

SECTION 26 09 43 – DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope: The following specifications detail the minimum performance and related criteria for the Distributed Lighting Control System. Provide, connect, and furnish all necessary equipment for proper installation and service of the system as indicated on the drawings and specified herein.
- B. Division 26 "Lighting Sequence of Operations" shall be referenced for the performance requirements of the Network Lighting Control system.
- C. Light fixtures shall be supplied with 0-10V dimming drivers, and the lighting control system shall integrate with these drivers.

1.2 SYSTEM DESCRIPTION & OPERATION

- A. The Distributed Lighting Control System, as defined under this section, shall include remote power supply cabinets with programming software for programming, dimming and switching interface modules, occupant sensors, daylight sensors, wall controls, and related accessories. The system shall also be capable of direct connection into digital ballasts/drivers and daylight sensors. All ballasts/drivers or modules of the system shall be connected by a communication bus configured of Class 1 or Class 2 wiring.
- B. While not required for functionality, the lighting system shall include a front-end file server/computer and software to allow for program changes and over-ride functions. The software shall include map of the building.
 - 1. Local programming shall be handled with the use of a Wi-Fi enabled hand-held device utilizing the owner's Wi-Fi network.
 - 2. All required connections to the Wi-Fi network must be included as part of the project.
 - 3. **In addition to including a map for this building, provide, and program maps for the existing High School and Reamstown Elementary School.**
- C. The lighting system shall be a fully distributed system, with no front-end file server/computer. Programming shall be handled with the use of a Wi-Fi enabled hand-held device utilizing the owner's Wi-Fi network.
 - 1. In order to achieve this requirement, the system shall be networked together. While it is expected that there will be multiple locations for connection to the owner's network, these connections shall be kept to a minimum.
 - 2. While the system is to be a fully distributed system with front-end file server/computer used as overrides, and for reporting.
- D. All programming of the system shall be handled via the owner's network. Under no circumstances shall the system require removal of devices or the ceiling to "plug-in" a device. Nor, shall the system utilize proprietary programmers, Bluetooth, RF or IR programmers.
- E. **The project shall include all connections into the owner's network. Coordinate all requirements with the owner's IT department.**
- F. All exterior lighting control shall be interconnected to allow for BAS integration.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

- G. UL 924 listed devices shall be provided to allow control of life safety lighting.

1.3 SUBMITTALS: Submit shop drawings in coordination with the "Lighting Sequence of Operations" shop drawings:

- A. Provide a written line-by-line review of the specification.
- B. Submit the following according to the Conditions of the Contract, Division 1 and Division 26 Specification Sections.
- C. Product data for each of the products specified. Include data on features, components, ratings, and performance. Include dimensioned drawings with isometric projections of components and enclosures and details of the Ballasts and Modules.
- D. Sample of the equipment, devices, and device plates for color selection and evaluation of technical features, as required by Architect/Engineer.
- E. Wiring diagrams detailing internal and interconnecting wiring for power signal, and control that distinguish between field installed and factory installed wiring.
 - 1. A full single-line diagram for the system shall be provided.
- F. Coordination Drawings, Equipment Riser Diagram.
- G. Operation and maintenance data for materials and products specified in this Section.
- H. When preparing submittals and any required final programming, use a room number schedule generated by the architect and/or the owner, which indicates the actual room numbers that will be used when the building is occupied. If the schedule is not available, revise the initial submittal, when a schedule is available, to reflect the proper room numbers. Panel directors shall also reflect the final number schedule.

1.4 APPROVALS

- A. Prior approval is required for alternate proposals.
- B. Complete Catalog data, specifications, and technical information on alternate equipment must be furnished to the Architect and Owner at least ten (10) calendar days in advance of the bid date.

1.5 QUALITY ASSURANCE

- A. Manufacturer of LMS shall have a minimum of 5 years of continuous experience in manufacturing lighting control products.
- B. Manufacturer of LMS shall have record/history of 5 years of successful lighting control installations.
- C. Manufacturer shall be capable of providing on-site service support within 24 hours in the United States.
- D. Comply with NFPA 70, "National Electrical Code."
- E. LMS, digital ballasts, ballast modules, power supplies, and related accessories shall be UL or CSA marked as appropriate.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

- F. Manufacturer shall maintain ISO9001 certification and shall provide copy of certificate upon Engineer's request.
- G. The contractor/manufacturer shall supply to the owner, a written certification of compatibility, to ensure that all components of the LMS are fully compatible with each other for proper system functionality.

