

SECTION 26 09 43 - LIGHTING CONTROLS

1.1 SECTION INCLUDES

- A. This extent of lighting control system work is indicated by drawings and by the requirements of this section. It is the intent of this section to provide an integrated, energy saving lighting control system including Lighting Control Panels, Occupancy Sensors and Low-Voltage Control Switches from a single supplier. Contractor is responsible for confirming that the panels and sensors interoperate as a single system.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

1.4 REGULATORY REQUIREMENTS

- A. National Fire Protection Association (NFPA): NFPA 70 – National Electrical Code
- B. Underwriters Laboratories Incorporated (UL):
 - 1. UL 916 - Energy Management Equipment
 - 2. UL 508 – Industrial Control Panels

1.5 SUBMITTALS

- A. Product Data: For control panels, low-voltage switches and plates, occupancy sensors, automatic daylighting control system components, and conductors and cables.
- B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.
 - 1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
 - 2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
 - 3. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
- C. Coordination Drawings: Submit evidence that lighting controls are compatible with connected control devices and systems specified in other Sections.
 - 1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.

2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.
- D. Programming Documentation:
 1. Program instruction manuals.
 2. Device address list.
 - E. Field quality-control test reports.
 - F. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
 - G. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
 - H. Warranty: Special warranty specified in this Section.
- 1.6 QUALITY ASSURANCE
- A. Source Limitations: Obtain lighting system components through one source from a single manufacturer.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
 - D. Comply with NFPA 70.
- 1.7 PROJECT RECORD DRAWINGS
- A. Submit documents under provisions of Division 1 and Section 26 00 00.
 - B. Record actual locations and devices, and routing of alarm wiring.
- 1.8 OPERATING AND MAINTENANCE INSTRUCTIONS
- A. Provide written operating and maintenance instructions as specified in Section 26 00 00. Include product data and operation/maintenance information for all system components
 - B. The Owner may assign personnel to participate with the Contractor during installation. Without delaying work, familiarize the Owner's personnel with the installation, equipment, and maintenance.
 - C. During tests and adjustments, permit the Owner's personnel to observe. When feasible, explain the significance of each test.

- D. Provide sufficient training to personnel selected by the Owner on operation and basic maintenance of all systems and equipment.
- E. Employ manufacturer's field representative to demonstrate system operation to designated Owner personnel.
- F. Conduct walking tour of project and briefly describe function, operation, and maintenance of each component.
- G. Use submitted operation and maintenance manual as reference during demonstration and training.
- H. Provide the owner with a training program designed to make all users familiar with the operation of the Lighting Control System.

1.9 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
 - 1. Match components and interconnections for optimum performance of lighting control functions.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of program input/output to execute switching or dimming commands.
 - b. Failure of modular relays to operate under manual or program commands.
 - c. Damage of electronic components due to transient voltage surges.
 - 2. Warranty Period: Two years from date of Substantial Completion.
 - 3. Extended Warranty Period Failure Due to Transient Voltage Surges: Eight years.
 - 4. Extended Warranty Period for Electrically Held Relays: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Lighting systems equipment shown on the Drawings and specified herein is based on equipment as manufactured by *Hubbell Building Automation*.

2.2 NETWORK LIGHTING CONTROL SYSTEM

- A. Network Data Line: The distributed intelligent lighting control network shall consist of intelligent lighting control devices consisting of but not limited to relays, touch tablet graphic user interfaces, controllers, enclosures, switch stations, photo sensors, occupancy sensors, and miscellaneous components linked together via a single data line that uses the Echelon/LonTalk™ protocol for communications.

