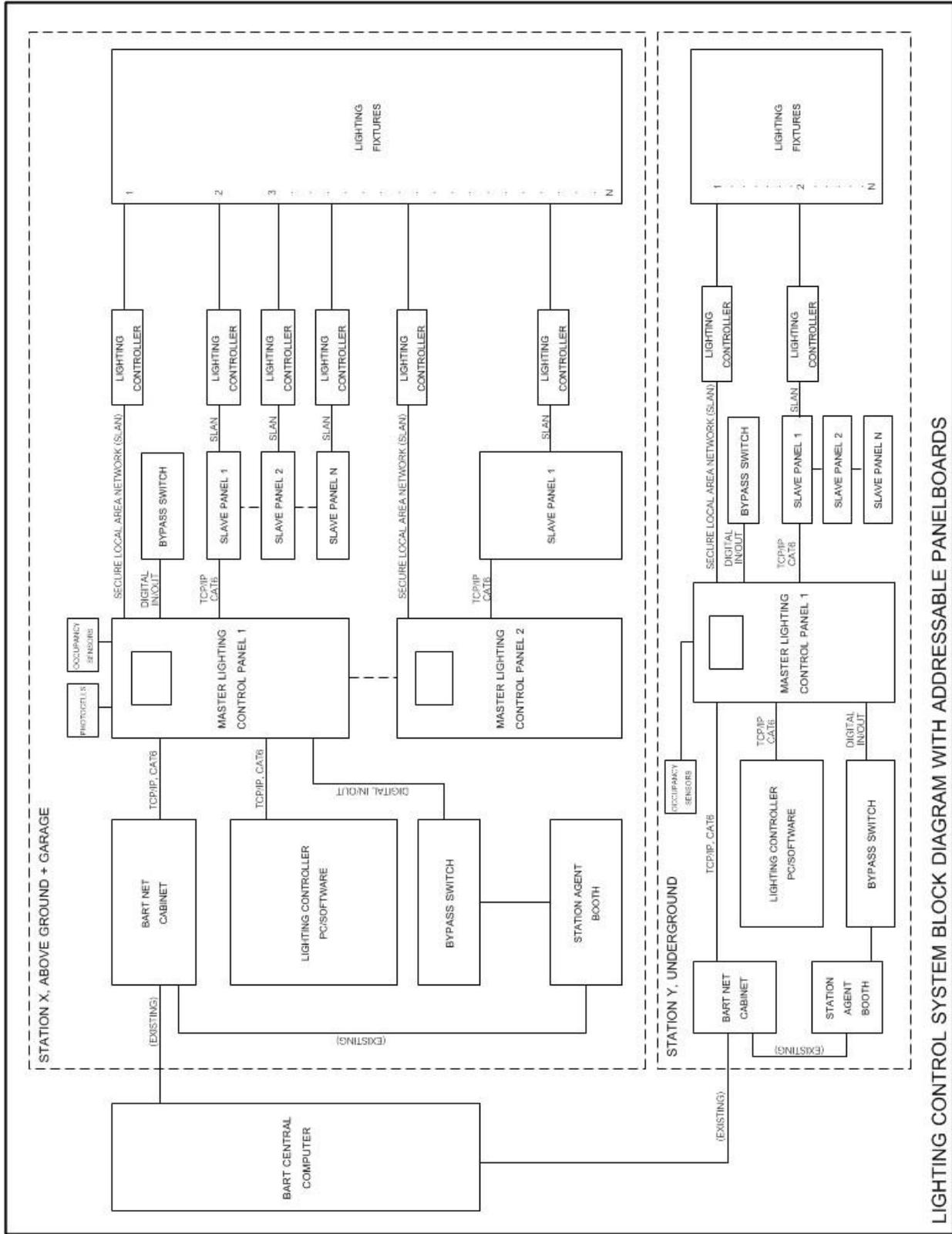
D. Central Management Software

1. The Central Management Software requirements are as described below:
 - a. Definition: Central Management Software (CMS) is the local or hosted Central Management Software that communicates to the master lighting controller(s) through TCP/IP, which uses standardized models such as: XML, SOAP, HTTP, CSV file exchange, or FTP.

E. Lighting Control System - Software

1. Lighting Control System Software requirements are as described below:
 - a. System software shall be fully licensed to the owner for the number of PC's/laptops furnished.
 - b. Monitor and supervise all control points.
 - c. Add new points and edit system database.
 - d. Change control setpoints and timing parameters in all control units.
 - e. Enter programmed start/stop, which shall have capabilities of annual, weekly, and temporary schedules.
 - f. View alarm and messages.
 - g. Modify existing control logic or sequence of operations in all control units.
 - h. Upload/Download programs, databases, control parameters, etc.
 - i. Modify graphic screens.
 - j. Provide all troubleshooting software necessary.
 - k. The Host software shall provide the capacity to run third party software packages for word processing, spreadsheets, or data management programs. The use of third party software shall not suspend operation of background tasks of multi-tasking operating systems such as: alarm, logging, and report generation.

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LIGHTING CONTROL SYSTEM BLOCK DIAGRAM WITH ADDRESSABLE PANELBOARDS

2.04 LEGACY LIGHTING CONTROL SYSTEMS

- A. Existing lighting installations, not under immediate consideration of overall improvement, shall be considered as legacy lighting installations. Where energy saving is of interest, a new lighting control panel, such as Eaton's PRC-2000 or Watt-Stopper LICA24 or accepted equal shall be installed.

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 master lighting control panels, expansion cabinets, switches, light sensors, lighting controllers data line, and central operator's station network connection.
 - 2. Master Lighting Control Panel Load Schedule: Show load placement and sizing.
 - 3. Master Lighting Control Panel Wiring Schedule: Show load terminations.
 - 4. Panelboard Load Schedule: Show load placement and sizing.
 - 5. Panelboard Wiring Schedule: Show load terminations.
 - 6. Wiring Diagrams: Show typical interconnect wiring diagram for each system component supplied.
 - 7. Installation Guide: Provide instructions on how to install system components.
 - 8. Manual: Provide System User's Guide and Programmer's Guide in loose leaf three-ring binders.
 - 9. Training Video: The contractor shall provide a complete training video for installation of software, basic operation of software, and common components of system.

10. 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 conductors and associated conduits external to any factory supplied equipment.
- B. All 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.

END OF SECTION 26 09 26