1.6 WARRANTY

- A. The manufacturer shall provide a full three-year warranty on all equipment supplied inclusive of system commissioning by a factory employed engineer.
- B. Warranty coverage shall begin on the date that the equipment is energized.

1.7 COMMISSIONING

- A. Before wiring between occupancy sensors and lighting control system is started, a pre-installation meeting, lasting a minimum of four (4) hours, shall be scheduled to ensure proper installation and functionality. This meeting shall be performed at the project site between the network lighting control manufacturer, occupancy sensor manufacturer and electrical contractor. During this meeting, wiring connections and placement of devices shall be discussed and fully coordinated to ease the installation process for the contractor. Meeting minutes shall be composed by the contractor indicating time, personal present and discussion topics.
- B. Upon completion of the installation, the system shall be completely commissioned by factory trained and authorized service personnel. The commissioning will be performed after the electrical contractor ensures the system installation is complete and that all loads have been tested live for continuity and freedom from defects. The system shall be capable of being programmed through the use of a PC with lighting management software. The site visits shall include:
 - 1. Visit site to inspect pre-wiring.
 - 2. Schedule a meeting with the Owner, Engineer, Contractor, and Factory-Employed Engineer to review the lighting control schedule, including but not limited to time limits of each mode, rooms in each group, and control functions per group, as programmed after the initial lighting control meeting.
 - 3. Determine what ballasts are addressed.
 - 4. Determine which sensors, daylight and occupancy, are connected and functioning with the ballasts.
 - 5. Setting lighting zones and device responses to sensor or control input.
 - 6. Upon completion of the installation, the system shall be completely commissioned by a factory-employed engineer. The check-out will be performed after all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for proper continuity. Commissioning tasks shall include entering each room or space and verifying proper operation of the system as it relates to the lighting control schedule. Issues with the lighting control occupancy sensor placement and sensitivity shall be noted so that they can be addressed by the occupancy sensor manufacturer.
 - 7. A factory-employed engineer shall demonstrate and educate the owner's representative(s) on the system capabilities, operation and maintenance.
- C. Upon completion of the system check-out, in a separate site visit, the installer/programmer shall demonstrate the operation of the system to the appropriate owner's representatives during a four (4) hour visit. This demonstration shall present the owner with all of the capabilities of the system, including software features. The visit shall also consist of a walkthrough the building to describe the different functions and user controls.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

- D. At least 4 weeks after substantial completion, schedule a follow-up minimum four (4) hour meeting with Owner, Occupancy Sensor Manufacturer and Engineer to make adjustments and address any issues regarding the lighting control schedule, and use of the system's abilities.
- E. Project shall include an additional two (2), four (4) hour site visits and changes to the programming after the owner occupies the building within the first year of operation.
- F. All commissioning visits shall be scheduled a minimum two (2) weeks in advance, and the Architect, Engineer, Owner and Construction Manager/Clerk of the Work shall be informed of all meetings in addition to parties that are to be present. A factory authorized technician shall be present at all required commissioning meetings. Any additional meetings required for a fully functioning system shall be included at no additional cost to the owner.

1.8 MAINTENANCE

- A. The manufacturer shall make available to the end user a method of ordering new equipment for expansions, replacement, or parts to be used as spares twenty-four hours a day, seven days a week. The manufacturer must make available new or remanufactured parts for a minimum period of ten years from the final date of commissioning.
- B. The manufacturer shall supply factory service, new or remanufactured replacement parts, and a service contract that extends the factory-limited warranty from three to five years. In addition, this shall allow end user to purchase this coverage on an annual basis for a minimum period of ten years from the date of final commissioning.

1.9 SPARE STOCK

- A. Provide a minimum of one (1) remote lighting hub, complete with four (4) bus power supplies and all other components.
- B. Provide a minimum of five (5) all other control and interface modules.
- C. Provide a minimum of ten (10) low voltage control stations used in educational spaces and two (2) low voltage control stations used in the corridors.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Lutron Electronics Co., Inc.
- B. Unless otherwise noted, all basic components (ballast/driver modules (and/or digital ballasts/drivers), wall controls, bus power supplies, relays (line and low voltage), related accessories and programmers) shall be provided by one manufacturer. The occupancy sensors shall be provided as per the Occupancy Sensor specification section.