- B. The distributed intelligent lighting control network shall facilitate data transmission between the distributed intelligent lighting control systems devices over a twisted pair of wires at 78K baud. Network communication shall use the LonWorks communication protocol to transmit/receive and negotiate messaging between networked devices.
- C. Network wiring shall be unshielded, twisted pair data communication wire with insulation ratings as required by local codes. The network shall support free topology wiring allowing loop, star, bus or any mixed combination of connection topologies between devices.
- D. Wiring distances shall be up to 1500 feet for free topology, 8000 feet for linear bus terminated topology.
- E. Communication over the network shall allow any switch input from any device to be linked to any relay output or group of relay outputs in the lighting control system for complete, unrestricted control.
- F. Network Technology: The distributed intelligent lighting control network shall consist of intelligent devices such as lighting control panels, switch stations, photo sensors and motion sensors that communicate with each other using the ANSI/EIA/CEA 709.1 protocol over one or more communications channels.
- G. Peer-to-Peer (P2P): The distributed intelligent lighting control network shall consist of true peer-to-peer network. In order to eliminate the potential of a single point of failure there shall be no master controller or node required for system operation. All nodes shall be capable of communicating with each other without the need of these types of devices. Systems which utilize master controllers or master/slave networking concepts shall not be acceptable.
- H. Network Topology: The lighting control system specified herein shall utilize a 2-wire topology free polarity insensitive powered network. Devices connected to the network shall be capable of doing so without regard for network topology or wiring polarity. Systems, which require the contractor to follow any kind of networking topology or to pay attention to the wiring polarity, are not acceptable.
- I. Network Capacities: Up to 32,000 individual distributed intelligent (NODES) shall be capable of being connected together within a single network.
- J. Programming: The distributed intelligent lighting control systems shall be capable of being programmed from any point or points anywhere on the system network. Systems that require a single point of system access are not acceptable. The lighting control network must remain completely functional during this process. Lighting control systems that must be taken "OFF LINE" for programming are not acceptable. All programming changes shall take effect immediately as they are programmed.
- K. System Updates and Upgrades: All device installed upon the distributed intelligent lighting control system network shall be capable of having their programs updated and/or upgraded over the network systems which require hardware or memory chips to be replaced to perform upgrades are not acceptable. Software and firmware upgrades shall be made available free of charge for the life of the system.
- L. Lighting Control Panels

1. Where shown on the drawings, the Contractor shall furnish and install lighting control panels of the quantities, sizes, and types shown on the drawings and/or specified herein.
2. Lighting panels shall contain relays, and other devices of the sizes and quantities indicated on the drawings and specified herein.
3. Hardware Features:
 - a. Controller Backbox: Each lighting control panel shall be provided with a factory furnished, UL listed NEMA 1 enclosure designed for wall mounting. Backbox must be capable of being shipped ahead of controller chassis insert to allow for rough-in of all electrical connections prior to receipt of the controller chassis insert.
 - b. Controller Finish: Each lighting control panel shall be of welded construction primed and painted with a powder coat finish. Unpainted or galvanized enclosures are not acceptable.
 - c. Controller Chassis Insert: Each lighting control panel shall be provided with a factory or field installable controller chassis insert. Controller chassis insert shall contain all controller electronics, power supplies, relays, and other required components. Controller chassis inserts shall arrive at the project site completely pre-wired and requiring only the connection of lighting circuits and network cable. Systems that require field assembly of controllers or chassis inserts are not acceptable.
 - d. High-Voltage/Low-Voltage Separation: Each programmable lighting controller shall be provided with a mechanical barrier that separates all high-voltage components and wiring from all low-voltage components and wiring. An additional barrier shall be installed within the high-voltage section that shall provide isolation between normal and emergency circuits where required.
 - e. Controller Covers: Each programmable lighting controller shall be provided with a dead front screw-held hinged locking cover that is designed for either surface or flush mounting.
4. Electrical:
 - a. Controller Power Supply: Each programmable lighting controller shall be provided with a single triple-rated, UL listed Class 2 transformer capable of either being connected to 120/277 or 347 VAC primary (+ or -20% VAC, 50 to 60 Hz).
 - b. Connections: All connections shall be made to clearly and permanently labeled termination points.
5. Lighting Control Panel Electronics:
 - a. Controller Module: Each lighting panel shall be provided with a LonWorks controller module that shall provide for all of the lighting panels controller functions, these functions shall include but not be limited to real time clock, LonWorks network interface, scheduling, relay control, monitoring, status and diagnostic information.
 - b. I/O Controller: I/O (input/output) cards shall be provided to expand the controller capability from 8 to 48 relay outputs in groups of 8. I/O controller cards shall be completely self-configuring and shall not require settings of any kind in order to be configured for use within the lighting control panel.
 - c. Capacity: Each controller shall be capable of controlled 1 to 48 individual lighting control relays. Controllers shall be available in three sizes: 16, 32 and 48 relay outputs. Relay must be capable of being individually added to or removed from the lighting controller for the purpose of service or expansion of the controllers capabilities.