2.2 LIGHTING MANAGEMENT SYSTEM COMPUTER

- A. The system shall include a Lighting Management System Computer.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

- B. The computer shall be used for system setup, monitoring, control, graphics, timeclock operation and data logging.
 - 1. Should the computer be disconnected for any reason, the LMS shall continue to function without issue. It is expected that certain interconnections, override functions and data logging will be interrupted in the event of a disconnection, but the normal function will continue.
- C. The LMS shall have lighting control software preinstalled, fully updated and tested prior to shipping.
 - 1. Updates for a minimum of one (1) year shall be furnished and installed by the manufacturer as part of the project.
- D. File Server / Computer will be furnished via Virtual Server by the Owner. Provide required specifications to the owner in order for a server to be provided for installation of the software.
- E. The LMS shall be provided with a client software/web address to provide remote log-in. The client software/web address shall be loaded on the same computer as the mechanical BMS terminal computer. Coordinate with the mechanical contractor to install any required programs to interface with the rack mounted computer with their software.

2.3 LIGHTING MANAGEMENT SYSTEM SOFTWARE

- A. Provide system software that is designed, tested, manufactured, and warranted by a single manufacturer.
- B. Software Overview:
 - 1. Software includes minimum five (5) Client Access Licenses (CALs).
 - a. Each CAL allows access to the Software.
 - b. Each CAL allows that user to operate the system concurrently.
 - 2. Software shall provide the following capabilities
 - a. Setup and Configuration
 - 1) Automatic discovery of all LMS equipment connected to the system.
 - 2) Assign unique names to all equipment and devices.
 - 3) Create and modify grouping of devices.
 - 4) Create and modify presets.
 - a) Presets are set per driver (if digital drivers are installed), module, zone, or per group.
 - b) Set single fade time.
 - 5) Define spaces and assign devices to the space.
 - 6) Graphical Creation Tool for Floorplan Control.
 - a) Import floorplan background from a standard file type.
 - b) Add icons and associate to devices.
 - c) Associate users with a defaulted floorplan.
 - b. Monitor and Control
 - 1) System summary.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

- 2) Individual device status.
 - 3) Set light levels or shade positions of groups or individual devices.
 - 4) Select presets on groups or individual devices.
 - 5) Average light level and calculated power consumption.
 - 6) Peak power demand control adjusts light levels to reduce peak power demand.
- c. Graphical Monitor and Control
- 1) Floorplan based.
 - a) Navigation between multiple floorplans.
 - b) Monitor individual device status.
 - c) Set light levels of groups or individual devices.
 - d) Select presets on groups or individual devices.
- d. Timeclock
- 1) Create and modify timeclock events.
 - 2) Time-of-day and astronomic events.
 - 3) Enable or disable individual timeclock events.
 - 4) Set light levels of groups or individual devices.
 - 5) Select presets on groups or individual devices.
 - 6) Enable or disable sensors per lighting bus.
- e. Alarms
- 1) Create and modify alarms.
 - 2) Alarm conditions include:
 - a) Driver failure (if digital drivers are installed) or module failure.
 - b) Power threshold by space.
 - c) Activate an alarm based on occupancy time periods.
 - d) Execute commands to turn lights on, turn lights off, dim the lights, enable sensors per lighting bus or, disable sensors per lighting bus.
- f. Reports/Logs
- 1) Calculated power consumption.
 - 2) Average light level.
 - 3) Log of user activity in LMS software.
 - 4) Timeclock events.
 - 5) Alarms generated and acknowledgment.
- g. User Management
- 1) Create users and assign access rights.
- h. Diagnostics
- 1) Test and verify device operation.
- i. Automatic Reconnect
- 1) If Ethernet connectivity is lost, the lighting hub will reconnect to the server automatically when connectivity is restored.

2.4 REMOTE LIGHTING HUB

- A. Lighting Hubs: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0° C (32°F) to 40° C (104°F) and 90 percent non-condensing relative humidity.
- B. Designed and tested to withstand electrostatic discharges up to 15,000 V without impairment per IEC 801-2.
- C. Design and test to withstand line-side surges without impairment to performance.
 - 1. Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41B.
- D. Provide lighting hub in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.
- E. Enables Light Management software to control and monitor digital dimming ballast/driver and interface modules.
 - 1. Remote Lighting Hub shall be capable of communicating with a central lighting file server, should one be installed in the future, utilizing Ethernet connectivity. However, the remote lighting hub shall also be capable of full operation without a central lighting file server.
 - 2. Remote Lighting Hubs shall be supplied with a programming tool, so that a hand-held programmer can program the remote lighting hubs utilizing Wi-Fi connectivity to the building Ethernet.
 - 3. Remote Lighting Hub - Bus Supply
 - a. Connect without interface to:
 - 1) digital ballasts/drivers and/or ballast/driver modules.
 - 2) Occupancy sensors.
 - b. Integral fault protection to prevent bus supply failure in the event of a mis-wire.
 - c. LED status indicators:
 - 1) Bus supply is powered.
 - 2) Bus supply operating properly.
 - 3) Bus communication.
 - 4) Emergency condition active / non-active.
 - d. Configuration switches:
 - 1) Override bus to full light output.
 - 2) Override bus to low end.
 - 3) Override bus to off.
 - 4) Closure inputs normally open/closed.
 - e. Each remote Lighting Hub shall be connected to a maximum 4 digital loops of 64 ballasts/drivers or modules.
 - 1) Each loop shall comprise of a maximum four (4) educational spaces.
 - 2) Each remote lighting hub shall only provide loops for the floor for which it is installed, with exception to the corridor/stairwells, which shall have one (1) remote lighting hub to control all corridors and stairwells.
 - 3) Remote lighting hubs shall be installed in panelboard closets, dedicated electric rooms or data closets.

2.5 REMOTE SYSTEM GENERAL PERFORMANCE

- A. The remote system shall be capable of the following performance, regardless of whether a particular feature is installed initially (i.e. daylight sensors are not part of the project, but can be added in the future).
- B. Based on integrated control requirements, system will control lighting with the following hierarchy:
 - 1. Emergency (Highest priority): Ignores all other inputs.
 - 2. Programming: During system programming, sensor inputs are ignored.
 - 3. Occupant sensor: Allows lights to be on/off.
 - 4. Daylight sensor: Imposes a high end limit for light output.
 - 5. Personal control: Fine tune light levels up to the daylight sensor limit.
- C. Response to a single sensor can be unique on fixture by fixture or control module by control module basis.
- D. Power failure recovery - All devices return to their previous light level prior to power loss.
- E. All programmable devices have integral power failure memory to maintain settings for a minimum of 10 years during power loss.
- F. Wall station and sensor replacement is accomplished without programming.

2.6 BUS SUPPLY

- A. General
 - 1. Connect without interface to:
 - a. Occupancy sensors.
 - b. Building management / integration contact closure outputs.
 - c. Fire alarm or security system contact closures.
 - d. Emergency lighting interface listed to UL 924.
 - 2. Integral fault protection to prevent bus supply failure in the event of a mis-wire.
 - 3. LED status indicators:
 - a. Bus supply is powered.
 - b. Bus supply operating properly.
 - c. Bus communication.
 - d. Emergency condition active / non-active.
 - 4. Configuration switches:
 - a. Override bus to full light output.
 - b. Override bus to low end.
 - c. Override bus to off.
 - d. Closure inputs normally open/closed.
- B. Field Mounted Bus Supply
 - 1. Integral clip for mounting on DIN rail.

C. Wall Mounted Bus Supply

1. Provide digital bus power supply in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.

2.7 BALLAST/DRIVER MODULE

A. General

1. Required to provide continuous 3-Wire signal dimming to 3-Wire electronic dimming ballast/driver. Or, provide 4-Wire signal dimming to a 4-Wire electronic dimming ballast/driver.
2. Generate digital communication commands to distribute ballast/driver and sensor data on the digital bus.
3. If power is interrupted and subsequently returned, lights automatically return to the setting prior to power interruption.
4. Each ballast/driver responds independently:
 - a. Up to 64 occupant sensors.
 - b. Up to 64 personal control inputs.
 - c. 2 daylight sensors.
5. Unique internal reference number visibly displayed on module cover.
6. Averages 2 independent daylight harvesting inputs internally.
7. Electrical: Dimmer to meet limited short circuit test as defined in UL 20.
8. Provide integral fault protection to prevent ballast/driver module failure in the event of a mis-wire.

B. 2 Amp 3-Wire Ballast Module

1. Ballast module to integrate up to 2 amps of Lutron 3-wire electronic dimming ballast into a digital control system as a single zone.

C. 16 Amp 3-Wire Ballast Module

1. Ballast module to integrate up to 16 amps of Lutron 3-wire electronic dimming ballast into a digital control system as a single zone.

D. 16 Amp Switching Module

1. Switching module to provide a 16-amp switch relay into a digital control system as a single zone.

2.8 DIGITAL BALLAST/DRIVER / I/O MODULE

A. General

1. I/O Module shall be the common interface to a ballast/driver or sensor.
2. Addressing: I/O Module shall be individually addressable via Energy Control Software.