- d. Diagnostic Aids: Each lighting control panel shall be provided with a status LED to indicate current operational status. Each relay output shall have an LED pilot to indicate the current status of all controlled relay outputs.
 - e. Data Protection and Storage: All programmed data shall be stored in nonvolatile flash memory that shall protect all stored programming data from loss during a power outage for a minimum period of 20 years without power of any type.
 - f. Power Failure and Power-Up Options: Each lighting control panel shall be provided with circuitry that shall automatically shut down the controller whenever the incoming power fails. When power is returned to the controlled, one of the following power-up modes will be implemented (user selectable) for each controlled relay output in the system.
 - g. No Action: Upon restoration of incoming control power, the lighting control panel electronics shall be restarted and resume normal operations, and all circuits will be maintained in the condition they were last in.
 - h. Forced ON: Controller will force selected relay output(s) to the ON state after power-up.
 - i. Forced OFF: Controller will force selected relay output(s) to the OFF state after power-up.
6. Blink Alert: Each relay output within the lighting control panel shall be individually programmable to blink prior to being turned OFF. Blink alert times shall be adjustable between 1 and 15 minutes. Relays programmed for the blink alert function shall blink prior to turning OFF to warn occupancies of the upcoming OFF event. If an ON command is received during the blink alert time, relay output will be overridden and left ON for the override time. Override times shall be adjustable from 1 to 3 hours.
 7. Real-Time Clock: Each lighting control panel shall have its own Real-Time Clock, which shall be used to perform all time-controlled functions. Real-Time Clock functions shall include time of day, day of week, date and automatic daylight savings and leap year adjustments. Time clock shall be protected against loss of time during a power outage for a period of up to 60 days without power of any type. Systems, which utilize a single central time clock, are not acceptable.
 8. Astronomical Clock: Each lighting control panel shall contain an astronomical time clock that shall calculate sunrise and sunset times based on the geographical positioning information provided during the programming of the system. Sunrise and sunset times may be used as activation times for any system timer. In addition to sunrise and sunset time activation, the control shall be capable of programming activation time for the system time for before and after these times based on an offset of 1 to 999 minutes either before or after the calculated sunrise or sunset event.
 9. Time-of-Day Scheduling: Each programmable lighting control panel shall be provided with a minimum of 99 scheduled events for use in developing time-of-day automated schedules. Each schedule shall have the ability to turn any relay or group of relays ON or OFF or activate a preset lighting scene and the scheduled time. Schedules shall be day-of-week selectable and may be programmed to activate on any combination of days of the week (Sunday through Saturday), on all days, or to activate on a specific date only ("Holiday Schedule"). Each non-holiday scheduled event shall be capable of being programmed either to halt operation on holidays or to ignore holidays and continue normal operations on holidays.
 10. Manual Relay Overrides: Lighting control panel relays shall be provided with 2 means of manual override.
 11. Mechanical Manual Override: Each relay shall be provided with a manual override switch. It shall be possible to change the state of each relay without the need for the controller electronics or any other part of the system to be operational or powered. Lighting

control panels that require power to be applied in order to change or maintain the state of relays are not acceptable.

12. Push Button Override: In addition to but not in lieu of the mechanical manual override each relay output shall be supplied with an ON and OFF manual override push-button with LED pilot that shall allow the system user to view the current status and/or manually override any relay output to the ON or OFF state.
13. True Relay Status Feedback: Each lighting control panel shall be provided with circuitry that shall monitor the actual current status of each relay.
14. Staggered Relay Activation: Lighting control panels shall be designed to stagger relays ON and OFF to limit the impact of switching multiple lighting loads ON or OFF at the same time.