B. Electrical Specifications

1. Ratings: Shall be low voltage input.
2. Voltage Compatibility: Universal voltage control capability to 347 VAC maximum.
3. Primary Relay Rating: 347V, 0.8A/277V, 1A/240V, 1.2A/120V, 2.5A.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

4. Ballast/driver Compatibility: Suitable for use with electronic dimming ballasts/driver using a 0 to 10 VDC dimming signal, such as Advance Mark VII 0-10V.
5. Power: Shall supply 12 VDC @ 25 mA power to attached sensor.
6. Control Signal: Shall supply 0 to 10 VDC dimming signal to attached ballast/driver or receive control signals from attached sensor.
7. Memory: Retains all system settings in non-volatile memory.

C. Mechanical Specifications

1. Wiring: I/O Module shall not require wiring connections to the System apart from prefabricated, quick connecting low voltage wiring.

D. Environmental Specifications

1. Operating Temperature Range: 0°C to +40°C.
2. Relative Humidity: 20% to 90% non-condensing.

2.9 LIGHTING CONTROL MODULE/PANEL

- A. Provide lighting control modules as required to control the loads indicated.

B. General Requirements:

1. Listed to UL 508 as industrial control equipment.
2. Delivered and installed as a listed factory-assembled panel.
3. Passively cooled via free-convection, unaided by fans or other means.
4. Mounting: Surface.
5. Connection without interface to wired:
 - a. Occupancy sensors.
 - b. Daylight sensors.
 - c. IR receivers for personal control.
6. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
7. Contact Closure Input:
 - a. Directly accept contact closure input from a dry contact closure or sold-state output without interface to:
 - 1) Activate scenes.
 - a) Scene activation from momentary or maintained closure.
 - 2) Enable or disable after hours.
 - a) Automatic sweep to user-specified level after user-specified time has elapsed.
 - b) System will provide occupants a visual warning prior to sweeping lights to user-specified level.
 - c) Occupant can reset timeout by interacting with the lighting system.
 - 3) Activate or deactivate demand response (load shed).
 - a) Load shed event will reduce lighting load by user-specified amount.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

8. Emergency Contact Closure Input:
 - a. Turn all zones to full output during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.
 - b. Allow configurable zone response during emergency state.
 - c. Disable control operation until emergency signal is cleared.
 9. Supplies power for control link for keypads and control interfaces.
 10. Distributes sensor data among multiple lighting control modules.
 11. Capable of being controlled via wireless sensors and controls.
- C. Switching Lighting Control Modules/Panels:
1. Switching:
 - a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
 - b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
 - c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
 - d. Module to integrate up to four individually controlled zones.
 - e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.
 2. Provide switching lighting control modules to control exterior and other relay loads indicated.
- D. 0-10V Lighting Control Modules:
1. Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to single zone.
 2. Single low voltage dimming module; capable of controlling following light sources:
 - a. 0-10 V analog voltage signal.
 - 1) Provide Class 2 isolated 0-10 V output signal conforming to IEC 60929.
 - 2) Sink current per IEC 60929.
 3. Switching:
 - a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
 - b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
 - c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
 - d. Module to integrate up to four individually controlled zones.
 - e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.
 4. Provide 0-10V lighting control modules to control 0-10V dimming loads. Refer to lighting fixture schedule for fixtures with 0-10V drivers.
- E. Digital Fixture Lighting Control Modules:
1. Provides two-way feedback with digital fixtures for energy monitoring, light level status, lamp failure reporting, and ballast/driver failure reporting.
 2. Provide testing capability using manual override buttons.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

3. Each low-voltage digital communication link to support up to 64 ballasts or LED drivers capable of NFPA 70 Class 1 or Class 2 installation.