M. 20 Amp Relays

1. Electrical Contractor shall provide and install quantities of mechanically latching lighting control relays as indicated on the drawings and schedules as specified herein. Electrically held or non-mechanically latching relays shall not be considered.
2. Lighting control relays shall be individually UL and CUL listed and shall bear labels indicating compliance. Lighting control relays shall be tested to UL Standard 508 for both safety and durances and bare labels signifying compliance.
3. Lighting control relays shall be designed and tested to have a minimum cycle life of 30,000 ON/OFF cycles @ FULL LOAD switching into any and all loads that the relay is rated to control. Manufacturer shall provide test data certifying compliance to this section.
4. Lighting control relays shall be specifically designed for control of 120, 277, or 347 VAC lighting loads including but not limited to incandescent, low-voltage, neon, cold cathode, LED, fluorescent and HID lighting sources at a full 20 AMPS and motor loads of 1/2 Hp @ 120 VAC or 1.5 Hp @ 277 VAC.
5. Lighting control relays shall be designed with a mechanical latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power.
6. Lighting control relay shall contain an electrical means of monitoring the current status of the relay contacts electronically isolated, but mechanically linked to the main contacts for the purpose of true status monitoring and pilot light activation.
7. Each lighting control relay shall include a mechanical means of turning the relay ON or OFF without the need for electrical power of any kind.
8. Each lighting control relay shall include a mechanical visual indicator showing the current status of relay itself.

N. Touch Tablet Graphic User Interface

1. The Electrical Contractor shall provide LX Touch Tablet Graphic User Interface(s) as shown on drawings and described herein.
2. The LX Touch Tablet Graphic User Interface shall consist of a microprocessor-based lighting control station specifically designed for the control of lighting control systems.
3. To provide for clarity of operation a high resolution graphic liquid crystal display with wide viewing angle and an electroluminescent backlight shall be used to display system information in both alphanumeric and graphical format.
4. All programming shall be accomplished through the use of a graphical user interface.
5. The LX Touch Tablet Graphic User Interface shall provide the system user access to the following system features:
 - a. Current status of any device on the systems network.
 - b. Time and date information and programming.

- c. Astro-clock and daylight saving time adjustments.
 - d. Scheduling
 - e. Manual overrides.
 - f. System programming.
 - g. System diagnostics.
6. All programming information stored in the LX Touch Tablet Graphic User Interface shall be stored in nonvolatile flash memory preventing loss of stored information in the event of a power failure up to 20 years.
 7. The LX Touch Tablet Graphic User Interface shall be capable of being to the lighting control system at any point on the network. One or multiple LX Touch Table Graphic User Interface shall be capable of being connected to the system at any time.
 8. The LX Touch Tablet Graphic User Interface shall contain no special programming causing it to become a required part of the lighting control system it is being utilized with. The lighting control system shall provide full-functionality with or without this device attached to the system.

O. Lx Networked Switch Stations

1. The Electrical Contractor shall provide and install networked switch station of the types and quantities shown on the drawings and specified herein.
2. Network switch stations shall be injection molded and designed to mount in a standard single-gang junction box with standard Decora switch plate opening.
3. Networked switch stations shall be available in three colors: white, almond, and gray.
4. Networked switch stations shall be 2-button standard configurations.
5. Labeling and switch identification shall be accomplished through the use of hot-stamped labels, permanently attached to the switch face itself. Silk-screened or painted labeling shall not be acceptable.
 - a. Button 1: 'ON'
 - b. Button 2: 'OFF'
6. Each networked switch station shall be provided with both pilot and non-pilot version of buttons, which can be selected by the Contractor at the time of installation or change at any time throughout the life of the system. Switch stations, which require switches to be ordered with, or without pilots and are not field-modifiable shall not be considered.
7. Network switch stations shall connect to the self-powered topology free network via a single pair of wires. Network switch stations requiring more than two wires or requiring that the Installing Contractor install them with a stick topology or maintain correct polarity are unacceptable.
8. Buttons on LX networked switch stations shall be programmed to perform the following functions:

LOW-VOLTAGE LIGHTING SWITCH SCHEDULE				
Switch Designation	Lighting Control Panel	Relays Controlled	Quantity of Switches	Switch Locations
S ₀₁	LC1	1, 2, 3	6	Corridor 106 (exterior door); Corridor 113 (exterior door); Lobby 100; Sales 123; Sales 123;Sales 123
S ₀₂	LC1	4	2	Sales 123; Sales 123
S ₀₃	LC1	7	1	Corridor 113 (exterior door)

S04	LC1	6	1	Lobby 100
S05	LC1	8	4	Stair 108, First Floor; Stair 108, Mezzanine Level
S06	LC2	1, 2, 3	8	Operations 129; Corridor 139 (exterior door); West Entry Stairs; West Entry Stairs; Lounge 125; Sales 123; Sales 123; Central Stair
S07	LC2	7	2	South End Stair, First Floor; South End Stair, Second Floor
S08	LC2	8	1	Corridor 139 (exterior door)
S09	LC2	4	1	Lounge 125
S010	LC2	6	2	Operations 129; Operations 129
S011	LC2	10,11	3	Lobby 143; Lobby 143; Lobby 143 (side entrance)
S012	LC2	12	1	Lobby 143
S013	LC1	9,10	5	Finance 216; Central Stair; Finance 216; Lobby 200; Copy 209
S014	LC1	11,12	2	Finance 216; Finance 216
S015	LC2	13, 14	3	Corridor, Information 218, Finance 216
S016	LC2	18	2	Finance 216; Information 218
S017	LC2	16	2	Expansion 219, Information 218
S018	LC2	17	2	Expansion 219, Information 218
S019	LC2	20, 21	1	Exercise room 225
S020	LC2	22	1	Lobby 143

LIGHTING CONTROL PANEL RELAY SCHEDULE			
Lighting Control Panel	Relay Number	Lights Controlled	Ltg. Ckt. Numbers Controlled
LC1	1	Part A, emergency egress lights in vestibule, lobby and corridors.	P-EL1, #1
LC1	2	Part A, emergency egress lights in Sales 123.	P-EL1, #3
LC1	3	Part A, lights in lobby and corridors.	P-E1, #46
LC1	4	Part A, lights in Sales 123.	P-E1, #44
LC1	5	Type S1 and Type S3 exterior lights	P1, #38
LC1	6	Type S4 and Type S5 exterior lights	P1, #40
LC1	7	Type S2 exterior lights	P1, #42
LC1	8	Part A, emergency egress lights in Stair 108 and Basement Corridor	P-EL1, #10
LC1	9	Part A, emergency egress lights at mezzanine, corridors, lobby, Finance 216	P-EL1, #2

LC1	10	Part A, lights at mezzanine, corridors, lobby, Finance 216	P2, #2
LC1	11	Part A, emergency egress lights in Finance 216	P-EL1, #2
LC1	12	Part A, lights in Finance 216, Managers' Offices and Guest Offices	P2, #3
LC1	13-16	Spare relays	
LC2	1	Part B, emergency egress lights in corridors and central stair	P-EL1, #5
LC2	2	Part B, emergency egress lights in lounge and west entry stairs	P-EL1, #7
LC2	3	Part B, lights in corridors	P1, #1
LC2	4	Part B, lights in lounge	P1, #2
LC2	5	Part B, emergency egress lights in Operations 129	P-EL1, #9
LC2	6	Part B, lights in Operations 129	P1, #3
LC2	7	Part B, emergency egress lights in south end stair	P-EL1, #5
LC2	8	Type S2 and Type S3 exterior lights	P3, #44
LC2	9	Type S1 and Type S5 exterior lights	P3, #46
LC2	10	Part C, emergency egress lights in lobby, vestibule, and side entrance	P-EL1, #11
LC2	11	Part C, lights in lobby, vestibule, and side entrance	P1, #4
LC2	12	Type S4 and S5 exterior lights	P3, #48
LC2	13	Part B, emergency egress lights in corridors	P-EL1, #6
LC2	14	Part B, lights in corridors and Managers Offices	P3, #6
LC2	15	Part B, emergency egress lights in Information 218 and Expansion 219	PEL1, #8
LC2	16	Part B, Lights in Information 218	P3, #2
LC2	17	Part B, Lights in Expansion 219	P3, #5
LC2	18	Part B, Lights over workstations beside Conf. 217 and over open area	P3, #4
LC2	19	Type S6 exterior light	P3, #1
LC2	20	Part C, emergency egress lights in exercise room	P3, #11
LC2	21	Part C, Lights in exercise room	P3, #7
LC2	22	Part C, Lights over corner open area	P3, #8
LC2	23-32	Spare relays	

2.3 OCCUPANCY SENSORS

- A. Ceiling mounted passive-infrared sensors shall be *Hubbell* model OMNIIR.
1. Sensor shall use a micro-processor for motion signal analysis and internal self-adjustment. Sensor shall adapt automatically to changing room conditions. Sensor micro-processor shall monitor PIR background levels and automatically make corresponding adjustments. Sensor shall recognize any motion detected within 15 seconds of turning off the lighting as a false off. Sensor shall recognize as a false on, the failure to detect motion 6 seconds after motion is detected initially.
 - a. Test Setting: 8 second timeout.
 - b. Timer Adjustability: 8 to 40 minutes (factory set at 15 minutes).
 - c. Sensitivity: Adjustable from 0 to 100%.
 - d. Indicator Light: LED.
 - e. Detection Field: 360 degrees.
 - f. Coverage: 450 square feet.
 - g. Voltage: 24 volts DC.