2.10 LIGHTING RELAY PANELS

- A. Where more than four (4) zones of switched fixture zones are indicated, or where specifically called out, provide lighting relay panels
- B. Mechanical:
 1. Panels shall be UL listed, CSA certified, NOM approved, or CE marked (as appropriate).
 2. Panels shall be wall or recess mountable. Enclosure shall be NEMA Type 1 and IP-20 rated as specified by IEC 60529. Panel shall be constructed of steel with steel gauge of type required by UL508. Contractor shall reinforce wall as required.
 3. Panels shall be completely pre-assembled and factory tested by the manufacturer prior to shipment. The contractor shall be required to provide input feed wiring, load wiring, and control wiring. No other wiring or assembly by the contractor shall be permitted. Panels requiring field assembly are not acceptable.
 4. All input feed, load, and control terminals shall be front accessible without the need to remove switching assemblies or other components.
 5. Panels shall be passively cooled via free-convection and unaided by fans. Systems that are fan dependent or fan assisted for cooling of components are not acceptable. Systems that require or recommend regularly scheduled maintenance for air filtration components are not acceptable.
- C. Electrical:
 1. Panel shall contain the number of switched outputs as per the drawings. Each output may be controlled independently or in combination with any other output within the panel or with outputs from other panels within the system.
 2. The panels shall be dedicated feed-through-type without the use of branch circuit protection or main lug with rated breakers as indicated on the documents.
 3. Panels shall be rated for 120/240 volt, or 277/480 volt as dictated by the feeding circuit breakers.
 4. Panel should have minimum UL listed short circuit current rating (SCCR) of 14,000A.
 5. Panels shall be equipped with an electronic module BYPASS feature which electronically switches outputs to ON by toggling the individual branch circuit breakers (for individual circuits) or main breaker (for all circuits) when there is no data available from the control system.
 6. Panel shall be capable of operating from a normal feed, an emergency feed, or a normal/emergency feed.
 - a. Normal/Emergency Panels
 - 1) Upon the loss of normal input power, a panel operating from a normal/emergency feed shall immediately turn all circuits within that panel to full-on condition when emergency input power is present.
 - 2) During the presence of normal power, circuits designated as emergency circuits shall be controlled via the same controls as circuits designated normal.
 - 3) Emergency power feed may be provided by an emergency generator. Alternatively, the generator can be turned on only under emergency conditions.
 - 4) Normal/Emergency loads shall be fed by Normal /Emergency feeds through the use of a line side (upstream) normal/emergency power transfer switch supplied by others.
 - 5) Under Emergency input power feed, all local control stations shall be inoperable. Once normal power is restored, all lighting circuits shall revert back to their status prior to the emergency condition without requiring any action on the part of the user.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

- 6) Use of a separate UL 924 listed emergency relays shall be an acceptable alternative to Normal Emergency panel; however, the emergency relays shall be located directly above or adjacent to the relay panel, be clearly labeled and be wired to match the above sequences. Individual emergency relays shall be provided for each individual circuit, plus spares as specified on the drawings.
 - b. 3 Phase detection/sensing device shall:
 - 1) Be UL924 listed as Emergency Lighting and Power Equipment.
 - 2) Have two dry contact closure inputs (normally open and "supervisory" normally closed). The normally open input requires a maintained dry contact closure to activate the Emergency mode. The "supervisory" normally closed input will activate the Emergency mode when a dry contact closure is opened. A status indicator will indicate when this closure is activated.
 - 3) Have a function test switch with status indicator to simulate a phase failure.
 - 4) Have a phase status indicator.
 - c. 1 Phase detection/sensing device shall:
 - 1) Have two dry contact closure inputs (normally open and "supervisory" normally closed). The normally open input requires a maintained dry contact closure to activate the Emergency mode. The "supervisory" normally closed input will activate the Emergency mode when a dry contact closure is opened. A status indicator will indicate when this closure is activated.
 - 2) Have a function test switch with status indicator to simulate a phase failure.
 - 3) Have a phase status indicator.
- D. Switching Module:
1. A positive air gap switch shall be employed by each switched output in the panel to ensure that the load circuits are open when the "off" function is selected from the control system. If the manufacturer is not utilizing an air gap style switch (i.e. standard latching relay), the rating of the relay shall be of a higher rating.
 2. Switched output shall be capable of withstanding inrush current of 75 times operating current typically generated by a full circuit of switching electronic non-dim ballasts.
 3. Each switched output shall be rated for 16A continuous duty for the following load types: resistive (incandescent/tungsten), inductive (magnetic low voltage (MLV), electronic low voltage (ELV), neon/cold cathode, magnetic and electronic fluorescent lamp ballasts, high intensity discharge (HID), LED and Motor Loads (1/3HP at 100-127V, 1/2Hp at 220-347V). Relays rated only for resistive loads shall not be acceptable.
 - a. Should the relays not utilize an air gap style switch (i.e. standard latching relay), the relay shall be rated for 30A to ensure a long life.
 4. Switching modules shall be tested to 300,000 cycles.
- E. Lighting relay panels shall be installed directly adjacent to the panelboard that is feeding the loads being controlled by the lighting relay panel.