- B. Ceiling mounted ultrasonic sensors shall be *Hubbell* model OMNIUS500.
 - 1. Sensor shall utilize Doppler shift technology with a micro-processor for motion signal analysis and internal self-adjustment. Sensor shall adapt automatically to changing room conditions. Sensor micro-processor shall monitor PIR background levels and automatically make corresponding adjustments. Sensor shall recognize any motion detected within 15 seconds of turning off the lighting as a false off. Sensor shall recognize as a false on, the failure to detect motion 6 seconds after motion is detected initially.
 - a. Test Setting: 8 second timeout.
 - b. Timer Adjustability: 8 to 40 minutes (factory set at 15 minutes).
 - c. Sensitivity: Adjustable from 0 to 100%.
 - d. Ultrasonic Output: 40 kHz
 - e. Indicator Light: LED.
 - f. Detection Field: 360 degrees.
 - g. Coverage: 500 square feet.
 - h. Voltage: 24 volts DC.
- C. Occupancy sensor power packs shall be *Hubbell* model UVPP.
 - 1. Power packs shall include an integral transformer and relay designed for switching 20-ampere loads. Power packs shall be capable of being installed within a standard 4-inch square electrical box.
 - a. Input Voltage: 100-277VAC
 - b. Output Rating: 24VDC, 150 mA

2.4 WALL STATION DIMMING CONTROLS

- A. Wall station dimming controls shown on the Drawings and specified herein is based on equipment as manufactured by *Lutron*. If an alternate product is proposed it is the contractor's responsibility to demonstrate that it meets the specified performance criteria without exception:
- B. 0-10V Dimmer for Electronic Fluorescent Ballasts, *Lutron* model NFTV-I/PP-20
 - 1. Description: Preset slide dimmer a slide knob for full range dimming control. Dimmer shall be compatible with *Lutron* Series TVE, or *Advance* Mark 7 fluorescent electronic dimming ballasts.
 - a. Voltage: 120 VAC
 - b. Load Rating: 16 Amperes
 - c. Color: Ivory

2.5 CONDUCTORS AND CABLES

- A. Classes 2 Control Cables: Multi-conductor cable with copper conductors not smaller than No.18 AWG.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Wire interior lighting circuits as well as all exterior lighting circuits through relays in the relay control panels as indicated in the Lighting Control Panel Schedule included in this specification. Provide local interior light switches shall provide for timed override of program schedules.

Individual override switches shall control the lighting control panel relays as indicated in the Switch Schedule included in this specification.

- B. Comply with NECA 1.
- C. Wiring Method: Install low-voltage wiring in raceways except where installed above suspended accessible ceilings. Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" Minimum conduit size shall be 1/2 inch (13 mm).
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- E. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- F. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- G. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.
- H. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.2 OCCUPANCY SENSOR INSTALLATION

- A. Provide ceiling mounted ultrasonic occupancy sensors in the following spaces (all other ceiling mounted occupancy sensors shall be PIR type):
 - 1. Conference Room 101
 - 2. Conference Room 102
 - 3. Conference Room 103
 - 4. Conference Room 104
 - 5. Women's Room 109
 - 6. Men's Room 110
 - 7. Men's Room 136
 - 8. Women's' Room 137
 - 9. Men's Room 214
 - 10. Women's Room 215
 - 11. Shower 221

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to provide full commissioning services including the inspection, testing, field-assembled components adjustments and system start-up. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Test for circuit continuity.

2. Verify that the control panel features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components selected by Architect.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 2 months of date of Substantial Completion, provide on-site assistance in adjusting sensors and to assist Owner's personnel in making program changes to suit actual occupied conditions.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 09 43