2.11 LOW-VOLTAGE WALL STATIONS

- A. Product: Provide low-voltage wall station controls as defined on projects drawings and schedules

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

B. General:

1. Class 2 (low voltage).
2. Integral IR receiver for programming where required for system programming.
3. Immediate local LED response upon button activation to indicate that a system command has been requested.
4. Wall stations can be replaced without reprogramming.
5. Provide finish as selected by architect from manufacturer's full list of standard finishes (not metal finish).
6. Wall stations shall be wired to the bus power supply, ballast/driver, ballast/driver module or ballast/driver digital loop. If the bus power supply is disconnected from the lighting system for any reason, this shall not restrict the use of the wall stations.
7. **Wall stations shall be provided with inset style, fitting a Decora style wall plate. Wall plates shall match those as specified in Division 26 "Wiring Devices."**

C. Standard room stations shall be provided as follows, unless noted otherwise:

1. Offices and educational spaces (including cafeteria, gymnasium, etc.) shall be provided with stations as follows:
 - a. LEED Projects: Three (3) button + raise lower station to provide the following functions: 'on', 'off', 'AV mode', 'raise' and 'lower'.
 - 1) Four (4) button station where there is a combined 'on/off', 'AV mode', 'raise' and 'lower' button shall be acceptable.
 - b. Non-LEED Projects: Two (2) button + raise lower station to provide the following functions: 'on', 'off', 'raise' and 'lower'.
 - 1) Three (3) button station where there is a combined 'on/off', 'raise' and 'lower' button shall be acceptable.
 - c. The use of a single button that combines 'on' and 'raise', 'off' and 'lower', or any other function, other than described above shall not be acceptable.
2. Corridors shall be provided with single key type stations to provide simple on/off control.
3. Where possible, provide analog type controls, however digital controls shall be provided where required to achieve desired control.

D. One Button Control

1. Toggle on/off and master raise/lower control for group of fixtures.
2. "Press and Hold" button programming for creating and modifying groups.

E. Four Button Control

1. Recall 4 Scenes plus all on or all off for one group of fixtures.
2. Master raise/lower control entire group of fixtures.
3. "Press and Hold" button programming supports:
 - a. Create and modify groups.
 - b. Modify scene levels.

2.12 SENSORS

A. General:

1. Use Class 2 wiring for low voltage communication.
2. Can be replaced without reprogramming.

B. Interior Daylight Sensors

1. Open-loop basis for daylight sensor control scheme.
2. Stable output over temperature from 0° to 40° C.
3. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
4. Provide linear response from 0 to 500 foot-candles.
5. Integral IR receiver for programming.
6. Constructed with plastic meeting UL94 HB.
7. Daylight sensors shall be wired to the bus power supply, ballast, ballast module or ballast digital loop. If the bus power supply is disconnected from the LMS for any reason, this shall not restrict the use of the sensors.

C. Occupancy Sensors

1. Provide occupancy sensors as per Division 26 "Occupancy Sensors."
2. Connect occupancy sensors to the network lighting control system as per manufacturer's recommendations.
3. Low Voltage (24V) occupancy sensors shall be wired to the bus power supply, ballast, ballast module or ballast digital loop. If the bus power supply is disconnected from the LMS for any reason, this shall not restrict the use of the sensors.

2.13 POWER INTERFACES

A. Product: Provide required power interfaces as defined on projects drawings and schedules.

B. Electrical:

1. Phase independent of control input.
2. Dimmer to meet limited short circuit test as defined in UL 20.

C. Diagnostics and Service: Replacing power interface does not require re-programming of system or processor.

2.14 ACCESSORIES

A. Tamper Proof Covers:

1. Locking covers for preset control units and wall stations: Reversible to allow lock to be located on either side of control.
2. Compatible with IR controls.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

2.15 SOURCE QUALITY CONTROL

- A. Perform full-function testing on all completed assemblies at end of line. Statistical sampling is not acceptable.
- B. Diagnostics and Service - Tiered control scheme for dealing with component failure that minimizes loss of control for occupant.
 - 1. Bus failure: Lights go to emergency level for safety.
 - 2. Failure of one sensor type: Ballast/driver still controllable via other sensors.
 - 3. Ballast/Driver failure: Only impacts one fixture - remainder of system operates as programmed.
- C. Equipment shall be 100% tested for proper operation at three different levels—printed circuit board, end of line, and for two hours at 40°C (104°F) ambient—prior to shipment from the factory. Manufacturers sampling at end-of-line shall not be acceptable.

2.16 CONTROL INTERFACES

- A. Contact Closure Interface(s)
 - 1. Control shall provide two-way interface between controls and dry contact closure devices such as from Timeclock Inputs, Building Management Systems, Fire Alarm Systems, Security Systems, and Occupancy Sensors. Control shall provide a minimum of five input and five output terminals. Input terminals must be able to accept maintained or momentary inputs with a minimum pulse time of 40msec. Inputs must have an on-state saturation voltage less than 2.0VDC and an off-state leakage current less than 10mA. Outputs must be capable of controlling other manufacturers' equipment. Customer provided output indicators must not exceed 200mA at 30VDC. Following functions shall be available and shall be set up in software: scene selection, panic mode, occupancy response, sequencing, zone and scene lockouts, and partitioning.

2.17 INTERCONNECTIONS TO OTHER SYSTEMS

- A. UL924 listed voltage sensing units shall be provided at each remote lighting hub and be connected to the lighting panel associated with the lighting in the area. Connect to the breaker indicated in the lighting panelboards.
- B. Provide contact closure inputs from the fire alarm system to determine when the fire alarm system is initiated. All necessary contact closures shall be furnished as part of the system and be programmed as required.
- C. Refer to Division 26, "Lighting Sequence of Operations" for additional interconnection requirements. Provide all devices, accessories, wiring and programming required to meet these requirements.
- D. BACnet Interface
 - 1. Control shall provide the ability to communicate via BACnet IP communication to the LCS from a user supplied 10/100BaseT Ethernet network.
 - 2. The control shall provide access to scene selection in defined spaces or setting of Intensity in defined zones.
 - 3. The control shall be capable of interfacing to other equipment (Building Automation System, Security System, Fire Alarm System, Life Safety System, and Card Access System) via the BACnet IP interface. The BACnet IP based interface software shall be the responsibility of secondary system manufacturers (Building Automation System, Security System, Fire Alarm System, Life Safety

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

System, and Card Access System). The Manufacturer shall provide a BACnet IP interface object model specification to secondary equipment manufacturers for their use.

4. Provide points list to HVAC contractor for interface between the systems.
5. Refer to Division 23 specifications for additional information on the interface.

2.18 ADDITIONAL EQUIPMENT

- A. **Furnish and install all necessary data wiring and hardware, including, but not limited to, data cable, terminations, data switches, etc. to provide a fully functioning lighting control system.**
- B. Furnish and install all necessary power connections for relay panel, dimming panels, lighting control power supplies, etc. Power shall be derived from spare 20A/1P breakers in the nearest 120/208V normal power panel. Provide any additional breakers as required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Communication wiring between ballasts may be either Class 1 or Class 2 wiring as required. If wiring is run separate from power, provide plenum rated Class 2. If run with power, the wiring shall be Class 1 rated.
- B. Contractor shall furnish all equipment, labor, system setup, and other services necessary for the proper installation of the devices as indicated on the drawings and specified herein. System setup shall include defining and setting all control functions, installation of hardware and software, and instructions to the owner or owner representative.
- C. Contractor shall install lighting hubs on wall in data closets, electrical closets or as directed on the drawings. Provide cord and plug on lighting hubs and connect to dedicated receptacle located on wall adjacent to remote lighting hubs.
- D. **The project shall include all connections into the owner's network. Coordinate all requirements with the owner's IT department.**

3.2 LABELING

- A. Provide self-adhesive label with software identification on all connected devices.
- B. Provide self-adhesive label with data jack identification on all data network connected devices.
- C. Where devices are located above the ceiling, provide self-adhesive label on ceiling T-bar with device identification and the words "Lighting Control System Device."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer shall be capable of providing on-site service support within 24 hours of a service call in the USA, + within 72 hours anywhere in the world, except where special visas are required.
- B. Manufacturer shall provide toll-free technical support 24 hours per day, 7 days a week.
- C. Manufacturer shall offer upgraded warranty based upon successful field commissioning.

DISTRIBUTED LIGHTING MANAGEMENT SYSTEM

- D. Manufacturer shall offer a renewable service contract on a year-to-year basis, which will include parts and factory labor as well as annual training visits.
- E. Service Contracts will be available for up to ten years from date of system commissioning.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Provide services as listed under Commissioning in Part 1 of this section.

END OF SECTION 26 09 43